STRUCTURE OF THE ANTHRAX RESEARCH LITERATURE

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ABSTRACT

Text mining was used to extract technical intelligence from the open source global anthrax research literature. An anthrax-focused query was applied to the Science Citation Index/ Social Science Citation Index (SCI/ SSCI) (SCI, 2006) databases. The anthrax research literature infrastructure (prolific authors, key journals/ institutions/ countries, most cited authors/ journals/ documents) was obtained using bibliometrics, and the anthrax research literature technical structure (hierarchical taxonomy) was obtained using computational linguistics/ document clustering. A novel addition was the use of author and institution auto-correlation maps to show co-publishing networks, and the use of author-phrase and institution-phrase cross-correlation maps to show author and institution networks based on use of common terminology (proxy for common interests).

INTRODUCTION

Bio-terrorism has become a major concern in the post-9/11 era. The mailings of letters containing spores of *Bacillus anthracis* to the media and members of the U.S. Congress in September and October of 2001 resulted in 22 cases of anthrax with 5 deaths, closed part of the U.S. government's operations, and terrorized the American public (Jernigan et al, 2002; Hsu et al, 2002; Morse et al, 2003). This event affected numerous countries (Polyak et al, 2002) and there are now major world-wide efforts devoted to countering bio-terrorism (and other potential weapons of mass destruction [WMD], such as chemical and nuclear).

One of the less tangible weapons in the arsenal to combat bio-terrorism is intelligence. This has myriad forms, including the direct use of humans to access information, use of sophisticated computer systems to track infrastructure and resource movements, and development of technologies to detect, neutralize, shield and vaccinate against bio-warfare agents. There appears to be little reported use of strategic technical intelligence to help predict potential bio-warfare agents, based on the ability to modify microorganisms using emerging technologies. The only published study, which used an information technology (IT)/ text mining variant known as literature-based discovery to predict potential bio-warfare agents, was published in 2001 (Swanson et al, 2001), two months before the anthrax attack. This study examined the disjoint literatures of viral pathogenicity/lethality and viral transmissibility/survivability. Through indirect linkages between these disjoint literatures, the study was able to predict those viruses that would be potential bio-warfare agents.

The goal of the present study is to use other aspects of text mining to extract technical intelligence. The anthrax research literature will be used as a model system. The results may provide a different perspective on anthrax, as well as complement the study by Swanson et al. as an auxiliary IT approach related to bio-warfare, and could add capabilities to any future literature-based discovery study aimed at countering bio-terrorism.

BACKGROUND

The study consists of two inter-disciplinary components: text mining and anthrax. The text mining background is presented in the present section. The comprehensive anthrax background is presented in Appendix 1.

Text Mining

Text mining is the extraction of useful information from large volumes of text. Its component capabilities of computational linguistics and bibliometrics were the main analytical techniques used in the present study.

Computational Linguistics

Science and technology (S&T) computational linguistics (Kostoff, 2003a; Hearst, 1999; Zhu, 2002; Losiewicz, 2000) is a process that underlies the extraction of useful information from large volumes of technical text. It identifies pervasive technical themes in large databases from technical phrases that occur frequently. It also identifies relationships among these themes by grouping (clustering) the phrases (or their parent documents) on the basis of similarity. Computational linguistics has been used for:

- enhancing information retrieval and increasing awareness of the global technical literature (Kostoff et al, 1997a; Greengrass, 1997; TREC, 2004);
- discovery and innovation based on merging common linkages among very disparate literatures (Swanson, 1986; Swanson and Smalheiser, 1997; Kostoff, 2003b; Kostoff, 2005a; Gordon and Dumais, 1998);
- uncovering unexpected asymmetries in the technical literature (Goldman et al, 1999; Kostoff, 2003c);
- estimating global levels of effort in S&T sub-disciplines (Kostoff et al, 2000a; 2004a; Viator and Pestorius, 2001);
- helping authors to increase their citation statistics by improving access to their published papers, which also may help journals increase their Impact Factors (Kostoff et al, 2004a, 2004b); and
- tracking the impact of a specific research area across time and applications areas (Davidse and VanRaan, 1997; Kostoff et al, 2001b).

Bibliometrics

Evaluative bibliometrics (Narin, 1976; Garfield, 1985; Schubert et al, 1987) uses counts of publications, patents, citations and other potentially informative items to develop S&T performance indicators. Its validity is based on the premises that:

- counts of patents and papers are a valid indicator of R&D activity in the subject area of those patents or papers;
- the number of times those patents or papers are cited in subsequent patents or papers is a valid indicator of the importance or impact of the cited patent or paper; and
- the citations from papers to papers, from patents to patents, and from patents to papers are an indicator of the intellectual linkages between the organizations that are producing the patents and papers, and knowledge linkage between their subject areas (Narin et al, 1994).

Evaluative bibliometrics can be used to:

- identify the infrastructure (authors, journals, institutions) of a technical domain;
- identify experts for innovation-enhancing technical workshops and review panels;
- develop site visitation strategies for assessment of prolific organizations globally; and
- identify impacts (literature citations) of individuals, research units, organizations, and countries.

Evaluative bibliometrics was also used in the present study to help generate the anthrax research background material, shown in Appendix 1. The documents cited most (relative to their contemporaries) by the retrieved anthrax research literature were considered to be seminal, and formed the core of the background material. Other relevant documents were added to enhance the background material and eliminate gaps in the narration. This approach for generating background review narratives has been used in three other ongoing text mining studies (nanotechnology, high speed compressible flow, nonlinear dynamics), and, as in the present study, has been shown to capture the major seminal documents. Another advantage of this citation-assisted background (CAB) approach (Kostoff and Shlesinger, 2005f) over traditional literature reviews is that the core seminal papers identified are

based on the larger technical community's consensus (highest citations), rather than based solely on the author(s)' personal experiences and biases.

A typical text mining study of the published literature by the first author's group develops a query for comprehensive information retrieval, processes the database using computational linguistics and bibliometrics, and integrates the processed information. At this point, a variety of different analyses can be performed. For databases of non-journal technical articles (Kostoff, 1993), the final results have been the identification of the pervasive technical themes of the database, the relationship among these themes, and the relationship of supporting sub-thrust areas (both high and low frequency) to the high frequency themes. For more recent studies in which the databases consist of journal article abstracts and associated bibliometric information (authors, journals, addresses, etc.), the final results have also included relationships among the technical themes and authors, journals, and institutions (Kostoff et al, 1998a, 1999, 2000a, 2000b, 2001a, 2001b, 2002, 2004a, 2004b, 2004c, 2005b, 2005c, 2005d, 2005e, 2006a, 2006c, 2006d).

As a result of the renewed interest in anthrax, there have been a number of recent review articles that provide comprehensive and complementary perspectives on this disease (Dixon et al., 1999; Mock and Fouet, 2001; Gardner, 2001; Khanna and Singh, 2001; Koehler, 2002; Oncu et al., 2003; Lindler et al, 2005; Anderson et al, 2006). These review articles are structured along traditional lines in that they cover the etiology and pathologic mechanisms of anthrax, addressing both biological and medical considerations. However, none of these reviews provide the infrastructure and technology structure of the anthrax research literature that text mining can provide.

The anthrax research literature, as defined by the authors of this study, consists of published open-literature papers that focus on theoretical, laboratory, biological, clinical, and epidemiological aspects of anthrax, and emphasizes the original research literature accessed by the SCI and SSCI. For reasons that will be explained in the Database Generation section, editorials, letters to the editor, etc., were not included.

The anthrax literature is defined operationally by the following query: "anthrax OR anthracis OR anthraxin". In recent years, especially since the anthrax attack of 2001 (Jernigan et al, 2002), there has been increased concern over the use of *B. anthracis* and other potentially lethal

microorganisms for bio-terrorism. Thus, some anthrax-related research papers that address various aspects of bio-terrorism have been retained in the database. As a result of the actual use as well as the potential for the future use of *B. anthracis* for bioterrorism, research funding and the number of research articles appearing in the open literature have increased substantially in recent years.

Figure 1 shows the number of SCI/ SSCI articles retrieved with the above query as a function of time. Between 1991 and 1998, there were relatively few anthrax research articles appearing in the open literature, averaging about 30 articles per year in the 1991-1995 time frame and 45 articles per year in the 1995-1998 time frame. As the threat of bio-terrorism began to be taken more seriously, the number of anthrax research papers increased to 75-100 per year. However, the number of research papers per year has increased substantially since 2001, and is now an order of magnitude larger than in the early 1990s.

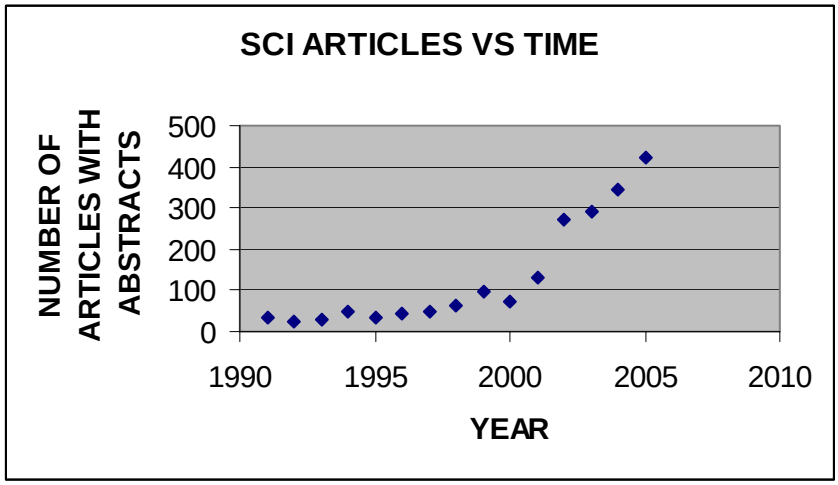
For the major country producers of anthrax research articles, the temporal production is as follows (country/ number of SCI/ SSCI articles):

- 1995: USA (19); France (7); England (4); Canada (2).
- 2000: USA (32); France (13); Norway (5); South Korea (5).
- 2005: USA (289); France (24); England (22); Germany (19); Canada (18).

In 2005, the USA collaboration statistics were: USA/ France (4); USA/ England (8); USA/ Germany (5); USA/ Canada (3).

Thus, in the five years since 2000, the USA went from ~2.5 times the number of research articles as its nearest competitor to more than eleven times its nearest competitor.

FIGURE 1 – SCI/ SSCI ARTICLES VS TIME



MATERIALS AND METHODS

Database generation. The primary objective of this study was to identify the global research literature that was related directly to anthrax. A secondary objective was to estimate the relative level of global effort in the sub-categories of anthrax research, as reflected by the emphasis in the published literature.

To accomplish these objectives, the first step was to define the most appropriate databases to be accessed consistent with available resources. There are multiple global biomedical databases that contain biomedical research articles, multiple global patent databases, sponsoring agency award narrative databases, classified databases, proprietary technology databases, technical report databases (e.g., DTIC, NTIS), books, biomedical magazines not accessed by the major databases, Web articles/ pages, and many other types.

Each of these databases/ sources has its own perspective to offer on the anthrax problem, and each has value to contribute. Unfortunately, because of terminology that tends to be specific to each database (e.g., the basic research literature databases tend to use different terminology from the very applied research literature databases.), a separate text mining analysis of each database, including database-specific query development, is required to maximally exploit the information available from each database. These multiple database analyses translate into massive resource expenditures. Therefore, the database selection task translates into a decision to select the most appropriate database(s) that will allow the study objectives to be attained.

Two databases were considered: SCI/ SSCI and Medline. For the time frame 1991-2005 (Abstracts were first introduced in the SCI/ SSCI in 1991), 1949 research Articles were retrieved from the SCI/ SSCI with the anthrax query, and 2016 articles with Abstracts were retrieved from Medline, so numbers of articles accessed did not influence the choice of databases. Because citation bibliometrics are an important tool used by the first author's text mining group, and this citation capability is an SCI/ SSCI specialty, the SCI/ SSCI was selected as the database for the analyses. Additionally, it was desired to focus on the original research component of the SCI/ SSCI, and not mix objects of different categories (e.g., editorials,

letters, etc). Therefore, only records classified as Articles in the SCI/ SSCI were downloaded.

Restricting the retrieval to Articles impacted some journals more than others. For example, the following experiment was run to illustrate this conclusion. The anthrax query used for retrieval (anthrax or anthracis or anthraxin) was inserted into the SCI/ SSCI search engine for all journals for the years 1991-2005. When All Document Types was selected for record type, 2912 records were retrieved. When Articles was selected for record type, 1949 records were retrieved. Thus, on average, about 1/3 of total records were not retrieved due to not being classified as original research (Articles).

Further, the experiment was repeated for two leading biomedical journals: JAMA and Infection and Immunity. For JAMA, selecting All Document Types retrieved 69 records, whereas selecting Articles retrieved 14 records, an 80% reduction. For Infection and Immunity, selecting All Document Types retrieved 109 records, whereas selecting Articles retrieved 105 records, a reduction of less than four percent.

Once the source database was selected, the iterative search approach of Simulated Nucleation (Kostoff et al, 1997a) was used to generate the search query. The SCI/ SSCI-retrieved database consisted of selected journal records (including authors, titles, journals, author addresses, author keywords, abstract narratives, and references cited for each paper) obtained by searching the Web version of the SCI/ SSCI for anthrax research articles. It covered a finite period of time (1991 through 2005). The database used represented the bulk of the documented, peer-reviewed high quality anthrax research open literature.

To extract relevant articles from the SCI/ SSCI, a test query was used, and the Title, Keyword, and Abstract fields were searched using phrases relevant to anthrax. The resultant Abstracts were then culled to leave those relevant to anthrax. Gradations of relevancy or non-relevancy were not considered. Phrase frequency analyses were performed on the textual database of retrieved papers. The high frequency single, double, and triple word phrases judged to be characteristic of relevant papers, and their Boolean combinations, were then added to produce the final query "Anthrax OR Anthracis OR Anthraxin", to expand the papers retrieved.

Because of the relatively focused scope and subject matter of the present study, this short three-term query resulted. However, in some previous text mining studies, where topics were more ambiguous or broader, much larger queries and a more complicated iterative technique were required to eliminate the non-relevant records from those retrieved. Some of these previous studies required hundreds of query terms (Kostoff et al, 1998a, 2004a).

RESULTS

The results from the publications bibliometric analyses are presented first, followed by the results from the citations bibliometrics analysis. Results from the computational linguistics analyses follow the bibliometrics results. The SCI/ SSCI bibliometric fields incorporated into the database included, for each paper, the author, journal, institution, keywords, and references for each paper.

PUBLICATION BIBLIOMETRICS

The first group of metrics presented is counts of papers published by different entities. These metrics can be viewed as output and productivity measures. They are not direct measures of research quality, although there is some threshold quality level inferred, since these papers are published in the (typically) high caliber journals accessed by the SCI/ SSCI.

Author Frequency Results

Table 1A presents the 24 most prolific anthrax research authors over the 1991-2005 time frame and their publication frequency.

TABLE 1A – MOST PROLIFIC ANTHRAX RESEARCH AUTHORS

AUTHOR	INSTITUTION	COUNTRY	#PAPERS
MOCK, M	INSTITUTE PASTEUR	FRANCE	72
LEPPLA, SH	NIH	USA	67
COLLIER, RJ	HARVARD UNIV	USA	59
FOUET, A	INSTITUTE PASTEUR	FRANCE	32
KEIM, P	NORTHERN ARIZ UNIV	USA	30
FRIEDLANDER, AM	US ARMY - MED RES INST	USA	29
BHATNAGAR, R	NEHRU UNIV	INDIA	26
SINGH, Y	CENTER BIOCHEM TECH	INDIA	24
LITTLE, SF	US ARMY - MED RES INST	USA	22
KOEHLER, TM	UNIV TEXAS	USA	21
TURNBULL, PCB	ARJEMPTUR TECH, LTD	UK	21
MONTECUCCO, C	UNIV PADUA	ITALY	20
QUINN, CP	CDC	USA	18
POPOVIC, T	CDC	USA	17
TANG, WJ	UNIV CHICAGO	USA	17
IVINS, BE	US ARMY - MED RES INST	USA	16
HANNA, PC	UNIV MICHIGAN	USA	15
KLIMPEL, KR	NIH	USA	15
BAILLIE, LWJ	UNIV MARYLAND	USA	13
EZZELL, JW	US ARMY - MED RES INST	USA	13
KOLSTO, AB	UNIV OSLO	NORWAY	13
MESNAGE, S	UNIV PARIS	FRANCE	13
RUBINSTEIN, E	TEL AVIV UNIV	ISRAEL	13
SIRARD, JC	INSTITUTE PASTEUR	FRANCE	13

Three authors (Mock, Leppla, and Collier) account for 33% of the total number of articles (N=599) published by the top 24 most prolific anthrax research authors. Fourteen of the authors were from the USA, four from France, two from India, and one each from Italy, Norway, UK, and Israel. In previous text mining studies, either the majority or all of the most prolific authors were from universities. However, in the present study, twelve (50%) of the authors were from research institutions, 11 (46%) from universities, and one (4%) was from industry [Turnbull wasn't from industry when he wrote the majority of his papers]. As will be supported by additional bibliometrics and computational linguistics results, the concentration of prolific authors in research institutes reflects the applied nature of the open literature search, and a potential gap in the type of research accessed and

pursued. It should be noted that many researchers are quite mobile, and may have worked at multiple institutions when they published the papers reflected in Table 1A (e.g., Leppla moved from the US Army Medical Research Institute to the NIH).

What are the journals preferred by the most prolific authors of anthrax research articles? Table 1B is an author-journal matrix that includes 1) the top six authors listed in Table 1A, and 2) those journals from Table 2 (twenty journals containing the most anthrax research articles) in which at least one of these six authors had a publication. Each author appears to have a couple of journals favored for publication, and the main common favorite journal is Infection and Immunity. The six authors listed have publications in other journals as well but, on average, almost 80% of their SCI/ SSCI-accessed publications are in the journals listed in Table 1B.

TABLE 1B – AUTHOR-JOURNAL MATRIX

	AUTHOR					
	MOCK	LEPPLA	COLLIER	FOUET	KEIM	FRIEDLANDER
JOURNAL						
INFECTION AND IMMUNITY	10	15	6	2		8
JOURNAL OF BACTERIOLOGY	7	1	1	8	5	
PROC OF THE NATL ACAD OF SCIENCES - USA		8	12		3	1
APPLIED AND ENVIRONMENTAL MICROBIOLOGY	1			1	4	
JOURNAL OF BIOLOGICAL CHEMISTRY		11	7			1
JOURNAL OF APPLIED MICROBIOLOGY	5	1	2	2	4	2
VACCINE		3				8
JOURNAL OF CLINICAL MICROBIOLOGY	2				8	
BIOCHEMICAL AND BIOPHYSICAL RES COMMUN	1	2	2			1
FEMS MICROBIOLOGY LETTERS	7			3		
MOLECULAR MICROBIOLOGY	10	1	3	7		
BIOCHEMISTRY	4		8			
ANTIMICROBIAL AGENTS AND CHEMOTHERAPY	1				2	
JOURNAL OF INFECTIOUS DISEASES		1	1			
JAMA-JOURNAL OF THE AMERICAN MED ASSN						1
NATURE	1	4	3			1
MICROBIOLOGY-SGM				2		

JOURNAL OF IMMUNOLOGY	3	1	
CELLULAR MICROBIOLOGY	1		1

Which groups of these prolific authors publish as teams? Table 1C presents an asymmetric co-author matrix, with the most prolific authors from Table 1A listed in alphabetical order in the author column, and the six most prolific authors heading the columns (with most prolific starting from leftmost column). The matrix entries represent the co-authored publications by the author pairs. Thus, for example, Mock and Fouet have co-authored 25 research papers for the databases and time frames selected. The cells that reflect the same author in the column and row (e.g., Mock-Mock) reflect the total papers by that author in the retrieved database, and are included for reference purposes.

TABLE 1C – CO-AUTHOR MATRIX

AUTHOR	MOCK	LEPPLA	COLLIER	FOUET	KEIM	FRIEDLANDER
BAILLIE	0	0	0	0	0	0
BHATNAGAR	0	1	0	0	0	2
COLLIER	0	3	59	0	0	0
EZZELL	0	0	0	0	0	1
FOUET	25	0	0	32	0	0
FRIEDLANDER	0	4	0	0	0	29
HANNA	0	0	5	0	0	1
IVINS	0	1	0	0	0	6
KEIM	1	0	0	0	30	0
KLIMPEL	0	15	1	0	0	1
KOEHLER	1	0	1	0	1	1
KOLSTO	2	0	0	2	2	1
LEPPLA	0	67	3	0	0	4
LITTLE	0	3	0	0	0	9
MESNAGE	9	0	0	13	0	0
MOCK	72	0	0	25	1	0
MONTECUCCO	10	0	0	0	0	0
POPOVIC	0	0	0	0	1	0
QUINN	0	2	0	0	0	0
RUBINSTEIN	0	0	0	0	0	0
SINGH	0	9	0	0	0	2
SIRARD	13	0	0	4	0	0
TANG	1	1	0	0	0	0
TURNBULL	0	0	0	0	0	0

Strong intra-regional collaborative research/ publishing teams are evident. Mock's (Institute Pasteur) most frequent co-authors (from the top twenty) are Fouet (Institute Pasteur), Sirard (Institute Pasteur), and Montecucco

(Univ Padua). Leppla's (NIH) most frequent co-authors are Klimpel (NIH) and Singh (Center Biochem Tech). Collier's (Harvard) most frequent co-author is Hannah (Univ Michigan). Fouet's (Institute Pasteur) most frequent co-authors are Mock (Institute Pasteur) and Mesnage (Univ Paris). Friedlander's (US Army-Med Res Inst) most frequent co-authors are Little (US Army-Med Res Inst) and Ivins (US Army-Med Res Inst).

A more visual way of displaying these co-authoring teams is through an auto-correlation map (An auto-correlation function describes the correlation between a random function and a copy of itself shifted by some 'lag' distance. An auto-correlation map of authors shows teams of people who publish together). The authors are represented as map nodes, and those related are connected by lines of different thicknesses, thicker being stronger.

FIGURE 2 – AUTHOR AUTO-CORRELATION MAP

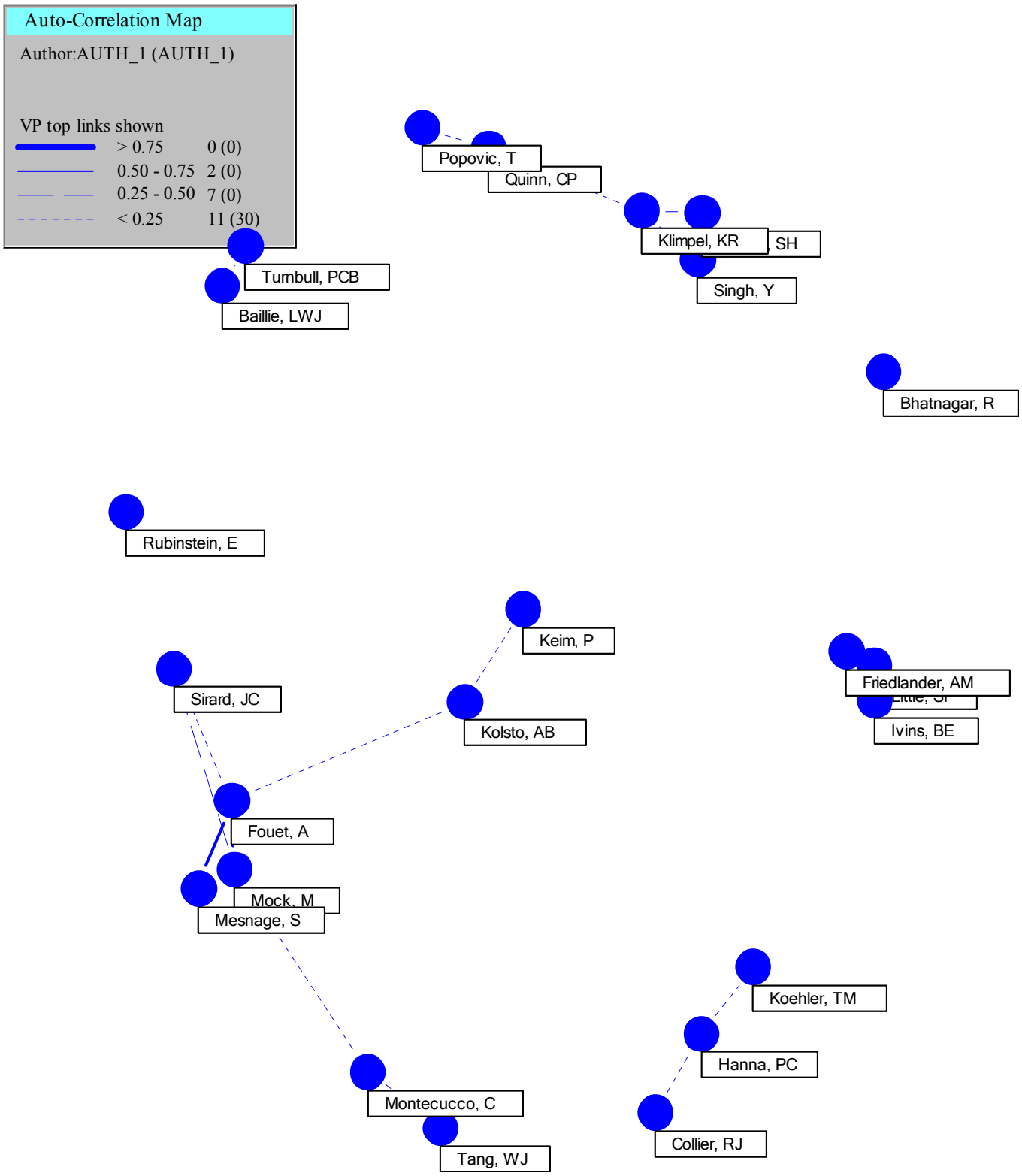


Figure 2 is an author auto-correlation map of the prolific authors listed in Table 1A. Three publishing groups are evident:

- The French group (lower left) centered around Mock, which contains the strongest link on the diagram (Fouet-Mesnage)
- The NIH-India group (upper right), weakly connected to the CDC group and centered about Leppla
- The US Army group (mid-right) centered around Friedlander

Also evident is a somewhat more weakly connected university group (bottom right) centered about Collier.

Other than the intra-connection within these three groups, there is not a great deal of inter-connection across groups evident from this diagram, based on the threshold values necessary to display linkages. Almost all the connections that do exist, whether intra- or inter-group, are relatively weak, based on the bands used to define the link strengths.

Factor analysis provides a more quantitative perspective on author publishing groups. Table 1D is an author factor matrix. The author names listed in Table 1A constitute the first column, and the factors are the remaining columns. Each factor represents a 'theme', a group of authors who co-author significantly. The matrix entries (the factor loadings) represent the contribution of the particular author to the factor 'theme'. The main co-authors in each factor (the 'theme') are those that have the highest absolute values of factor loadings. In determining the 'theme' for each factor, the factor column is sorted in both ascending and descending order. The tail (those phrases at the highest positive and lowest negative value ends of the column) with the highest absolute values of factor loadings determines the 'theme'. Typically, one tail is dominant, and there is one theme per factor. On rare occasions, the tails are of similar absolute value magnitude, and both tails are treated as separate 'themes'.

Based on the auto-correlation map results, the number of factors entered into the TechOasis factor matrix algorithm was four. However, factor 4 had two themes of equal weight, so factor 4 was copied into a column headed as factor 5 in order for both tails to be displayed. In Table 1D, the factor loadings in each column were sorted in descending order of absolute value. The high absolute value factor loadings that determine the factor 'themes' are shaded.

TABLE 1D – AUTHOR FACTOR MATRIX

FACTOR	1	2	3	4	5
Fouet, A	0.794	0.021	-0.323	0.029	0.029
Mock, M	0.746	-0.001	-0.271	-0.041	-0.041
Mesnage, S	0.644	0.023	-0.273	0.081	0.081
Sirard, JC	0.417	0.007	-0.15	-0.092	-0.092
Montecucco, C	0.164	-0.021	-0.029	-0.013	-0.013
Klimpel, KR	-0.038	0.799	-0.023	0.016	0.016
Leppla, SH	-0.074	0.722	-0.056	-0.033	-0.033
Arora, N	-0.004	0.672	0.042	-0.05	-0.05
Singh, Y	-0.061	0.57	-0.076	0.064	0.064
Little, SF	-0.309	0	-0.735	0.006	0.006
Ivins, BE	-0.288	-0.048	-0.693	0.018	0.018
Friedlander, AM	-0.276	0.029	-0.635	-0.083	-0.083
Quinn, CP	-0.02	0.145	0.032	0.511	0.511
Popovic, T	-0.019	-0.016	0.034	0.473	0.473
Turnbull, PCB	-0.024	-0.047	0.039	0.298	0.298
Baillie, LWJ	-0.02	-0.045	0.031	0.232	0.232
Hanna, PC	-0.03	-0.007	0.031	-0.501	-0.501
Collier, RJ	-0.037	0.025	0.099	-0.402	-0.402
Koehler, TM	0.007	-0.02	0.009	-0.358	-0.358
Kolsto, AB	0.08	-0.016	-0.049	-0.238	-0.238
Keim, P	-0.002	-0.04	0.042	-0.049	-0.049
Tang, WJ	0.018	-0.007	0.027	0.002	0.002
Bhatnagar, R	-0.049	0.022	-0.027	0.014	0.014
Rubinstein, E	-0.015	-0.027	0.032	0.016	0.016

Factor 1 is centered about the French group. There are strong ties among Fouet, Mock, and Mesnage, and reasonable ties with Sirard. There is a weak tie with Montecucco (Padua).

Factor 2 is centered about the NIH group. There are strong ties between Klimpel and Leppla, strong ties with the India group members Arora and Singh, and a weak tie with Quinn (CDC).

Factor 3 is centered about the US Army group. There are strong ties among Little, Ivens, and Friedlander.

Factor 4 is centered about the CDC group. There are strong ties between Quinn and Popovic, and moderate ties with Turnbull (Arjemptur) and Baillie (Maryland).

Factor 5 is centered about the university group. There are reasonably strong ties between Hanna (Michigan) and Collier (Harvard), a moderate tie with Koehler (Texas), and a weak tie with Kolsto (Oslo).

Kiem, the fifth most prolific author, does not play a strong or even moderate role in any of the five factors. He has a weak association with factors four and five, and based on the co-author matrix and the auto-correlation map, has a mild association with Kolsto.

These results corroborate those of the auto-correlation map, and provide further insights among the relationships.

Another perspective on the author linkages is through evaluation of the common terminology used in their papers. Obviously, co-authored documents will provide the highest values for any common terminology metric. However, for those authors who do not co-author but work on similar technical themes, a common terminology metric will show overlapping interests.

Abstract phrases were generated by the TechOasis Natural Language Processor, and an author-phrase co-occurrence matrix was generated. The phrases associated with the six most prolific authors are as follows:

- Mock (*Bacillus anthracis*, anthrax, lethal factor, protective antigen, proteins, pXO1, vitro, mice, vivo, macrophages, binding, expression, strains, protein, EF);
- Leppla (protective antigen, lethal factor, anthrax toxin, *Bacillus anthracis*, cells, anthrax, cytosol, data, vitro, edema factor, cleavage, role, toxicity, furin, mice, expression, *Pseudomonas* exotoxin);
- Collier (anthrax toxin, protective antigen, cytosol, translocation, lethal factor, cells, toxin, mammalian cells, edema factor, protein, anthrax, vivo, mechanism, binding, surface, pore, prepore, cytoplasm, entry, receptor, form, pore formation);

- Fouet (*Bacillus anthracis*, Sap, anthrax, expression, genes, *Bacillus thuringiensis*, pXO1, regulation, *Bacillus cereus* group, cell surface, proteins, bacteria, EA1, members, sequence analysis, parental strain);
- Keim (*Bacillus anthracis*, anthrax, *B. cereus*, contrast, data, sequences, region, DNA, collection, evolution, anthracis strains, species, *B. thuringiensis*, three, PCR, markers, phylogenetic analysis);
- Friedlander (*Bacillus anthracis*, protective antigen, anthrax, vaccine, virulence, macrophages, anthrax vaccine adsorbed AVA, mice, toxin, binding, infection, lethal factor, lethal toxin, death, animals, rabbits).

Leppla and Collier have some linkages due to the common relatively high frequency use of protective antigen, anthrax toxin, lethal factor, and edema factor.

To display the terminology relationships among the authors more visually, two cross-correlation maps (A cross-correlation map shows relationships among items in a list based on the values in another list. A cross-correlation map of authors and phrases can show groups of people who write about the same things.) linking authors by their use of common terminology were generated, and are displayed in Figures 3A and 3B. The first cross-correlation map, Figure 3A, includes the general anthrax descriptors as stand-alone phrases (e.g., anthrax, *anthracis*, *Bacillus anthracis*, etc). Because of their universal use in many papers, these general terms tend to blur the differentiation among papers. The second cross-correlation map, Figure 3B, does not include these general terms as stand-alone phrases (but they may be included as part of a larger phrase e.g., anthrax spores), and does include more detailed lower frequency phrases.

Compared to Figure 2 (author auto-correlation map), both Figures 3A and 3B show a larger number of linkages among the authors and much stronger linkages among the authors. There appears to be a gap between commonality of interests and commonality of publications, at least at the level of analysis (Abstract phrases) reflected in these diagrams and the threshold required for displaying connectivity. Figure 3A shows more and stronger inter-connections than Figure 3B because of the binding effect of the generic phrases, whereas the linkages in Figure 3B are due to common interest at a deeper level of detail.

Two main groups emerge from Figure 3A. One is the French-based group, centered about Mock. The other is a strongly-connected group

encompassing NIH, an Indian component and strong university component, and weakly linked to the US Army group. The strongly-connected group is centered about Leppla, and the weakly–connected group is centered about Friedlander.

Most of the common terminology groups from Figure 3A publish together as shown on the author auto-correlation map of Figure 2. However, on Figures 3A and 3B, the US Army group is linked to the NIH group by common terminology, but not shown linked on the publishing map of Figure 2 or the factor matrix of Table 1D.

FIGURE 3A – AUTHOR-PHRASE CROSS-CORRELATION MAP (General Phrases Included)

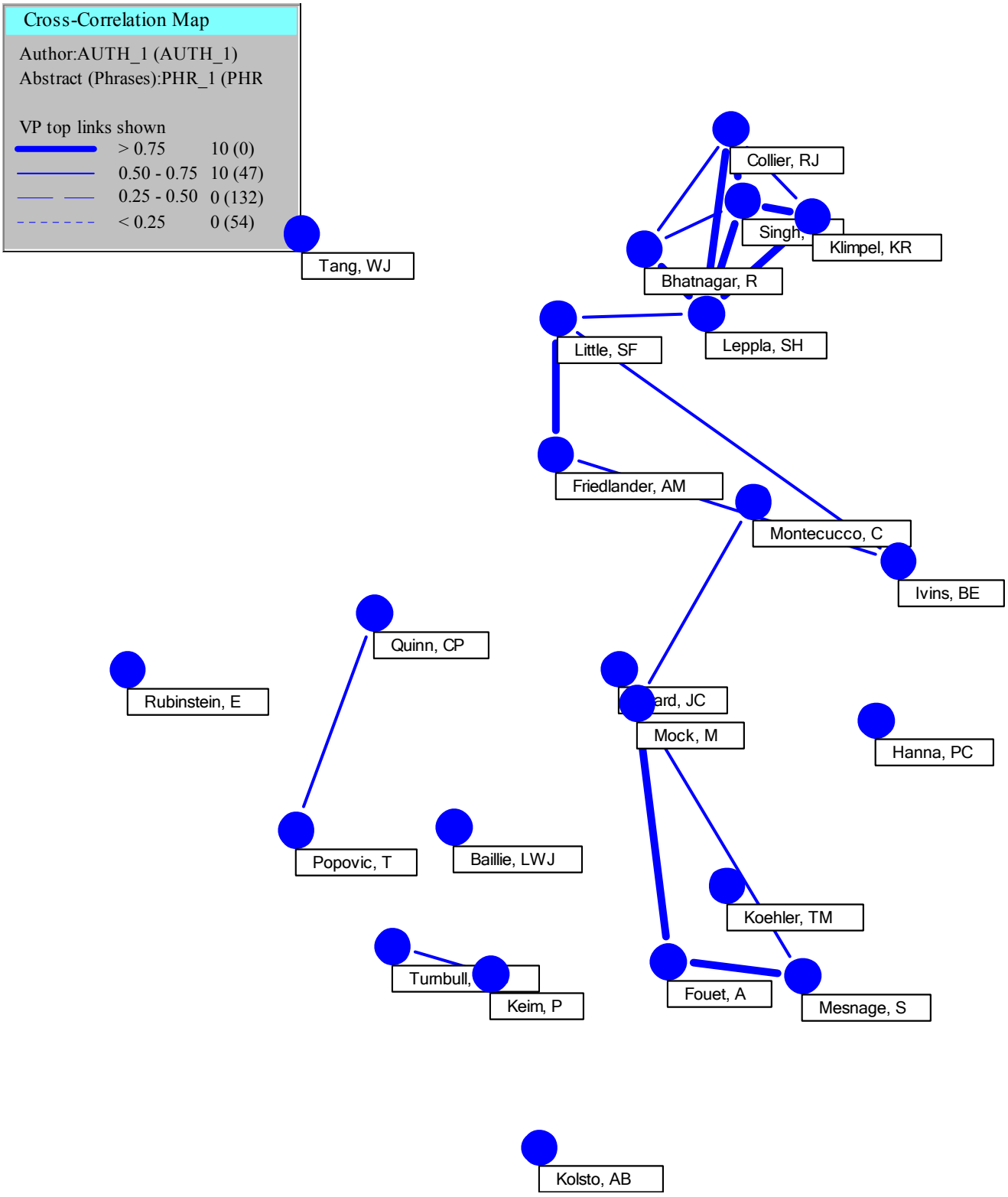
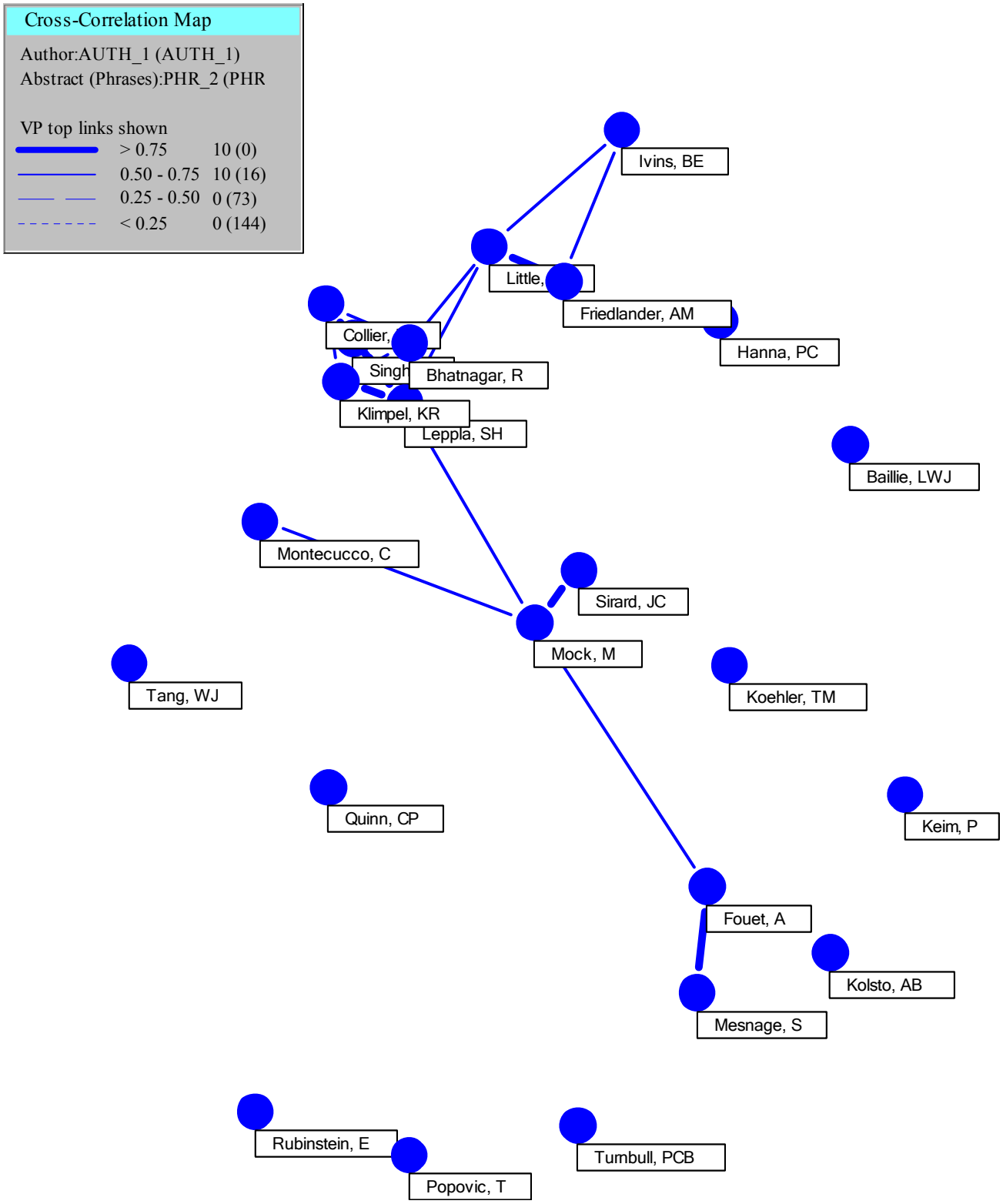


FIGURE 3B – AUTHOR-PHRASE CROSS-CORRELATION MAP (General Phrases Excluded)



Journals Containing Most Anthrax Papers

Table 2 presents the twenty journals containing the most anthrax research papers.

TABLE 2 – JOURNALS CONTAINING MOST ANTHRAX PAPERS

JOURNAL	# RECORDS		
	TOTAL	<2001	>2000
INFECTION AND IMMUNITY	105	39	66
JOURNAL OF BACTERIOLOGY	67	14	53
EMERGING INFECTIOUS DISEASES	61	5	56
APPLIED AND ENVIRONMENTAL MICROBIOLOGY	59	13	46
PROC OF THE NATIONAL ACADEMY OF SCIENCES-USA	59	14	45
JOURNAL OF BIOLOGICAL CHEMISTRY	57	15	42
JOURNAL OF APPLIED MICROBIOLOGY	56	39	17
VACCINE	50	11	39
JOURNAL OF CLINICAL MICROBIOLOGY	43	7	36
BIOCHEMICAL AND BIOPHYSICAL RESEARCH COMMUNICATIONS	40	4	36
FEMS MICROBIOLOGY LETTERS	35	16	19
MOLECULAR MICROBIOLOGY	25	15	10
ANALYTICAL CHEMISTRY	18	1	17
BIOCHEMISTRY	18	9	9
ANTIMICROBIAL AGENTS AND CHEMOTHERAPY	16	0	16
CLINICAL INFECTIOUS DISEASES	16	5	11
JOURNAL OF INFECTIOUS DISEASES	15	1	14
JAMA-JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION	14	4	10
LETTERS IN APPLIED MICROBIOLOGY	14	7	7
NATURE	13	1	12

Infection and Immunity stands out in terms of numbers of papers published, having 50% more than its nearest competitor. Many of the journals are highly specialized, and appear quite applied. The technical emphases of these journals are medicine (mainly infectious diseases), biology, and chemistry.

Two time bands were analyzed: pre 2001, and post 2000. Journals that published substantially relatively more papers after 2000 included Emerging Infectious Diseases, Journal of Clinical Microbiology, Biochemical and Biophysical Research Communications, Analytical Chemistry, Antimicrobial Agents and Chemotherapy, Journal of Infectious Diseases, And Nature. Journals that published substantially relatively less papers after 2000 included Journal of Applied Microbiology, FEMS Microbiology

Letters, Molecular Microbiology, Biochemistry, and Letters in Applied Microbiology. The latter are almost all microbiology journals, while the former cover a broader variety of topics.

Institutions Producing Most Anthrax Papers

Table 3 presents the 21 institutions producing the most anthrax research papers.

TABLE 3 – INSTITUTIONS PRODUCING MOST ANTHRAX PAPERS

		#RECORDS		
INSTITUTION	**CTRY**	**TOTAL**	**<2001**	**>2000**
US Army	USA	145	46	99
NIH	USA	133	32	101
Inst Pasteur	FRANCE	107	65	42
Harvard Univ	USA	89	27	62
CDC	USA	89	4	85
Univ Texas	USA	43	11	32
US Navy	USA	41	4	37
Johns Hopkins Univ	USA	32	3	29
No Arizona Univ	USA	30	13	17
US FDA	USA	29	1	26
Univ Maryland	USA	25	5	20
Jawaharlal Nehru Univ	INDIA	24	4	20
Univ Chicago	USA	23	1	22
Univ Michigan	USA	22	4	18
Louisiana State Univ	USA	21	11	10
Univ Padua	ITALY	19	11	8
Israel Inst Biol Res	ISRAEL	18	1	17
Stanford Univ	USA	18	1	17
Emory Univ	USA	16	1	15
Univ Oklahoma	USA	16	0	16
Lawr Livermore Natl Lab	USA	16	0	16

Five of the top ten are government research institutions, and six of the top 21 are government laboratories. The total research article production was divided into two time bands: pre-2001 and post-2000. Institute Pasteur was the most prescient of the leading producers, having generated about 2/3 of its articles before 2001. Other forward-looking organizations in this field include Northern Arizona University, Louisiana State University, and University of Padua. The bulk of the organizations (those with 5 or less articles pre-2001) appear to have reactively accelerated publication of anthrax articles after the anthrax attacks in the USA in 2001.

Five institutions stand out in terms of productivity:

- U.S. Army (including all variants);
- NIH (including all institutes);
- Institute Pasteur;
- Harvard University ; and
- CDC (a public health agency-includes all variants).

Thirteen are universities, and the others are research institutions (with the exception of CDC). The fraction of research institutions is much higher than in previous text mining studies performed by the first author (e.g., Kostoff et al, 2004a, 2004b, 2005b, 2006a). The USA has seventeen of these prolific institutions, Western Europe has two, and India and Israel have one apiece.

Which institutes collaborate significantly on publications? To identify cross-institution collaboration, an institution-institution co-occurrence matrix was generated. The major institutional collaborators for the top five institutions from Table 3 are as follows (collaborator/ [# papers]):

- US Army (NIH [7], Institute Pasteur [5], CDC [4], Clin Res Management [4]);
- NIH (US Army [7], US FDA [7], Harvard [5], Ctr Biochem Technol [4], Van Andel Res Inst [4]);
- Institute Pasteur (Univ Padua [11], US Army [5], CNRS [4], Ctr Etud Bouchet [4]);
- Harvard (Children's Hospital [6], NIH [5], Albert Einstein Coll Med [5], Salk Inst Biol Studies [5]);
- CDC (Emory Univ [8], US Army [4], New Jersey Dept Health and Senior Serv [4], Connecticut Dept Public Health [4], NYC Dept Health [4]).

What are the technical areas of emphasis of the major anthrax research institutions? To identify these technical themes, an institution-phrase co-occurrence matrix was generated for the five leading institutions. The major Abstract phrases for the top five institutions are as follows:

- US Army (*Bacillus anthracis*, anthrax, protective antigen, spores, vaccine, detection, AVA, binding, vitro, anthrax vaccine, infection, mice, identification, animals, assay, lethal factor, exposure, *Yersinia pestis*, survival, rabbits, bioterrorism, agents, virulence, immunization, protection, macrophages, contrast, guinea pigs);

- NIH (protective antigen, anthrax, *Bacillus anthracis*, anthrax toxin, lethal factor, cells, edema factor, toxin, vitro, cytosol, mice, vivo, expression, toxicity, binding, treatment, protein, combination, internalization, cleavage, furin, animals, contrast, protection, disease, interaction, cell surface, translocation, LeTx, *Pseudomonas* exotoxin);
- Institute Pasteur (*Bacillus anthracis*, anthrax, proteins, lethal factor, binding, vitro, protective antigen, mice, vivo, expression, macrophages, bacteria, Sap, cells, contrast, cell surface, genes, pXO1, edema factor, strains, *B. cereus*, *Bacillus thuringiensis*, *Bacillus cereus* group, virulence, infection, spores, identification, lethal toxin, production);
- Harvard (anthrax toxin, protective antigen, cytosol, translocation, lethal factor, toxin, anthrax, cells, protein, edema factor, mammalian cells, PA(63, mechanism, *Bacillus anthracis*, vivo, binding, surface, treatment, pore, prepore, entry, receptor, form, pore formation);
- CDC (*Bacillus anthracis*, anthrax, inhalational anthrax, patients, exposure, bioterrorism, *Bacillus anthracis* spores, prevention, risk, disease, patient, surveillance, cutaneous anthrax, treatment, infection, information, negative, antibiotics, reports, facility, outbreak)

NIH and Harvard have some linkages due to the common high frequency use of protective antigen, anthrax toxin, lethal factor, edema factor, and translocation. In general, the research thrusts of each institution based on phrase co-occurrences agree quite well with the thrusts based on journal frequency shown above.

To display these linkages more visually, two mapping approaches were performed: auto-correlation mapping and cross-correlation mapping. Figure 4A is an institution auto-correlation map that shows institutional relationships based on actual co-authorships. Figures 4B and 4C are institution-phrase cross-correlation maps that show institutional relationships based on use of common terminology.

As in the author auto- and cross-correlation maps, publication connectivity is much weaker than common interest connectivity. On Figure 4A, all links are weak (barely visible), based on the link strength criteria listed in the legend on the figure. On Figure 4B, many links are very strong, and on Figure 4C many links are strong.

There appears to be one main co-publishing group. It is centered about the University of Maryland, with satellites centered about Johns Hopkins University and University of Texas. The US Army is not linked to any of the extensions of this core publishing group, at least at the threshold level for connectivity display on the auto-correlation map.

The first cross-correlation map, Figure 4B, includes the general anthrax descriptors as stand-alone phrases (e.g., anthrax, *anthracis*, *Bacillus anthracis*, etc). Because of their universal use in many papers, they tend to blur the differentiation among papers. The second cross-correlation map, Figure 4C, does not include these general terms as stand-alone phrases (but they may be included as part of a larger phrase e.g., anthrax spores), and does include more detailed lower frequency phrases. The NIH, Institute Pasteur, and US Army form the core group based on use of common terminology. Additionally, NIH links to the university and Indian groups in terms of common interests, Institute Pasteur links to a number of universities in terms of common interests, and US Army links to other governmental organizations in terms of common interests. But while Institute Pasteur and NIH have some mild publishing link strengths with those institutions that have overlapping terminology usage, US Army does not, at least at the threshold level for connectivity display on the auto-correlation map.

FIGURE 4A – INSTITUTION AUTO-CORRELATION MAP

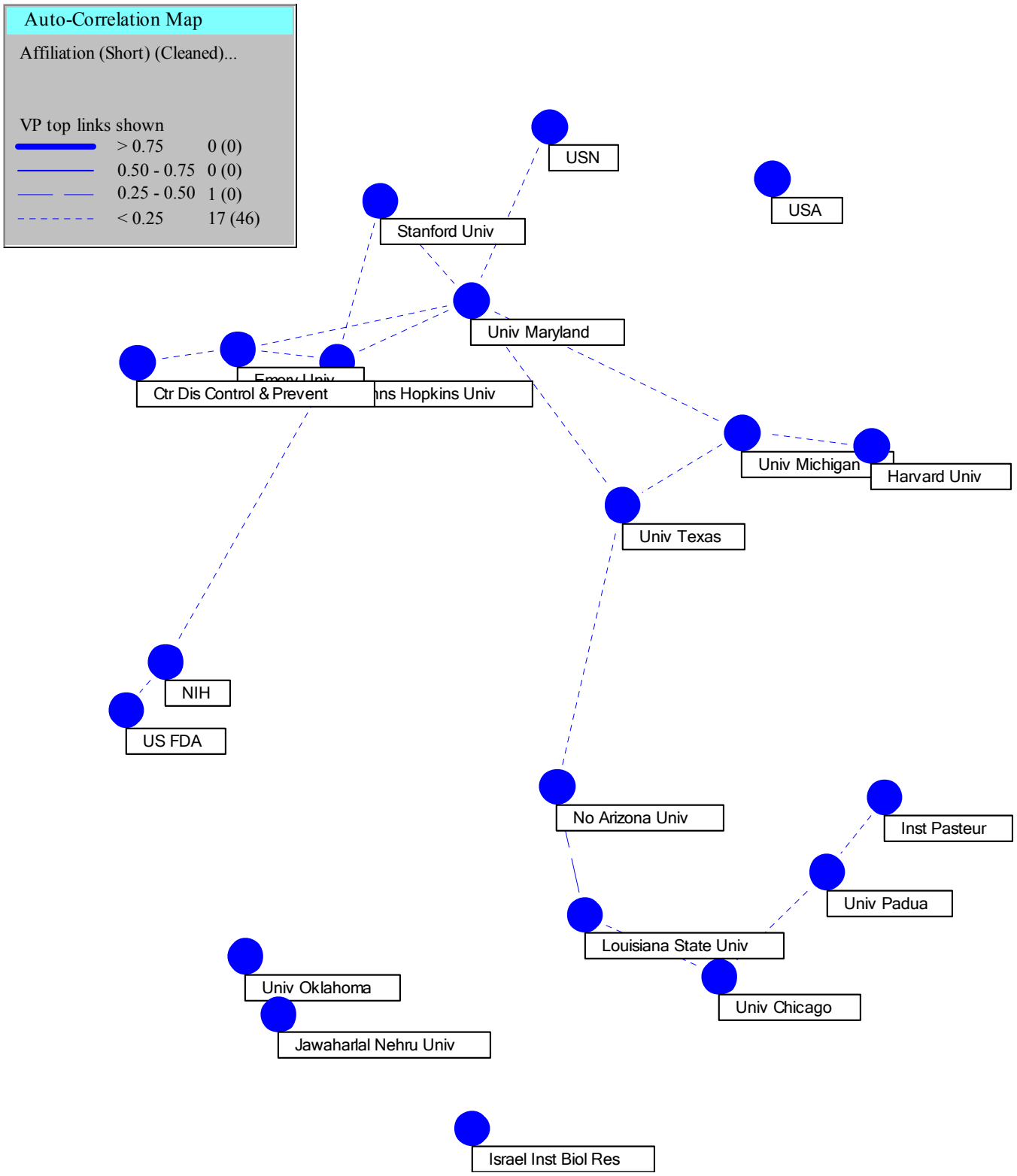

Auto-Correlation Map
Affiliation (Short) (Cleaned)...
VP top links shown
> 0.75 0 (0)
0.50 - 0.75 0 (0)
0.25 - 0.50 1 (0)
< 0.25 17 (46)
USN
USA
Stanford Univ
Univ Maryland
Ctr Dis Control & Prevent
Univ Michigan
Harvard Univ
Univ Texas
NIH
US FDA
No Arizona Univ
Inst Pasteur
Univ Padua
Louisiana State Univ
Univ Chicago
Univ Oklahoma
Jawaharlal Nehru Univ
Israel Inst Biol Res

FIGURE 4B – INSTITUTION-PHRASE CROSS-CORRELATION MAP (Generic Phrases Included)

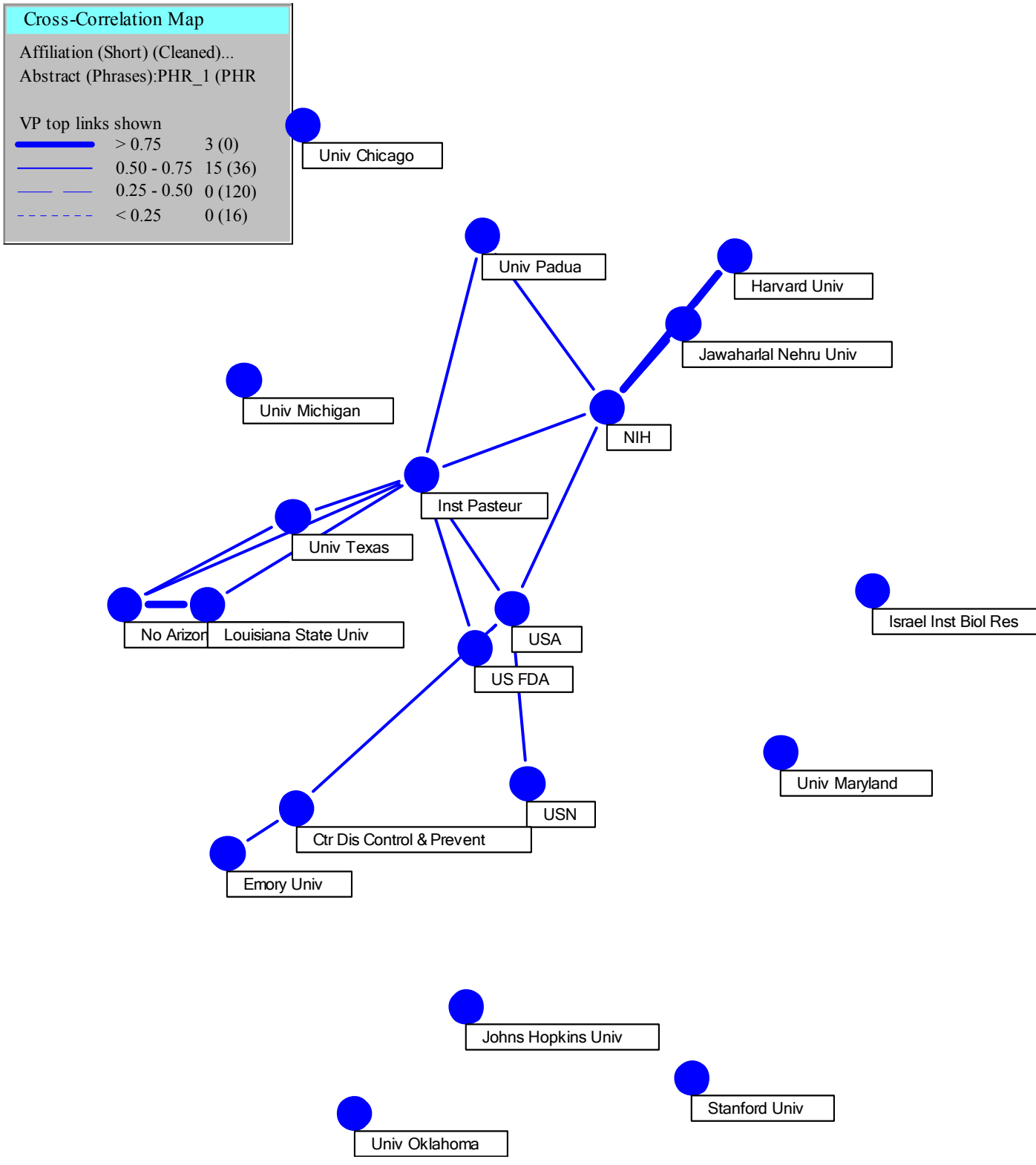
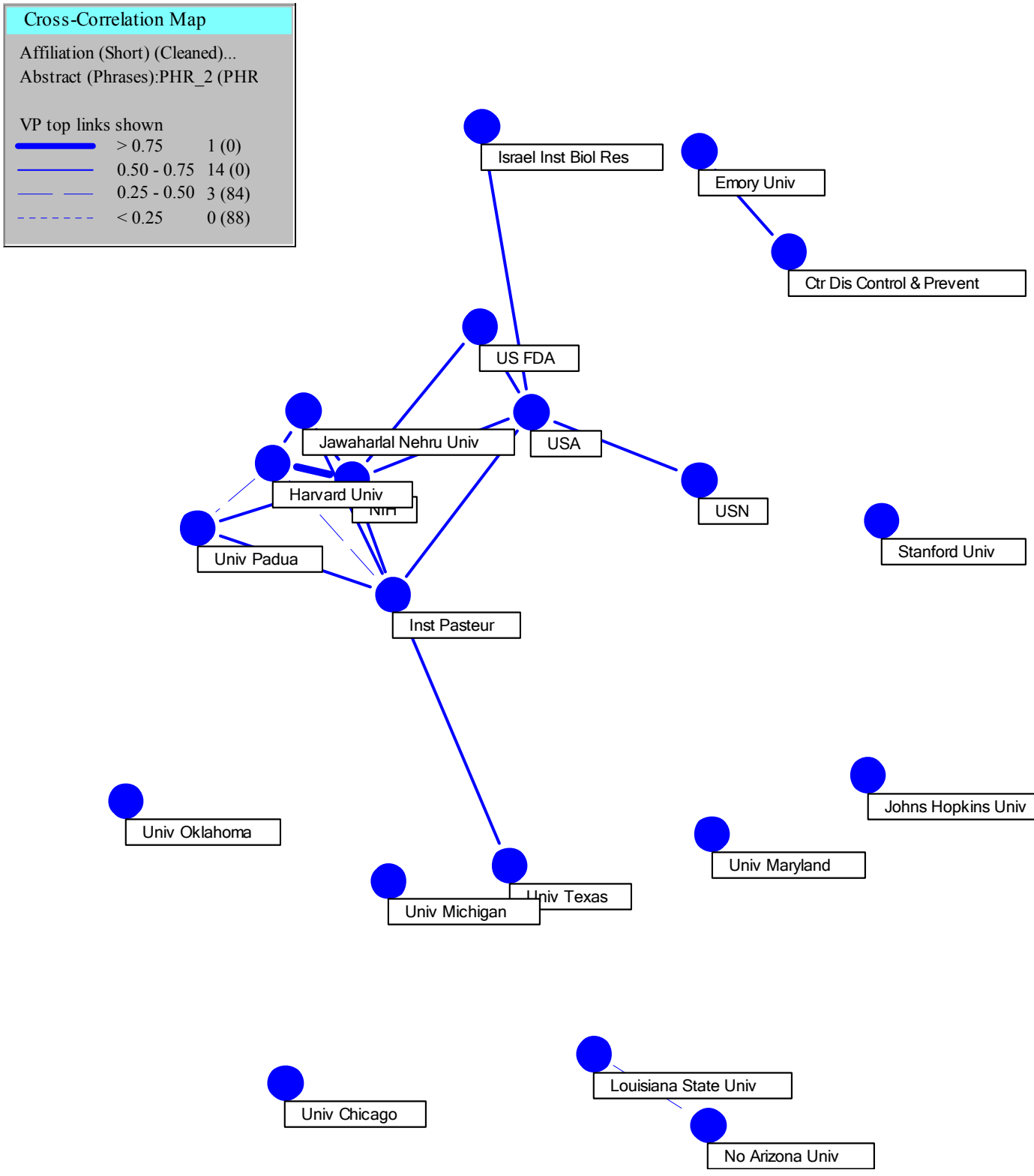


FIGURE 4C – INSTITUTION-PHRASE CROSS-CORRELATION MAP (Generic Phrases Excluded**)**



To identify preferred institutional publishing venues, an institution-journal co-occurrence matrix was generated, with the journal Impact Factors included in the display. The journal Impact Factors are a measure of the level of citation of the journal's research articles, and are a function of journal publication quality, publication development level (e.g., basic research, applied research, technology development, engineering), activity in discipline covered by journal (number of researchers available to cite), and journal availability/ visibility. The major journals for the top five institutions are as follows (journal [# papers][Impact Factor]):

- US Army (Vaccine [20][2.82], Infection and Immunity [14][4.03], Journal of Clinical Microbiology [7][3.44], Applied and Environmental Microbiology [6][3.81], Microbial Pathogenesis [6][2.05]);
- NIH (Journal of Biological Chemistry [16][6.36], Infection and Immunity [14][4.03], Proceedings of the National Academy of Sciences [8][10.45], Vaccine [6][2.82]);
- Institute Pasteur (Journal of Bacteriology [13][4.15], Infection and Immunity [12][4.03], Molecular Microbiology [12][5.96]);
- Harvard (Proceedings of the National Academy of Sciences [13][10.45], Journal of Biological Chemistry [8][6.36], Biochemistry [8][4], Infection and Immunity [7][4.03]);
- CDC (Emerging Infectious Diseases [32][5.64], Clinical Infectious Diseases [4][5.59], JAMA [4][24.83], Journal of Health Communication [4][0]).

The thrusts of each institution in anthrax research can be seen from analysis of the leading journals in which the anthrax research is published. The US Army emphasizes vaccines and microbiology. NIH emphasizes biochemistry and infection. Institute Pasteur emphasizes bacteriology, microbiology, and infection. Harvard emphasizes biochemistry and infection. CDC emphasizes the public health aspects of infectious diseases and epidemiology.

A weighted Impact Factor for each institution, based only on the journals in which it published most frequently (those listed above), was computed. This metric is the product of number of papers per journal (listed above) times journal Impact Factor (listed above) summed over the journals listed above, and divided by the total number of papers per institution in the above list.

The results are: US Army 3.25; NIH 5.88; Institute Pasteur 4.70; Harvard 6.86; CDC 6.87. The main finding is the relatively low weighted Impact Factor of the US Army relative to that of Harvard and the CDC. It may be due to the Army's emphasis on applications, especially the heavy emphasis on vaccines, and the relatively limited readership for this rather specialized topical area.

Countries Producing the Most Anthrax Papers

Table 4A contains the twenty countries producing the most anthrax research papers.

TABLE 4A – COUNTRIES PRODUCING MOST ANTHRAX PAPERS

COUNTRY	#RECORDS
USA	1185
FRANCE	154
ENGLAND	127
GERMANY	87
INDIA	66
CANADA	54
ITALY	52
JAPAN	40
ISRAEL	39
SOUTH KOREA	34
TURKEY	28
AUSTRALIA	25
NORWAY	23
RUSSIA	19
BELGIUM	18
NETHERLANDS	18
SWITZERLAND	17
BRAZIL	15
PEOPLES R CHINA	13
TAIWAN	12

The production of research articles over time by the major countries was summarized at the end of the Background section. The United States dominates the output reflected in Table 4A, contributing over half the open research article literature on anthrax (N=1185). Following are France (N=154), England (N=127) and Germany (N=87), with other countries far behind. The low numbers of China are interesting. In recent text mining studies of different technical disciplines by the first author (Kostoff et al,

2006a, 2006d, 2006e), China has been near the top in country, institution, and author listings. Here, China appears nineteenth in the top twenty countries.

To identify country-country collaborations for the major research article producers, a country-country matrix was generated. The three most prolific countries, and their major collaborators, are presented (collaborator, # papers):

- USA (England 32, Germany 20, France 17, Canada 12);
- France (USA 17, Italy 12, Germany 7, Norway 5);
- England (USA 32, Germany 6, France 4, Canada 3, Netherlands 3)

To identify the visibility of the major journals in which each country publishes, a country-journal matrix was generated. Table 4B presents this matrix. Most significant entries are shaded (high numbers of papers in high Impact Factor journals). The numbers of total research articles published in each journal are shown in column 1. The Impact Factors of the journals are shown in column 3. There are two columns headed by each country. The left of the two columns represents the numbers of papers in the specific journal, and the right of the two columns is the product of the Impact Factor for the specific journal times the number of papers for the specific journal, divided by the total number of papers for all journals.

A weighted Impact Factor (SUM OVER JOURNALS [papers per journal]*[Impact Factor for journal]/[total number of papers]) was computed for each country in the matrix. The results are: USA 5.6; France 5.0; England 4.54; Germany 6.44; India 3.38. Thus, Germany is publishing (on average) in the most cited journals while India is publishing in the least cited. The journal Impact Factor, or citability in general, is a complicated function of quality of papers and/ or level of development (basic/ applied) and/ or availability of journal and/ or number of researchers in sub-field available to cite. The above analysis did not distinguish among these components as the cause for high and low Impact Factors for specific countries.

TABLE 4B – COUNTRY JOURNAL MATRIX

REC	JOURNAL	IMPACT FACTOR	USA PAPERS	USA *FRACT*	FRANCE PAPERS	FRANCE *FRACT*	ENGLAND PAPERS	ENGLAND *FRACT*	GERMANY PAPERS	GERMANY *FRACT*	INDIA PAPERS	INDIA *FRACT*
105	INFECTION AND IMMUNITY	4.03	73	0.12	12	0.14	5	0.10	4	0.13	6	0.21
67	JOURNAL OF BACTERIOLOGY	4.15	40	0.07	13	0.15	4	0.08	1	0.03		0.00
61	EMERGING INFECT DISEASES	5.64	56	0.10		0.00		0.00	1	0.03		0.00
59	PROC: NATL ACAD SCI-USA	10.45	56	0.10	2	0.02	2	0.04	4	0.13		0.00
59	APPL/ ENVIRON MICROBIOLOGY	3.81	33	0.06	4	0.05	2	0.04	3	0.10		0.00
57	JOURNAL OF BIOL CHEMISTRY	6.36	46	0.08	5	0.06	3	0.06	5	0.16	3	0.10
56	JOURNAL OF APPL MICROBIOL	1.84	22	0.04	6	0.07	11	0.21	1	0.03		0.00
50	VACCINE	2.82	31	0.05	1	0.01	10	0.19		0.00	1	0.03
43	JOURNAL OF CLIN MICROBIOL	3.44	28	0.05	3	0.03	1	0.02	3	0.10		0.00
40	BIOCHEM/ BIOPHYS RES COMM	2.9	18	0.03	1	0.01		0.00	1	0.03	16	0.55
35	FEMS MICROBIOLOGY LETTERS	1.84	6	0.01	7	0.08	2	0.04	3	0.10	3	0.10
25	MOLECULAR MICROBIOLOGY	5.96	9	0.02	12	0.14		0.00		0.00		0.00
18	BIOCHEMISTRY	4	11	0.02	5	0.06		0.00	2	0.06		0.00
18	ANALYTICAL CHEMISTRY	5.45	17	0.03		0.00		0.00		0.00		0.00
16	CLINICAL INFECTIOUS DISEASES	5.59	15	0.03		0.00		0.00		0.00		0.00
16	ANTIMICROB AGENTS/ CHEMO	4.22	12	0.02	3	0.03	2	0.04		0.00		0.00
15	JOURNAL OF INFECT DISEASES	4.94	13	0.02		0.00	1	0.02		0.00		0.00
14	JAMA	24.83	13	0.02		0.00		0.00	1	0.03		0.00
14	LETTERS IN APPL MICROBIOL	1.46	3	0.01		0.00	4	0.08		0.00		0.00
13	NATURE	32.18	11	0.02	2	0.02	2	0.04	1	0.03		0.00
12	MICROBIOLOGY-SGM	3.11	5	0.01	4	0.05	2	0.04	1	0.03		0.00
12	BIOSECURITY AND BIOTERROR	0	11	0.02		0.00		0.00		0.00		0.00
11	JOURNAL OF IMMUNOLOGY	6.49	6	0.01	5	0.06	1	0.02		0.00		0.00
11	ASM NEWS	0.41	5	0.01		0.00		0.00		0.00		0.00
11	BIOSENSORS & BIOELECTRONICS	3.25	10	0.02		0.00		0.00		0.00		0.00
11	JOURNAL OF HEALTH COMM	0	10	0.02		0.00		0.00		0.00		0.00
10	MILITARY MEDICINE	0	9	0.02		0.00		0.00		0.00		0.00
10	CELLULAR MICROBIOLOGY	6.1	6	0.01	2	0.02		0.00		0.00		0.00
9	JOURNAL OF FOOD PROTECTION	1.87	6	0.01		0.00		0.00		0.00		0.00
8	AMER JOURNAL OF PUB HEALTH	3.24	7	0.01		0.00		0.00		0.00		0.00
	TOTALS>>>>>>>>>>>>>		588	1.00	87	1.00	52	1.00	31	1.00	29	1.00

CITATION BIBLIOMETRICS

The second group of metrics presented is counts of citations to documents published by different entities. While citations are ordinarily used as impact or quality metrics (Garfield, 1985), much caution needs to be exercised in their frequency count interpretation, since there are numerous reasons why authors cite or do not cite particular documents (MacRoberts and MacRoberts, 1989, 1996; Kostoff, 1998b).

The citations in all the retrieved SCI/ SSCI papers were aggregated, the authors, specific documents, years, journals, and countries cited most frequently were identified, and are presented in order of decreasing frequency. A small percentage of any of these categories received large numbers of citations.

Most Cited First Authors

Table 5A contains the twenty first authors receiving the most total citations.

TABLE 5A – MOST CITED FIRST AUTHORS

AUTHOR	INSTITUTION	COUNTRY	# CITES
LEPPLA SH	NIH	USA	662
FRIEDLANDER AM	US ARMY - MED RES INST	USA	429
TURNBULL PCB	ARJEMPTUR TECH, LTD	UK	416
INGLESBY TV	JOHNS HOPKINS UNIV	USA	346
IVINS BE	US ARMY - MED RES INST	USA	321
WELKOS SL	US ARMY - MED RES INST	USA	254
SINGH Y	CENTER BIOCHEM TECH	INDIA	248
DUESBERY NS	VAN ANDEL RES INST	USA	241
HANNA PC	UNIV MICHIGAN	USA	236
MILNE JC	HARVARD	USA	232
LITTLE SF	US ARMY - MED RES INST	USA	224
KLIMPEL KR	NIH	USA	224
DIXON TC	DUKE UNIV	USA	217
BRACHMAN PS	EMORY UNIV	USA	203
KEIM P	NORTHERN ARIZONA UNIV	USA	191
HELGASON E	UNIV OSLO	NORWAY	179
PEZARD C	INSTITUTE PASTEUR	FRANCE	175
VITALE G	UNIV UDINE	ITALY	169
MOCK M	INSTITUTE PASTEUR	FRANCE	168
UCHIDA I	NATL INST ANIM HLTH	JAPAN	165

Thirteen of the most cited first authors are from the USA, five are from Western Europe, and two are from Asia. Eight of the authors are from universities, eleven are from research institutions, and one is from industry. Since past text mining studies performed by the present paper's first author have shown that cited documents tend to be at a more fundamental level than the citing papers, the heavy contribution from research institutions relative to universities is again in stark contrast to these previous text mining studies. An additional difference from past text mining results is that ten of the 24 most prolific authors are in common with the twenty most cited first authors. In the first author's past text mining studies, perhaps one or two authors would be in common between the two lists. The reasons for this high degree of overlap are not clear, but may reflect a highly in-bred community. It may also reflect the relatively high fraction of research institutes, where typically (not always) researchers have a higher first author fraction than universities.

In addition, the SCI downloads citations by first author only. Thus, authors who may publish many papers, but who tend to get listed behind the first author, will be under-represented in this tabulation.

For example, for the first five of the twenty most cited first authors, the numbers of research articles in which they are first authors divided by the total numbers of research articles they have published are as follows: Leppla (5/111); Friedlander (8/57); Turnbull (22/49); Inglesby (10/28); Ivins (10/29). Based on past text mining bibliometrics studies, the small fractions for Leppla tend to be typical of university professors, while authors from national laboratories or research institutions tend to have larger fractions. In the present case, based on first author statistics, Leppla is highly under-represented in citations received. Highly cited papers (>90 SCI-listed citations) in which he was a co-author, but was not the first author, had the following first authors: Molloy, Duesbery, Petrosa, Klimpel (2), Gordon (2), Pannifer, Welkos, and Vodkin.

To identify the authors most associated with the highly cited papers, the 75 anthrax-related documents cited most highly (as listed in the SCI) were retrieved, and the author frequency was extracted. This method of author extraction includes all the paper authors, not limited to first author. Table 5B shows the results. The central authors are clearly evident from this result.

TABLE 5B – AUTHORS OF MOST CITED PAPERS

AUTHOR	#PAPERS
LEPPLA--SH	15
COLLIER--RJ	7
MOCK--M	7
FRIEDLANDER--AM	6
KLIMPEL--KR	6
HANNA--PC	4
KEIM--P	4
KOEHLER--TM	4
GORDON--VM	3
IVINS--BE	3
MONTECUCCO--C	3
THOMAS--G	3
THORNE--CB	3
VITALE--G	3

The citation data for authors and journals represent citations generated only by the specific records extracted from the SCI/ SSCI database for this study. The data does not represent all the citations received by the references in those records; these references in the database records could have been cited additionally by papers in other technical disciplines. The next metric provides examples of these differences.

Most Cited Documents

Table 6 contains the twenty most cited documents. The column headed #CITES reflects the citations from the retrieved documents only, whereas the column headed TOTAL SCI CITES reflects citations from all documents contained in the SCI/ SSCI. Finally, the right-most column labeled MAX JRNL CITES is the maximum number of citations received by any paper published in that journal for that year. Thus, the first paper listed (published in Science in 1998) was cited 196 times by other papers in the retrieved anthrax-specific database, and was cited 297 times by all the papers in the SCI/ SSCI. The highest cited paper published in Science in 1998 received 2659 cites.

TABLE 6 – MOST CITED DOCUMENTS

DOCUMENT	#CITES	TOTAL SCI CITES	MAX JRNL CITES
DUESBERY NS, 1998, SCIENCE, V280, P734	196	297	2659
(PROTEOLYTIC INACTIVATION OF MAPKK BY ANTHRAX LETHAL FACTOR)			
LEPPLA SH, 1982, P NATL ACAD SCI USA, V79, P3162	190	357	3943
(ANTHRAX TOXIN EDEMA FACTOR)			
FRIEDLANDER AM, 1986, J BIOL CHEM, V261, P7123	178	255	1745
(MACROPHAGE SENSITIVITY TO ANTHRAX LETHAL TOXIN)			
DIXON TC, 1999, NEW ENGL J MED, V341, P815	173	270	5067
(ANTHRAX)			
INGLESBY TV, 1999, JAMA-J AM MED ASSOC, V281, P1735	167	293	871
(ANTHRAX AS BIO-WEAPON-MEDICAL MANAGEMENT)			
PETOSA C, 1997, NATURE, V385, P833	146	272	2749
(ANTHRAX TOXIN PROTECTIVE ANTIGEN CRYSTAL STRUCTURE)			
GREEN BD, 1985, INFECT IMMUN, V49, P291	123	189	266
(CAPSULE PLASMID IN BACILLUS-ANTHRACIS)			
KLIMPEL KR, 1992, P NATL ACAD SCI USA, V89, P10277	123	211	2338
(ANTHRAX TOXIN PROTECTIVE ANTIGEN PROTEASE ACTIVATION)			
BRADLEY KA, 2001, NATURE, V414, P225	121	181	4733
(IDENTIFICATIOIN OF THE CELLULAR RECEPTOR FOR ANTHRAX TOXIN)			
HELGASON E, 2000, APPL ENVIRON MICROB, V66, P2627	121	194	194
(BACILLUS ANTHRACIS, BACILLUS CEREUS, AND BACILLUS THURINGIENSIS - ONE SPECIES)			
MILNE JC, 1994, J BIOL CHEM, V269, P20607	121	173	1458
(OLIGOMER FORMATION BY ANTHRAX PROTECTIVE ANTIGEN)			
JERNIGAN JA, 2001, EMERG INFECT DIS, V7, P933	120	196	196
(BIOTERRORISM-RELATED INHALATIONAL ANTHRAX)			
INGLESBY TV, 2002, JAMA-J AM MED ASSOC, V287, P2236	113	175	2656
(ANTHRAX AS A BIOLOGICAL WEAPON)			
MESELSON M, 1994, SCIENCE, V266, P1202	112	245	2620
(THE SVERDLOVSK ANTHRAX OUTBREAK OF 1979)			
MOCK M, 2001, ANNU REV MICROBIOL, V55, P647	111	149	316
(ANTHRAX)			
PEZARD C, 1991, INFECT IMMUN, V59, P3472	109	139	492
(CONTRIBUTION OF INDIVIDUAL TOXIN COMPONENTS TO VIRULENCE OF BACILLUS-ANTHRACIS)			
SAMBROOK J, 1989, MOL CLONING LAB MANU	105	>75000	NA
(MOLECULAR CLONING LAB MANUAL)			
HANNA PC, 1993, P NATL ACAD SCI USA, V90, P10198	103	156	2086
(MACROPHAGE ROLE IN ANTHRAX)			
MIKESELL P, 1983, INFECT IMMUN, V39, P371	97	172	477
(PLASMID-MEDIATED TOXIN PRODUCTION IN BACILLUS-ANTHRACIS)			
READ TD, 2003, NATURE, V423, P81	96	181	554
(THE GENOME SEQUENCE OF BACILLUS ANTHRACIS AMES)			

In general, the most cited anthrax documents receive relatively low numbers of citations (<10% of the highest cited papers) when published in the broad

multi-disciplinary journals, but seem to perform much better when published in the specialty journals.

The twenty most cited publications appear to be highly applied. Additionally, the ratio of citations by other papers in the retrieved anthrax database to total citations as listed in the Science Citation Index (the ratio of the left to middle numerical columns) is, on average, higher than in previous text mining studies conducted by the first author. This reflects the highly applied literature, where most of the citing papers are within the focused topical area, and the highly cited documents are not sufficiently fundamental to be cited outside the specific anthrax literature of interest.

The twenty most cited documents can be divided into four topical groups. The largest group contains nine documents (45%) focused on the three proteins (PA, EF,and LF) that comprise the two binary anthrax toxins (LT [PA + LF] and ET [PA + EF]). The next largest groups consist of: five documents focused on bio-terrorism, post-exposure prophylaxis and medical management of anthrax; five documents focused on broader biological aspects of *B. anthracis* and its pathologies. These documents have a medical, epidemiological, and highly experimental focus. Fundamental theory, computer modeling, and access to other literatures are not evident from the citations.

Most Cited vs Least Cited SCI Papers

The following analysis was performed in 2003, and its objective was to identify the differences between least and most cited anthrax research articles in the SCI/ SSCI. The ten most cited anthrax papers published between 1993-1998 were compared to the thirteen least cited papers published during the same period, and the results presented in Table 7. This period was sufficiently historical to allow citations to accumulate, yet sufficiently recent to be of current interest. This comparison technique has been used previously by the first author (e.g., Kostoff, 2005a), and can sometimes produce insightful results not easily obtainable by other techniques.

TABLE 7 – MOST CITED VS LEAST CITED PAPERS

MOST CITED

#AUTH	#REF	#CITES	#ABS WORDS	PAPER LANG	JOURN COUNT	FIRST AUTH COUNT	FIRST AUTH INST	ART TYPE
11	31	219	94	ENGL	USA	USA	RES INS	LAB RES
7	47	207	109	ENGL	USA	USA	UNIV	EPIDEM
5	30	200	203	ENGL	UK	UK	UNIV	LAB RES
5	42	137	191	ENGL	USA	USA	UNIV	LAB RES
4	53	132	188	ENGL	USA	USA	RES INS	HISTORY
3	28	127	205	ENGL	USA	USA	UNIV	LAB RES
10	25	118	277	ENGL	USA	USA	UNIV	LAB RES
1	43	115	164	ENGL	USA	USA	UNIV	ASSESS
3	57	105	157	ENGL	USA	USA	RES INS	LAB RES
6	34	99	181	ENGL	USA	ITALY	UNIV	LAB RES
AVER=	AVER=	AVER=	AVER=					
5.5	39	145.9	176.9					
MED=	MED=	MED=	MED=					
5	38	129.5	184.5					

LEAST CITED

2	14	0	57	RUSSIAN	RUSSIA	RUSSIA	RES INS	LAB RES
2	0	0	0	ENGLISH	INDIA	INDIA	UNIV	LAB RES
6	10	0	0	RUSSIAN	RUSSIA	RUSSIA	RES INS	EPIDEM
2	22	0	96	GERMAN	GERMANY	GERMANY	UNIV	FIELD TRIALS
2	61	0	0	ENGLISH	GERMANY	FRANCE	RES INS	LAB RES
3	0	0	0	ENGLISH	INDIA	INDIA	UNIV	LAB RES
6	5	0	45	RUSSIAN	RUSSIA	RUSSIA	RES INS	CLIN DIAG
2	22	0	218	ENGLISH	GERMANY	ISRAEL	UNIV	LAB RES
2	0	0	31	GERMAN	GERMANY	MALAGASY	RES INS	ASSESS
1	0	0	185	HUNGARIAN	HUNGARY	HUNGARY		EPIDEM
5	13	0	0	ENGLISH	AUSTRALIA	AUSTRALIA	RES INS	EPIDEM
7	15	0	150	ENGLISH	GERMANY	GERMANY	UNIV	EPIDEM
2	24	0	64	ENGLISH	NETHERLANDS	USA	UNIV	PRODUCTION
AVER=	AVER=	AVER=	AVER=					
3.231	14.31	0	65.08					
MED=	MED=	MED=	MED=					
2	14	0	45					

As Table 7 shows, compared to the thirteen lowest cited papers (all the papers that had zero citations), the ten highest cited papers had:

a) 2.5 times the median number authors (5/2) compared with the ten lowest cited papers
b) 2.7 times the median number of references (38/14)
c) median of 130 cites to zero
d) four times the number of median Abstract words (184.5/45)

Additionally, all the most cited articles were written in English, whereas only 7/13 of the least cited articles were written in English. Further, 9/10 of the most cited articles appeared in journals published in the USA, which are mainly highly respected international journals. None of the least cited articles were published in USA journals, but were published mainly in Central/ Eastern European and Indian journals. Still further, 8/10 of the most cited articles had a first author from USA, whereas only one of the thirteen least cited articles had a first author from USA. Seven of the top ten most cited articles were from universities, whereas only six of the bottom thirteen most cited articles were from universities.

In terms of technical characteristics, seven of the ten most cited articles could be classified as basic laboratory research, with the focus on protective antigen structure and lethal factor cleavage (key steps in the formation of lethal toxin). The remaining three articles were highly topical and related to biowarfare. Conversely, only five of the thirteen least cited articles could be classified as basic laboratory research, and they focused on less mechanism-oriented macrovariable measurements. The remainder could be classified as epidemiological studies (typically in animals), fabrication/ production studies, and clinical/ field trials.

In summary, compared to the least cited articles, the most cited, on average, had

- more authors,
- more references,
- longer Abstracts,

were

- more often written in English,
- much more often published in the USA,
- much higher frequency of USA first author,
- more likely to be from universities,
- more often basic research,
- much more often “high tech”,
- more focused on understanding basic mechanisms,
- more biowarfare-focused for the non-research laboratory articles.

Most Cited Journals

Table 8 contains the twenty journals cited most frequently in the specific records extracted for this study.

TABLE 8 – MOST CITED JOURNALS

JOURNAL	#CITES
INFECT IMMUN	2829
J BACTERIOL	2585
J BIOL CHEM	2347
P NATL ACAD SCI USA	2049
NATURE	1365
SCIENCE	1286
MOL MICROBIOL	1286
APPL ENVIRON MICROB	1154
JAMA-J AM MED ASSOC	1120
J CLIN MICROBIOL	799
BIOCHEMISTRY-US	738
VACCINE	723
EMERG INFECT DIS	721
MMWR-MORBID MORTAL W	592
FEMS MICROBIOL LETT	564
NUCLEIC ACIDS RES	561
NEW ENGL J MED	519
J APPL MICROBIOL	518
GENE	511
J INFECT DIS	488

There appear to be four major groups of journals. The first group is comprised of the four most cited journals (Infection and Immunity, Journal of Bacteriology, Journal of Biological Chemistry, and Proceedings of the National Academy of Sciences), the second group contains the next five journals (Nature, Science, Molecular Microbiology, Applied and Environmental Microbiology, and JAMA), the third group contains the next four journals (Journal of Clinical Microbiology, Biochemistry-US, Vaccine, and Emerging Infectious Diseases), and the fourth group contains the remainder. The first group and most of the second group consist of basic science journals, whereas about half the remaining journals in Table 8 address clinical/ epidemiological/ public health-related issues.

Computational Linguistics Results

Past text mining studies by the first author (e.g., Kostoff et al, 1998a, 1999, 2000a, 2000b, 2001a, 2001b, 2002, 2004a, 2004b, 2004c, 2005b, 2005c, 2005d, 2005e, 2006a, 2006c, 2006d) have used a variety of approaches to identify the main technical themes in the database(s) being analyzed. These approaches include extracting key phrases and manually assigning them to categories; extracting key phrases and assigning them with a statistical computer algorithm, using factor analyses and multi-link clustering; and grouping documents based on text similarity.

Based on recent text mining results, document clustering was the only theme identification method used, and was performed using the Abstracts text only. In document clustering, documents are combined into groups based on their text similarity. Document clustering yields numbers of documents in each cluster directly, a proxy metric for level of emphasis in each taxonomy category.

Different document clustering approaches exist (Cutting et al, 1992; Guha et al, 1998; Hearst, 2000; Karypis et al, 1999; Prechelt et al, 2002; Rasmussen, 1992; Steinbach et al, 2000; Willet, 1988; Wise, 1992; Zamir and Etzioni, 1998). The approach presented in this section is based on a partitional clustering algorithm (Karypis, 2004; Zhao and Karypis, 2004) contained within a software package named CLUTO. Most of CLUTO's clustering algorithms treat the clustering problem as an optimization process that seeks to maximize or minimize a particular clustering criterion function defined either globally or locally over the entire clustering solution space. CLUTO uses a randomized incremental optimization algorithm that is greedy in nature, and has low computational requirements.

Sixty-four individual clusters were chosen for the database (1991-2005 Articles retrieved from the SCI/ SSCI), and are presented in detail in Appendix 2. Compared to past document clustering algorithm inputs, a much larger trivial words list was selected to eliminate obvious non-technical words. With more trivial words eliminated, text similarity becomes based on the desired high technical content words, and sharper, less ambiguous clusters result. CLUTO also agglommorates the 64 clusters in a hierarchical tree (taxonomy) structure, and this taxonomy is presented in the next section.

Anthrax Taxonomy

Figure 5 displays the first three levels of the hierarchical taxonomy of the retrieved anthrax literature.

FIGURE 5 – ANTHRAX LITERATURE TAXONOMY

LEVEL 1	LEVEL 2	LEVEL 3
Anthrax Clinical Medicine/ Animal Epidemiology; Bio-terrorism (461)	Anthrax Bio-terrorism (219)	Biological Agent Threat/ Attack/ Detection (97)
		Planning/ Surveillance/ Communication/ Preparedness/ Response For Bioterrorist Attacks (122)
	Anthrax Clinical Medicine/ Animal Epidemiology (242)	Evolution, transmission, and impact of infectious disease on animal populations(108)
		Inhalation and cutaneous anthrax, and anthrax meningitis and meningoencephalitis (134)
Anthrax Biology (1318)	Anthrax Spore Detection/ Prevention (956)	Vaccination/ immunization and spore detection (498)
		Bacillus cereus/ anthracis strain identification (458)
	Toxin Lethality Pathways (362)	Binding of anthrax lethal toxin to host cell receptors (228)
		Lethal toxin inactivation of macrophages and protein kinase (134)

The following describes the first three levels of the hierarchical taxonomy of the anthrax literature. Subsequently, the third level is treated as a flat taxonomy (eight separate non-hierarchical categories) and the themes of the elemental clusters in each category are summarized and shown in bulletized form. These data are shown in greatly expanded form, *including bibliometrics for each cluster*, in Appendix 2.

The first taxonomy level (N=1779 records with Abstracts) can be sub-divided into two categories: Anthrax Clinical Medicine/ Animal Epidemiology; Bio-terrorism (N=461 records) and Anthrax Biology (N=1318 records). The Anthrax Clinical Medicine/ Animal Epidemiology; Bio-terrorism category focuses on anthrax patient modalities of treatment, as well as more general public health preparedness and emergency care issues resulting from potential bio-terrorist attacks. The Anthrax Biology category focuses on the mechanisms and pathways, from detection to final

intoxification. The boundaries between the two categories are relatively sharp, reflecting the quality of the clustering approach used, and especially the tripling of trivial words compared to past text mining studies.

For the second level taxonomy, each first level category is divided into two sub-categories. Anthrax Clinical Medicine/ Animal Epidemiology; Bio-terrorism is divided into Anthrax Bioterrorism (N=219 records) and Anthrax Clinical Medicine/ Animal Epidemiology (N=242 records), while Anthrax Biology is divided into Anthrax Detection/ Prevention (N=956 records) and Toxin Lethality Pathways (N=362 records). The Anthrax Bioterrorism category focuses on potential public health responses to bio-terrorist attacks such as preparedness, emergency care, and the required underlying logistics, while the Anthrax Clinical Medicine/ Animal Epidemiology category focuses on non-bioterrorism clinical medicine and bioterrorism case studies in treating anthrax. The Anthrax Detection/ Prevention category focuses on vaccine development for protection and spore/ strain identification for detection, while the Toxin Lethality Pathways category focuses on the binding, activation, and delivery of the toxins to the cell at both the aggregate toxin level and the component factor level.

The second level categories are further sub-divided to form eight third level categories. This will be the final level discussed. The category heading (in ***bolded italics***) is followed by the category summary metrics (prolific Authors, Countries, Institutions), which are followed by the component cluster themes, bulletized.

There are two sources of differences between the category summary metrics to follow and the metrics in the main bibliometrics section (Publication Bibliometrics). First, the the metrics in the main bibliometrics section are based on total Articles retrieved, whereas the category summary metrics are based on Articles retrieved with Abstracts, since those are the only Articles clustered. Second, the category summary metrics were obtained with a different software package from that of the main bibliometrics section. No manual aggregation of variants was made for the category summary metrics, whereas variants were aggregated manually in the main bibliometrics section. For institutions with multiple components especially (e.g., NIH, US Army, US Navy), the differences can be significant. Most of the universities are exact, or very close.

The first four level 3 categories are under the level 1 Anthrax Clinical Medicine/ Animal Epidemiology; Bio-terrorism category.

Category 1, ***Biological Agent Threat/ Attack/ Detection*** (N=97 records):
(**Authors**: zilinskas, ra 3; mcbride, mt 3; makarewicz, aj 3; hindson, bj 3; henchal, ea 3; colston, bw 3; **Country**: usa 70; france 5; england 3; germany 2; canada 2; australia 2; **Institution**: us army 9; stanford univ 5; univ oklahoma 4; lawrence livermore natl lab 4; ctr dis control & prevent 4;)

- Biological Agent Detection (31 Records)
- Biological Agent Threat (28 Records)
- Biological Agent Threat/ Attack (38 Records)

Category 2, ***Planning/ Surveillance/ Communication/ Preparedness/ Response for Bioterrorist Attacks*** (N=122 records):
(**Authors:** evans, rg 3; clements, b 3; wrigley, bj 2; wolfe, mi 2; wein, lm 2; wagner, mm 2; treadwell, ta 2; terndrup, t 2; tanielian, tl 2; szeto, h 2; **Country:** usa 104; england 5; israel 3; **Institution**
ctr dis control & prevent 15; harvard univ 7; univ pittsburgh 4; st louis univ 4)

- Bioterrorism surveillance and Web-based informatics (25 Records)
- Bioterrorist attack preparedness/ response (42 Records)
- Public communication of bioterrorism-related health information (19 Records)
- Public health planning/ response to terrorism (36 Records)

Category 3, ***Evolution, transmission, and impact of infectious disease on animal populations*** (108):
(**Authors:** turnbull, pcb 5; martins, rp 4; dragon, dc 4; elkin, bt 3; **Country:** usa 23; england 9; canada 7; germany 6; france 6; brazil 6; **Institution:** niaid 4; who 3; univ sao paulo 3; louisiana state univ 3)

- Infectious diseases, emphasizing epidemics and zoonoses (33 Records)
- Animal-based infectious disease outbreaks (39 Records)
- Infectious disease ecological impacts on wild animal populations (19 Records)
- Nesting biology of insects and their anthrax parasitism (17 Records)

Category 4, ***Inhalation and cutaneous anthrax, and anthrax meningitis and meningoencephalitis*** (134):
(**Authors:** quinn, cp 8; zaki, sr 7; perkins, ba 7; ashford, da 7; shieh, wj 6; popovic, t 6; jernigan, ja 6; hadler, jl 6; guarner, j 6; **Country:** usa 78; turkey 19; germany 7; **Institution:** ctr dis control & prevent 23; numune hosp 5; us fda 4; emory univ 4; connecticut dept publ hlth 4)

- Inhalational anthrax, emphasizing patient care and postal worker exposure (42 Records)
- Cutaneous anthrax: exposure, transmission, symptoms, and treatment (41 Records)
- Anthrax etiology, pathology, and treatment, with emphasis on hemorrhaging during anthrax pathogenesis, especially thoracic lymph node hemorrhaging, and hemorrhagic mediastinitis, from inhalational anthrax (24 Records)
- Anthrax meningitis and meningoencephalitis: diagnoses and treatment (27 Records)

The last four level 3 categories are under the level 1 Anthrax Biology category. Category 5, ***Vaccination/ immunization and spore detection*** (498 records), has two main thrusts:
(**Authors:** mock, m 14; little, sf 14; ivins, be 14; friedlander, am 13; bhatnagar, r 11; williamson, ed 10; leppla, sh 9; fellows, pf 9; **Country:** usa 351; england 41; france 22; india 18; israel 16; germany 14; canada 11; **Institution:** us army 61; us navy 22; ctr dis control & prevent 18; inst pasteur 15; israel inst biol res 14; univ maryland 12; harvard univ 12; jawaharlal nehru univ 11)

THRUST 1
(Vaccination and immunization for anthrax protection)

- Anthrax vaccine absorption, emphasizing determination of IgG antibodies to anthrax protective antigen (26 Records)
- Human anthrax vaccines, including clinical trials (36 Records)
- Adverse reactions to anthrax vaccine, especially among Gulf War veterans (30 Records)
- Recombinant protective antigen against anthrax (26 Records)
- Purification of anthrax protective antigen from multiple sources (20 Records)
- Protection and immunity against anthrax by vaccinations that produce protective antigen (51 Records)
- Antibody responses to anthrax protective antigen (35 Records)

THRUST 2
(*Bacillus anthracis* spore detection)

- Irradiation of *Bacillus anthracis* spores; postexposure prophylaxis against anthrax (24 Records)
- Decontamination and cleanup of biological warfare agents (22 Records)

- Sampling for anthrax spores in potentially contaminated sites, including nasal swabs in humans (27 Records)
- Germination of *Bacillus anthracis* spores and endospores (19 Records)
- *Bacillus anthracis* exosporium, especially the major BclA glycoprotein layer coating the spore surface (17 Records)
- Inactivation of *Bacillus anthracis* spores (45 Records)
- Detection and identification of *Bacillus anthracis* spores using mass spectrometry, especially MALDI TOF, with some emphasis on small, acid-soluble protein bio-markers (16 Records)
- Detection of pathogenic bacteria by mass spectrometric profiling of fatty acids, with emphasis on pyrolysis mass spectrometry (13 Records)
- Detection of anthrax spores with Raman spectroscopy, emphasizing signal detection from dipicolinic acid in spores (19 Records)
- Biosensor detection of *Bacillus anthracis* spores (33 Records)
- Polymerase Chain Reaction for detection of nucleic acid from *Bacillus anthracis* spores (39 Records)

Category 6, ***Bacillus cereus/ anthracis strain identification*** (N=458 records), also has two main thrusts:
(**Authors:** mock, m 33; fouet, a 31; keim, p 28; koehler, tm 19; tang, wj 13; kolsto, ab 13; mesnage, s 12; **Country:** usa 210; france 64; england 32; japan 23; italy 21; germany 18; norway 17; canada 16; south korea 14; **Institution:** inst pasteur 52; no arizona univ 28; univ texas 22; us army 18; univ chicago 17)

THRUST 1
(Identification and differention of strains in *Bacillus cereus* group)

- Characterization of *Bacillus anthrascis* strains using Polymerase Chain Reaction, especially PCR analysis of sequences on plasmids pXO1 and pXO2 and chromosomal DNA, using primers to amplify DNA fragments (35 Records)
- Amplified fragment length polymorphism (AFLP) and single nucleotide polymorphisms of microbial genomes to analyze isolates of *Bacillus anthracis* strains and related *Bacillus* species, followed by further confirmatory sequence analyses. (30 Records)
- Variable number tandem repeat (VNTR) sequences as markers for genotyping *Bacillus anthracis* isolates (32 Records)
- Identification of *Bacillus* species (11 Records)
- Sequencing of 16S rRNA gene for identification of *Bacillus anthracis* strains (30 Records)

- Differentiating among strains in the *Bacillus cereus* group (51 Records)
- Identification of *Bacillus thuringiensis* serovars and strains (21 Records)

THRUST 2
(Plasmid virulence genes in anthrax strains, emphasizing *atx*A-regulated genes encoding proteins)

- Transcriptional analysis of the control of *Bacillus anthracis* capsule synthesis by *atx*A gene expression (30 Records)
- PlcR regulation of virulence factor gene expression in the *Bacillus* group strains (17 Records)
- Identification of sigma-dependent genes in the *Bacillus* group, emphasizing transcriptional analysis and focusing on sporulating bacteria (22 Records)
- *Bacillus cereus* group virulence plasmids, and DNA binding with PcrA interacting with plasmid (30 Records)
- Role of iron compounds in inhibiting or supporting growth of infections, particularly epidermidis and related staphylococci (17 Records)
- Bacteria genomics, emphasizing gene expression in Escherichia Coli (25 Records)
- Resistance of *Bacillus anthracis* strains to antibiotics, and antimicrobial susceptibilities of *Bacillus anthracis* isolates (32 Records)
- Gamma polyglutamic acid production and degradation, and biochemical analysis of gamma-polyglutamate (11 Records)
- Calmodulin-activated *Bacillus anthracis* enzyme adenylate cyclase, especially its ATP-binding sequences (31 Records)
- Surface layer homology domains for binding proteins to cell walls of *Bacillus anthracis* (20 Records)
- Surface layers in *Bacillus anthracis*, emphasizing surface layer proteins and surface array proteins (13 Records)

Category 7, ***Binding of anthrax lethal toxin to host cell receptors*** (228):
(**Authors:** collier, rj 49; leppla, sh 39; singh, y 17; klimpel, kr 13; **Country:** usa 157; india 22; germany 21; france 18; **Institution:** harvard univ 50; nidr 17; inst pasteur 16; niaid 12; univ freiburg 11)

- Prepore (heptameric) to pore conversion of the anthrax protective antigen, and its subsequent membrane translocation to the cytosol (21 Records)
- Translocation of the anthrax toxin components (lethal factor and edema factor) through protective antigen-formed channels in planar phospholipid bilayer membranes to cytosol (31 Records)
- Binding of anthrax toxin lethal factor residues to receptor domains (48 Records)
- Crystal structures with beta barrels or beta sheets and binding domains (22 Records)
- Binding domains of host cell receptors, especially TEM8 and CMG2, for binding protective antigen and mediating toxicity (27 Records)
- Clostridium botulinum C2 toxin, emphasizing its enzyme component C2I, and the separated binding/translocation component C2II. (9 Records)
- Modified anthrax toxin lethal factor (LFn) fusion protein for translocating antigens, especially cytotoxic epitopes, across cell membranes for inducing antiviral immunity (32 Records)
- Furin's toxin activation by proteolytic cleavage, and replacement of furin protease cleavage sites in anthrax toxin protective antigen proteins by sequences selectively cleaved by matrix metalloproteinases for designing tumor cell-selective cytotoxins. (18 Records)
- Polyarginine-containing peptides for inhibiting furin, and reducing activation of toxins. (20 Records)

Category 8, ***Lethal toxin inactivation of macrophages and protein kinase*** (134):
(**Authors:** leppla, sh 14; montecucco, c 12; mock, m 12; duesbery, ns 9; moayeri, m 8; alibek, k 8; **Country:** usa 89; france 15; italy 12; south korea 8; germany 8; **Institution:** inst pasteur 14; univ padua 11; niaid 10; us army 9; van andel res inst 8; us fda 8; harvard univ 8)

- Mitogen-activated protein kinase, emphasizing its proteolytic inactivation by lethal factor by cleavage within the N-terminal region (51 Records)
- Lethal toxin neutralization by monoclonal antibodies reactive with anthrax protective antigen (17 Records)
- Suppression of macrophages and dendritic cells by anthrax lethal toxin, including necrosis in macrophages and apoptosis in activated macrophages. (41 Records)

- Stimulation of macrophages by low levels of anthrax lethal toxin to produce cytokines (interleukin-1 beta and tumor necrosis factor-alpha), which induce systemic shock and death. (25 Records)

Categories 1 and 2 are the bioterrorism-related categories. The topic is broad, and goes well beyond focused technical/ medical research issues. Consequently, the author base is much more eclectic than for the more technically-focused categories. The most prolific authors in Categories 1 and 2 have publication frequencies about three percent of the total category papers. Additionally, the USA has an order of magnitude dominance of these categories. For Category 1, the ratio of USA/ France publications is 14, and for Category 2, the ratio of USA/ England publications is 21.

Contrast these results with those of Categories 7 and 8, which concentrate on lethal toxin mechanisms and pathways. The topic is focused, and the author base is narrow relative to that of Categories 1 and 2. The most prolific authors in Categories 7 and 8 have publication frequencies 10-20 percent of the total papers in the categories. Additionally, while the USA still dominates these categories, it is substantially less than Categories 1 and 2. For Category 7, the ratio of USA/ India papers is seven, while for Category 8, the ratio of USA/ France papers is six.

There was minimal mention of theoretical biological studies, or computer modeling studies. Several factors could have limited retrieval of these categories. The theme terms may not have been listed in the Title or Abstract. The use of theoretical or computer modeling may not have been evident from either the Title or Abstract. Many of these types of studies could be classified, and would not be accessible by the SCI/ SSCI. Or, the number of articles with these themes was sufficiently small that the themes were not identifiable from the cluster feature extraction capability.

None of the categories, or the Abstracts that were sampled, offered any evidence that findings from other disciplines were being imported into the anthrax studies. The approaches listed were highly experimental in nature. This correlates with the bibliometric findings of a smaller fraction of authors from universities than previous studies, and lack of citations external to the anthrax discipline. These conclusions apply to the database evaluated in this study, the open anthrax research literature as reflected by the SCI/ SSCI.

SUMMARY AND CONCLUSIONS

OVERVIEW

Text mining was used to extract technical intelligence from the open source global anthrax research literature. An anthrax-focused query was applied to the Science Citation Index/ Social Science Citation Index (SCI/ SSCI) databases. The anthrax research literature infrastructure (prolific authors, key journals/ institutions/ countries, most cited authors/ journals/ documents) was obtained using bibliometrics, and the anthrax research literature technical structure (hierarchical taxonomy) was obtained using computational linguistics/ document clustering. A novel addition was the use of author and institution auto-correlation maps to show co-publishing networks, and the use of author-phrase and institution-phrase cross-correlation maps to show author and institution networks based on use of common terminology (proxy for common interests). The open anthrax research literature appears to be quite applied, and the most cited documents reveal a lack of emphasis on fundamental theory and computer modeling. The USA is the dominant performer in the open anthrax research literature.

SUMMARY/ CONCLUSIONS

The primary objective of this study was to identify the global research literature that was related directly to anthrax. A secondary objective was to estimate the relative level of global effort in the sub-categories of anthrax research, as reflected by the emphasis in the published literature. The Science Citation Index/ Social Science Citation Index was used to retrieve anthrax research articles for the analysis.

Anthrax Literature Growth

The open literature in anthrax research was extremely small prior to the anthrax attacks in Washington, D.C. in October 2001. It has grown substantially since that time. Between 1991 and 1998, there were relatively few anthrax research articles appearing in the open literature, averaging about 30 articles per year in the 1991-1995 time frame and 45 articles per year in the 1995-1998 time frame. As the threat of bio-terrorism began to be taken more seriously, the number of anthrax research papers increased to 75-100 per year. However, the number of research papers per year has

increased substantially since 2001, and is now an order of magnitude larger than in the early 1990s.

For the major country producers of anthrax research articles, the temporal production is as follows (country/ number of SCI/ SSCI articles):

- 1995: USA (19); France (7); England (4); Canada (2).
- 2000: USA (32); France (13); Norway (5); South Korea (5).
- 2005: USA (289); France (24); England (22); Germany (19); Canada (18).

  In 2005, the USA collaboration statistics were: USA/ France (4); USA/ England (8); USA/ Germany (5); USA/ Canada (3).

Thus, in the five years since 2000, the USA went from ~2.5 times the number of research articles as its nearest competitor to more than eleven times its nearest competitor.

BIBLIOMETRICS

Authors

The 24 most prolific anthrax research authors were Mock M, Leppla SH, Collier RJ, Fouet A, Keim P, Friedlander AM, Bhatnagar R, Singh Y, Little SF, Koehler TM, Turnbull PCB, Montecucco C, Quinn CP, Popovic T, Tang WJ, Ivins BE, Hanna PC, Klimpel KR, Baillie LWJ, Ezzell JW, Kolsto AB, Mesnage S, Rubinstein E, Sirard JC. The top three authors (Mock, Leppla, and Collier) account for 33% of the total number of articles (N=599) published by the 24 most prolific anthrax research authors listed above. Fourteen of the authors were from the USA, four from France, two from India, and one each from Italy, Norway, and Israel. In previous text mining studies, either the majority or all of the most prolific authors were from universities. However, in the present study, twelve (50%) of the authors were from research institutions, 11 (46%) from universities, and one (4%) was from industry. The concentration of prolific authors in research institutes reflects the applied nature of the open literature search, and a potential gap in the type of research accessed and pursued.

Strong intra-regional collaborative research/ publishing teams are evident. Mock's (Institute Pasteur) most frequent co-authors (from the top twenty)

are Fouet (Institute Pasteur), Sirard (Institute Pasteur), and Montecucco (Univ Padua). Leppla's (NIH) most frequent co-authors are Klimpel (NIH) and Singh (Center Biochem Tech). Collier's (Harvard) most frequent co-author is Hannah (Univ Michigan). Fouet's (Institute Pasteur) most frequent co-authors are Mock (Institute Pasteur) and Mesnage (Univ Paris). Friedlander's (US Army-Med Res Inst) most frequent co-authors are Little (US Army-Med Res Inst) and Ivins (US Army-Med Res Inst).

An author auto-correlation map of the most prolific authors shows three strongly connected publishing groups:

- The French group centered around Mock
- The NIH-India group centered around Leppla
- The US Army group centered around Friedlander

Also evident is a somewhat more weakly-connected university group centered about Collier.

Other than the intra-connection within these three groups, there is not a great deal of inter-connection across groups evident from the map. Almost all the connections that do exist, whether intra- or inter-group, are relatively weak, based on the bands used to define the link strengths.

To provide a more quantitative perspective on author publishing groups, a five factor analysis of the most prolific anthrax research authors was performed. The results are as follows.

Factor 1 is centered about the French group. There are strong ties among Fouet, Mock, and Mesnage, and reasonable ties with Sirard. There is a weak tie with Montecucco (Padua).

Factor 2 is centered about the NIH group. There are strong ties between Klimpel and Leppla, strong ties with the India group members Arora and Singh, and a weak tie with Quinn (CDC).

Factor 3 is centered about the US Army group. There are strong ties among Little, Ivens, and Friedlander.

Factor 4 is centered about the CDC group. There are strong ties between Quinn and Popovic, and moderate ties with Turnbull (Arjemptur) and Baillie (Maryland).

Factor 5 is centered about the university group. There are reasonably strong ties between Hanna (Michigan) and Collier (Harvard), a moderate tie with Koehler (Texas), and a weak tie with Kolsto (Oslo).

These results corroborate those of the auto-correlation map, and provide further insights among the relationships.

Another perspective on the author linkages is through evaluation of their common terminology. Abstract phrases were generated by the TechOasis Natural Language Processor, and an author-phrase co-occurrence matrix was generated. The phrases associated with the six most prolific authors are as follows:

- Mock (*Bacillus anthracis*, anthrax, lethal factor, protective antigen, proteins, pXO1, vitro, mice, vivo, macrophages, binding, expression, strains, protein, EF);
- Leppla (protective antigen, lethal factor, anthrax toxin, *Bacillus anthracis*, cells, anthrax, cytosol, data, vitro, edema factor, cleavage, role, toxicity, furin, mice, expression, *Pseudomonas* exotoxin);
- Collier (anthrax toxin, protective antigen, cytosol, translocation, lethal factor, cells, toxin, mammalian cells, edema factor, protein, anthrax, vivo, mechanism, binding, surface, pore, prepore, cytoplasm, entry, receptor, form, pore formation);
- Fouet (*Bacillus anthracis*, Sap, anthrax, expression, genes, *Bacillus thuringiensis*, pXO1, regulation, *Bacillus cereus* group, cell surface, proteins, bacteria, EA1, members, sequence analysis, parental strain);
- Keim (*Bacillus anthracis*, anthrax, *B. cereus*, contrast, data, sequences, region, DNA, collection, evolution, anthracis strains, species, *B. thuringiensis*, three, PCR, markers, phylogenetic analysis);
- Friedlander (*Bacillus anthracis*, protective antigen, anthrax, vaccine, virulence, macrophages, anthrax vaccine adsorbed AVA, mice, toxin, binding, infection, lethal factor, lethal toxin, death, animals, rabbits).

Leppla and Collier have some linkages due to the common relatively high frequency use of protective antigen, anthrax toxin, lethal factor, and edema factor.

To display the terminology relationships among the authors more visually, two cross-correlation maps were generated linking authors by their use of common terminology. The first map included the very generic phrases related to anthrax, whereas the second map excluded these phrases and added more detailed phrases. Compared to the author auto-correlation map, both cross-correlation maps showed a larger number of linkages among the authors and much stronger linkages among the authors. There appeared to be a gap between commonality of interests and commonality of publications, at least at the level of analysis (Abstract phrases) reflected in these diagrams. The cross-correlation map including the generic phrases showed more and stronger inter-connections than the cross-correlation map excluding the generic phrases because of the binding effect of the generic phrases, whereas the linkages in the map with more detailed phrases are due to common interest at a deeper level of detail.

Two main groups emerge from the map with more detailed phrases. One is the French-based group, centered about Mock. The other is a strongly-connected group encompassing NIH, an Indian component and strong university component, and weakly linked to the US Army group. The strongly-connected group is centered about Leppla, and the weakly–connected group is centered about Friedlander.

Most of the common terminology groups on the author-phrase cross-correlation map publish together as shown on the author auto-correlation map. However, the US Army group is linked to the NIH group by common terminology, but not shown linked on the auto-correlation publishing map or the factor matrix, based on the threshold values becessary to display linkages.

Journals

The eight journals containing the most anthrax research articles are Infection and Immunity, Journal of Bacteriology, Emerging Infectious Diseases, Applied and Environmental Microbiology, Proceedings of the National Academy of Sciences - USA, Journal of Biological Chemistry, Journal of Applied Microbiology, and Vaccine. Infection and Immunity stands out in

terms of numbers of papers published, having 50% more than its nearest competitor. Many of the top twenty journals are highly specialized, and appear quite applied. The technical emphases of the top twenty journals are medicine (mainly infectious diseases), biology, and chemistry.

Two time bands were analyzed: pre 2001, and post 2000. Journals that published substantially relatively more papers after 2000 included Emerging Infectious Diseases, Journal of Clinical Microbiology, Biochemical and Biophysical Research Communications, Analytical Chemistry, Antimicrobial Agents and Chemotherapy, Journal of Infectious Diseases, And Nature. Journals that published substantially relatively less papers after 2000 included Journal of Applied Microbiology, FEMS Microbiology Letters, Molecular Microbiology, Biochemistry, and Letters in Applied Microbiology. The latter are almost all microbiology journals, while the former cover a broader variety of topics.

Institutions

The 21 institutions publishing the most anthrax research papers are US Army, NIH, Inst Pasteur, Harvard Univ, CDC, Univ Texas, US Navy, No Arizona Univ, US FDA, Johns Hopkins Univ, Jawaharlal Nehru Univ, Univ Chicago, Univ Maryland, Louisiana State Univ, Univ Michigan, Univ Padua, Israel Inst Biol Res, Stanford Univ, Emory Univ, Inst Genomic Res, and Univ Oklahoma. Five of the top ten are government research institutions, and six of the top 21 are government laboratories.

The total research article production was divided into two time bands: pre-2001 and post-2000. Institute Pasteur was the most prescient of the leading producers, having generated about 2/3 of its articles before 2001. Other forward-looking organizations in this field include Northern Arizona University, Louisiana State University, and University of Padua. The bulk of the organizations (those with 5 or less articles pre-2001) appear to have reactively accelerated publication of anthrax articles after the anthrax attacks in the USA in 2001.

Five institutions stand out in terms of productivity: U.S. Army (including all variants); NIH (including all institutes); Institute Pasteur; Harvard University; and CDC (a public health agency-includes all variants). Thirteen are universities, and the others are research institutions (with the exception of CDC). The fraction of research institutions is much higher than in

previous text mining studies. The USA has seventeen of these prolific institutions, Western Europe has two, and India and Israel each have one.

Which institutes collaborate significantly on publications? To identify cross-institution collaboration, an institution-institution co-occurrence matrix was generated. The major institutional collaborators for the top five institutions listed above are as follows (collaborator/ [# papers]):

- US Army (NIH [7], Institute Pasteur [5], CDC [4], Clin Res Management [4]);
- NIH (USA [7], US FDA [7], Harvard [5], Ctr Biochem Technol [4], Van Andel Res Inst [4]);
- Institute Pasteur (Univ Padua [11], US Army [5], CNRS [4], Ctr Etud Bouchet [4]);
- Harvard (Children's Hospital [6], NIH [5], Albert Einstein Coll Med [5], Salk Inst Biol Studies [5]);
- CDC (Emory Univ [8], US Army [4], New Jersey Dept Health and Senior Serv [4], Connecticut Dept Public Health [4], NYC Dept Health [4]).

What are the technical areas of emphasis of the major anthrax research institutions? To identify these technical themes, an institution-phrase co-occurrence matrix was generated for the leading institutions. The major Abstract phrases for the top five institutions are as follows:

- USA (*Bacillus anthracis*, anthrax, protective antigen, spores, vaccine, detection, AVA, binding, vitro, anthrax vaccine, infection, mice, identification, animals, assay, lethal factor, exposure, *Yersinia pestis*, survival, rabbits, bioterrorism, agents, virulence, immunization, protection, macrophages, contrast, guinea pigs);
- NIH (protective antigen, anthrax, *Bacillus anthracis*, anthrax toxin, lethal factor, cells, edema factor, toxin, vitro, cytosol, mice, vivo, expression, toxicity, binding, treatment, protein, combination, internalization, cleavage, furin, animals, contrast, protection, disease, interaction, cell surface, translocation, LeTx, *Pseudomonas* exotoxin);
- Institute Pasteur (*Bacillus anthracis*, anthrax, proteins, lethal factor, binding, vitro, protective antigen, mice, vivo, expression, macrophages, bacteria, Sap, cells, contrast, cell surface, genes, pXO1, edema factor, strains, *B. cereus*, *Bacillus thuringiensis*, *Bacillus*

cereus group, virulence, infection, spores, identification, lethal toxin, production);

- Harvard (anthrax toxin, protective antigen, cytosol, translocation, lethal factor, toxin, anthrax, cells, protein, edema factor, mammalian cells, PA(63, mechanism, *Bacillus anthracis*, vivo, binding, surface, treatment, pore, prepore, entry, receptor, form, pore formation);
- CDC (*Bacillus anthracis*, anthrax, inhalational anthrax, patients, exposure, bioterrorism, *Bacillus anthracis* spores, prevention, risk, disease, patient, surveillance, cutaneous anthrax, treatment, infection, information, negative, antibiotics, reports, facility, outbreak)

NIH and Harvard have some linkages due to the common high frequency use of protective antigen, anthrax toxin, lethal factor, edema factor, and translocation. In general, the research thrusts of each institution based on phrase co-occurrences agree quite well with the thrusts based on journal frequency shown above.

To display these linkages more visually, two mapping approaches were performed: institution auto-correlation mapping that shows institutional relationships based on actual co-authorships, and institution-phrase cross-correlation mapping that shows institutional relationships based on use of common terminology. As in the author auto- and cross-correlation maps, publication connectivity is much weaker than common interest connectivity. On the institution auto-correlation map, all links are weak (barely visible), based on the link strength criteria listed in the legend on the map. On the cross-correlation map that included generic anthrax-related phrases, many links are very strong, and on the cross-correlation map that excluded the generic phrases, many links are strong.

From the auto-correlation map, there appears to be one main co-publishing group. It is centered about the University of Maryland, with satellites centered about Johns Hopkins University and University of Texas. The US Army is not linked to any of the extensions of this core publishing group, at least at the threshold level for connectivity display on the auto-correlation map.

From the cross-correlation map, the NIH, Institute Pasteur, and US Army form the core group based on use of common terminology. Additionally, NIH links to the university and Indian groups in terms of common interests, Institute Pasteur links to a number of universities in terms of common

interests, and US Army links to other governmental organizations in terms of common interests. But while Institute Pasteur and NIH have some mild publishing link strengths with those institutions that have overlapping terminology usage, US Army does not, at least at the threshold level for connectivity display on the auto-correlation map.

To identify preferred institutional publishing venues, an institution-journal co-occurrence matrix was generated, with the journal Impact Factors included in the display. The journal Impact Factors are a measure of the level of citation of the journal's research articles, and are a function of journal publication quality, publication development level (e.g., basic research, applied research, technology development, engineering), activity in discipline covered by journal (number of researchers available to cite), and journal availability/ visibility. The major journals for the top five institutions are as follows (journal [# papers][Impact Factor]):

- USA (Vaccine [20][2.82], Infection and Immunity [14][4.03], Journal of Clinical Microbiology [7][3.44], Applied and Environmental Microbiology [6][3.81], Microbial Pathogenesis [6][2.05]);
- NIH (Journal of Biological Chemistry [16][6.36], Infection and Immunity [14][4.03], Proceedings of the National Academy of Sciences [8][10.45], Vaccine [6][2.82]);
- Institute Pasteur (Journal of Bacteriology [13][4.15], Infection and Immunity [12][4.03], Molecular Microbiology [12][5.96]);
- Harvard (Proceedings of the National Academy of Sciences [13][10.45], Journal of Biological Chemistry [8][6.36], Biochemistry [8][4], Infection and Immunity [7][4.03]);
- CDC (Emerging Infectious Diseases [32][5.64], Clinical Infectious Diseases [4][5.59], JAMA [4][24.83], Journal of Health Communication [4][0]).

The thrusts of each institution in anthrax research can be seen from analysis of the leading journals in which the anthrax research is published. The US Army emphasizes vaccines and microbiology. NIH emphasizes biochemistry and infection. Institute Pasteur emphasizes bacteriology, microbiology, and infection. Harvard emphasizes biochemistry and infection. CDC emphasizes the public health aspects of infectious diseases and epidemiology.

A weighted Impact Factor for each institution, based only on the journals in which it published most frequently (those listed above), was computed. This metric is the product of number of papers per journal (listed above) times journal Impact Factor (listed above) summed over the journals listed above, and divided by the total number of papers per institution in the above list. The results are: US Army 3.25; NIH 5.88; Institute Pasteur 4.70; Harvard 6.86; CDC 6.87. The main finding is the relatively low weighted Impact Factor of the US Army relative to that of Harvard and the CDC. It may be due to the Army's emphasis on applications, especially the heavy emphasis on vaccines, and the relatively limited readership for this rather specialized topical area.

Countries

The top twenty countries producing the most anthrax research papers are USA, France, England, Germany, India, Canada, Italy, Japan, Israel, South Korea, Turkey, Australia, Norway, Russia, Belgium, Netherlands, Switzerland, Brazil, Peoples Republic of China, and Taiwan. The United States dominates this output, contributing over half the open research article literature on anthrax (N=1185). Following are France (N=154), England (N=127) and Germany (N=87), with other countries far behind. China ranks nineteenth out of twenty. The low numbers of China are interesting. In recent text mining studies of different technical disciplines, China has been near the top in country, institution, and author listings.

To identify country-country collaborations for the major research article producers, a country-country matrix was generated. The three most prolific countries, and their major collaborators, are presented (collaborator, # papers):

- USA (England 32, Germany 20, France 17, Canada 12);
- France (USA 17, Italy 12, Germany 7, Norway 5);
- England (USA 32, Germany 6, France 4, Canada 3, Netherlands 3)

To identify the visibility of the major journals in which each country publishes, a country-journal matrix was generated. A weighted Impact Factor was computed for each country in the matrix. The results are: USA 5.6; France 5.0; England 4.54; Germany 6.44; India 3.38. Thus, Germany is publishing (on average) in the most cited journals while India is publishing in the least cited.

Cited Authors

The twenty first authors receiving the most total citations are Leppla SH, Friedlander AM, Turnbull PCB, Inglesby TV, Ivins BE, Welkos SL, Singh Y, Duesbery NS, Hanna PC, Milne JC, Little SF, Klimpel KR, Dixon TC, Brachman PS, Keim P, Helgason E, Pezard C, Vitale G, Mock M, and Uchida I. Thirteen of the most cited first authors are from the USA, five are from Western Europe, and two are from Asia. Eight of the authors are from universities, eleven are from research institutions, and one is from industry. Since past text mining studies have shown that cited papers tend to be at a more fundamental level than the citing papers, the heavy contribution from research institutions relative to universities is again in stark contrast to previous text mining studies. An additional difference from past text mining results is that ten of the 24 most prolific authors are in common with the twenty most cited first authors. In past text mining studies, perhaps one or two authors would be in common between the two lists. The reasons for this high degree of overlap are not clear, but may reflect a highly in-bred community. It may also reflect the relatively high fraction of research institutes, where typically (not always) researchers have a higher first author fraction than universities.

In addition, the SCI downloads citations by first author only. Thus, authors who may publish many papers, but who tend to get listed behind the first author, will be under-represented in this tabulation.

For example, for the first five of the twenty most cited first authors, the numbers of research articles in which they are first authors divided by the total numbers of research articles they have published are as follows: Leppla (5/111); Friedlander (8/57); Turnbull (22/49); Inglesby (10/28); Ivins (10/29). Based on past text mining bibliometrics studies, the small fractions for Leppla tend to be typical of university professors, while authors from national laboratories or research institutions tend to have larger fractions. In the present case, based on first author statistics, Leppla is highly under-represented in citations received. Highly cited papers (>90 SCI-listed citations) in which he was a co-author, but was not the first author, had the following first authors: Molloy, Duesbery, Petrosa, Klimpel (2), Gordon (2), Pannifer, Welkos, and Vodkin.

To identify the authors most associated with the highly cited papers, the 75 anthrax-related documents cited most highly (as listed in the SCI) were retrieved, and the author frequency was extracted. This method of author extraction includes all the paper authors, not limited to first author. The central authors most associated with the highly cited papers (Leppla [15], Collier [7], Mock [7], Friedlander [6], Klimpel [6]) are clearly evident from this result.

Cited Documents

The twenty most cited documents were examined. For each document, the number of citations from all other articles in the retrieved database was recorded, the number of citations received from all other articles published in the SCI was recorded, and the maximum number of citations received by any other paper published in the same journal for the same year was recorded.

In general, the most cited anthrax papers receive relatively low numbers of citations (<10% of the highest cited papers) when published in the broad multi-disciplinary journals, but seem to perform much better when published in the specialty journals. The twenty most cited publications appear to be highly applied. Additionally, the ratio of citations by other papers in the retrieved anthrax database to total citations as listed in the Science Citation Index is, on average, higher than in previous text mining studies conducted by the first author. This reflects the highly applied literature, where most of the citing papers are within the focused topical area, and the highly cited documents are not sufficiently fundamental to be cited outside the specific anthrax literature of interest.

The twenty most cited documents can be divided into four topical groups. The largest group contains nine documents (45%) focused on the three proteins (PA, EF,and LF) that comprise the two binary anthrax toxins (LT [PA + LF] and ET [PA + EF]). The next largest groups consist of: five documents focused on bio-terrorism, post-exposure prophylaxis and medical management of anthrax; five documents focused on broader biological aspects of *B. anthracis* and its pathologies. These documents have a medical, epidemiological, and highly experimental focus. Fundamental theory, computer modeling, and access to other literatures are not evident from the citations.

An analysis comparing most cited to least cited SCI/ SSCI papers was performed in 2003, and its objective was to identify the differences between least and most cited anthrax research articles in the SCI/ SSCI. The ten most cited anthrax papers published between 1993-1998 were compared to the thirteen least cited papers published during the same period. This period was sufficiently historical to allow citations to accumulate, yet sufficiently recent to be of current interest.

Compared to the thirteen lowest cited papers (all the papers that had zero citations), the ten highest cited papers had:

e) 2.5 times the median number authors (5/2) compared with the ten lowest cited papers
f) 2.7 times the median number of references (38/14)
g) median of 130 cites to zero
h) four times the number of median Abstract words (184.5/45)

Additionally, all the most cited articles were written in English, whereas only 7/13 of the least cited articles were written in English. Further, 9/10 of the most cited articles appeared in journals published in the USA, which are mainly highly respected international journals. None of the least cited articles were published in USA journals, but were published mainly in Central/ Eastern European and Indian journals. Still further, 8/10 of the most cited articles had a first author from USA, whereas only one of the thirteen least cited articles had a first author from USA. Seven of the top ten most cited articles were from universities, whereas only six of the bottom thirteen most cited articles were from universities.

In terms of technical characteristics, seven of the ten most cited articles could be classified as basic laboratory research, with the focus on protective antigen structure and lethal factor cleavage (key steps in the formation of lethal toxin). The remaining three articles were highly topical and related to bio-warfare. Conversely, only five of the thirteen least cited articles could be classified as basic laboratory research, and they focused on less mechanism-oriented macro-variable measurements. The remainder could be classified as epidemiological studies (typically in animals), fabrication/ production studies, and clinical/ field trials.

In summary, compared to the least cited articles, the most cited, on average, had

- more authors,
- more references,
- longer Abstracts,

were

- more often written in English,
- much more often published in the USA,
- much higher frequency of USA first author,
- more likely to be from universities,
- more often basic research,
- much more often "high tech",
- more focused on understanding basic mechanisms,
- more biowarfare-focused for the non-research lab articles.

Finally, the citation-assisted background (CAB) method was used to identify the seminal anthrax research papers as those most highly cited in their time frame of publication. The journals in which they were published most frequently over a 25 year period were examined, and a temporal analysis was performed.

There were three distinct patterns in the data. Infection and Immunity has dominated publication of most cited anthrax articles for almost three decades. It completely dominated the decade of the 1980s. The specialty biology and biochemistry journals dominated the 1990s. The 2000s seem to be dominated by the multi-disciplinary journals.

Cited Journals

An analysis of most cited journals shows that there appear to be four major groups of journals. The first group is comprised of the four most cited journals (Infection and Immunity, Journal of Bacteriology, Journal of Biological Chemistry, and Proceedings of the National Academy of Sciences), the second group contains the next five journals (Nature, Science, Molecular Microbiology, Applied and Environmental Microbiology, and JAMA), the third group contains the next four journals (Journal of Clinical Microbiology, Biochemistry-US, Vaccine, and Emerging Infectious Diseases)and the fourth group contains the remainder. The first group and most of the second group consist of basic science journals, whereas about

half the remaining journals address clinical/ epidemiological/ public health-related issues.

COMPUTATIONAL LINGUISTICS

Anthrax Literature Structure

Document clustering was used to identify the pervasive technical/ medical themes of the anthrax research literature and the relationships among those themes. Sixty-four individual clusters were generated, and were aggregated in an eight-level hierarchical taxonomy.

The following describes the first three levels of the hierarchical taxonomy of the anthrax research literature. Subsequently, the third level is treated as a flat taxonomy (eight separate non-hierarchical categories) and the themes of the elemental clusters in each category are summarized and shown in bulletized form.

The first taxonomy level (containing all the retrieved N=1779 records with Abstracts) can be sub-divided into two categories: Anthrax Clinical Medicine/ Animal Epidemiology; Bio-terrorism (N=461 records) and Anthrax Biology (N=1318 records). The Anthrax Clinical Medicine/ Animal Epidemiology; Bio-terrorism category focuses on anthrax patient modalities of treatment, as well as more general public health preparedness and emergency care issues resulting from potential bio-terrorist attacks. The Anthrax Biology category focuses on the mechanisms and pathways, from detection to final intoxification. The boundaries between the two categories are relatively sharp, reflecting the quality of the clustering approach used, and especially the tripling of trivial words compared to past text mining studies.

For the second level taxonomy, each first level category is divided into two sub-categories. Anthrax Clinical Medicine/ Animal Epidemiology; Bio-terrorism is divided into Anthrax Bioterrorism (N=219 records) and Anthrax Clinical Medicine/ Animal Epidemiology (N=242 records), while Anthrax Biology is divided into Anthrax Detection/ Prevention (N=956 records) and Toxin Lethality Pathways (N=362 records). The Anthrax Bioterrorism category focuses on potential public health responses to bio-terrorist attacks such as preparedness, emergency care, and the required underlying logistics, while the Anthrax Clinical Medicine/ Animal Epidemiology category

focuses on non-bioterrorism clinical medicine and bioterrorism case studies in treating anthrax. The Anthrax Detection/ Prevention category focuses on vaccine development for protection and spore/ strain identification for detection, while the Toxin Lethality Pathways category focuses on the binding, activation, and delivery of the toxins to the cell at both the aggregate toxin level and the component factor level.

The second level categories are further sub-divided to form eight third level categories. This will be the final level discussed. The category heading (in ***bolded italics***) is followed by the category summary metrics (prolific Authors, Countries, Institutions), which are followed by the component cluster themes, bulletized.

The first four level 3 categories are under the level 1 Anthrax Clinical Medicine/ Animal Epidemiology; Bio-terrorism category.

Category 1, ***Biological Agent Threat/ Attack/ Detection*** (N=97 records):
(**Authors**: zilinskas, ra 3; mcbride, mt 3; makarewicz, aj 3; hindson, bj 3; henchal, ea 3; colston, bw 3; **Country**: usa 70; france 5; england 3; germany 2; canada 2; australia 2; **Institution**: us army 9; stanford univ 5; univ oklahoma 4; lawrence livermore natl lab 4; ctr dis control & prevent 4;)

- Biological Agent Detection (31 Records)
- Biological Agent Threat (28 Records)
- Biological Agent Threat/ Attack (38 Records)

Category 2, ***Planning/ Surveillance/ Communication/ Preparedness/ Response for Bioterrorist Attacks*** (N=122 records):
(**Authors:** evans, rg 3; clements, b 3; wrigley, bj 2; wolfe, mi 2; wein, lm 2; wagner, mm 2; treadwell, ta 2; terndrup, t 2; tanielian, tl 2; szeto, h 2; **Country:** usa 104; england 5; israel 3; **Institution**
ctr dis control & prevent 15; harvard univ 7; univ pittsburgh 4; st louis univ 4)

- Bioterrorism surveillance and Web-based informatics (25 Records)
- Bioterrorist attack preparedness/ response (42 Records)
- Public communication of bioterrorism-related health information (19 Records)
- Public health planning/ response to terrorism (36 Records)

Category 3, ***Evolution, transmission, and impact of infectious disease on animal populations*** (108):
(**Authors:** turnbull, pcb 5; martins, rp 4; dragon, dc 4; elkin, bt 3; **Country:** usa 23; england 9; canada 7; germany 6; france 6; brazil 6; **Institution:** niaid 4; who 3; univ sao paulo 3; louisiana state univ 3)

- Infectious diseases, emphasizing epidemics and zoonoses (33 Records)
- Animal-based infectious disease outbreaks (39 Records)
- Infectious disease ecological impacts on wild animal populations (19 Records)
- Nesting biology of insects and their anthrax parasitism (17 Records)

Category 4, ***Inhalation and cutaneous anthrax, and anthrax meningitis and meningoencephalitis*** (134):

(**Authors:** quinn, cp 8; zaki, sr 7; perkins, ba 7; ashford, da 7; shieh, wj 6; popovic, t 6; jernigan, ja 6; hadler, jl 6; guarner, j 6; **Country:** usa 78; turkey 19; germany 7; **Institution:** ctr dis control & prevent 23; numune hosp 5; us fda 4; emory univ 4; connecticut dept publ hlth 4)

- Inhalational anthrax, emphasizing patient care and postal worker exposure (42 Records)
- Cutaneous anthrax: exposure, transmission, symptoms, and treatment (41 Records)
- Anthrax etiology, pathology, and treatment, with emphasis on hemorrhaging during anthrax pathogenesis, especially thoracic lymph node hemorrhaging, and hemorrhagic mediastinitis, from inhalational anthrax (24 Records)
- Anthrax meningitis and meningoencephalitis: diagnoses and treatment (27 Records)

The last four level 3 categories are under the level 1 Anthrax Biology category. Category 5, ***Vaccination/ immunization and spore detection*** (498 records), has two main thrusts:

(**Authors:** mock, m 14; little, sf 14; ivins, be 14; friedlander, am 13; bhatnagar, r 11; williamson, ed 10; leppla, sh 9; fellows, pf 9; **Country:** usa 351; england 41; france 22; india 18; israel 16; germany 14; canada 11; **Institution:** us army 61; us navy 22; ctr dis control & prevent 18; inst pasteur 15; israel inst biol res 14; univ maryland 12; harvard univ 12; jawaharlal nehru univ 11)

THRUST 1
(Vaccination and immunization for anthrax protection)

- Anthrax vaccine absorption, emphasizing determination of IgG antibodies to anthrax protective antigen (26 Records)
- Human anthrax vaccines, including clinical trials (36 Records)
- Adverse reactions to anthrax vaccine, especially among Gulf War veterans (30 Records)
- Recombinant protective antigen against anthrax (26 Records)

- Purification of anthrax protective antigen from multiple sources (20 Records)
- Protection and immunity against anthrax by vaccinations that produce protective antigen (51 Records)
- Antibody responses to anthrax protective antigen (35 Records)

THRUST 2
(*Bacillus anthracis* spore detection)

- Irradiation of *Bacillus anthracis* spores; postexposure prophylaxis against anthrax (24 Records)
- Decontamination and cleanup of biological warfare agents (22 Records)
- Sampling for anthrax spores in potentially contaminated sites, including nasal swabs in humans (27 Records)
- Germination of *Bacillus anthracis* spores and endospores (19 Records)
- *Bacillus anthracis* exosporium, especially the major BclA glycoprotein layer coating the spore surface (17 Records)
- Inactivation of *Bacillus anthracis* spores (45 Records)
- Detection and identification of *Bacillus anthracis* spores using mass spectrometry, especially MALDI TOF, with some emphasis on small, acid-soluble protein bio-markers (16 Records)
- Detection of pathogenic bacteria by mass spectrometric profiling of fatty acids, with emphasis on pyrolysis mass spectrometry (13 Records)
- Detection of anthrax spores with Raman spectroscopy, emphasizing signal detection from dipicolinic acid in spores (19 Records)
- Biosensor detection of *Bacillus anthracis* spores (33 Records)
- Polymerase Chain Reaction for detection of nucleic acid from *Bacillus anthracis* spores (39 Records)

Category 6, ***Bacillus cereus/ anthracis strain identification*** (N=458 records), also has two main thrusts:
(**Authors:** mock, m 33; fouet, a 31; keim, p 28; koehler, tm 19; tang, wj 13; kolsto, ab 13; mesnage, s 12; **Country:** usa 210; france 64; england 32; japan 23; italy 21; germany 18; norway 17; canada 16; south korea 14; **Institution:** inst pasteur 52; no arizona univ 28; univ texas 22; us army 18; univ chicago 17)

THRUST 1
(Identification and differention of strains in *Bacillus cereus* group)

- Characterization of *Bacillus anthrascis* strains using Polymerase Chain Reaction, especially PCR analysis of sequences on plasmids pXO1 and pXO2 and chromosomal DNA, using primers to amplify DNA fragments (35 Records)
- Amplified fragment length polymorphism (AFLP) and single nucleotide polymorphisms of microbial genomes to analyze isolates of *Bacillus anthracis* strains and related *Bacillus* species, followed by further confirmatory sequence analyses. (30 Records)
- Variable number tandem repeat (VNTR) sequences as markers for genotyping *Bacillus anthracis* isolates (32 Records)
- Identification of *Bacillus* species (11 Records)
- Sequencing of 16S rRNA gene for identification of *Bacillus anthracis* strains (30 Records)
- Differentiating among strains in the *Bacillus cereus* group (51 Records)
- Identification of *Bacillus thuringiensis* serovars and strains (21 Records)

THRUST 2
(Plasmid virulence genes in anthrax strains, emphasizing *atx*A-regulated genes encoding proteins)

- Transcriptional analysis of the control of *Bacillus anthracis* capsule synthesis by *atx*A gene expression (30 Records)
- PlcR regulation of virulence factor gene expression in the *Bacillus* group strains (17 Records)
- Identification of sigma-dependent genes in the *Bacillus* group, emphasizing transcriptional analysis and focusing on sporulating bacteria (22 Records)
- *Bacillus cereus* group virulence plasmids, and DNA binding with PcrA interacting with plasmid (30 Records)
- Role of iron compounds in inhibiting or supporting growth of infections, particularly epidermidis and related staphylococci (17 Records)
- Bacteria genomics, emphasizing gene expression in Escherichia Coli (25 Records)
- Resistance of *Bacillus anthracis* strains to antibiotics, and antimicrobial susceptibilities of *Bacillus anthracis* isolates (32 Records)
- Gamma polyglutamic acid production and degradation, and biochemical analysis of gamma-polyglutamate (11 Records)

- Calmodulin-activated *Bacillus anthracis* enzyme adenylate cyclase, especially its ATP-binding sequences (31 Records)
- Surface layer homology domains for binding proteins to cell walls of *Bacillus anthracis* (20 Records)
- Surface layers in *Bacillus anthracis*, emphasizing surface layer proteins and surface array proteins (13 Records)

Category 7, ***Binding of anthrax lethal toxin to host cell receptors*** (228):
(**Authors:** collier, rj 49; leppla, sh 39; singh, y 17; klimpel, kr 13; **Country:** usa 157; india 22; germany 21; france 18; **Institution:** harvard univ 50; nidr 17; inst pasteur 16; niaid 12; univ freiburg 11)

- Prepore (heptameric) to pore conversion of the anthrax protective antigen, and its subsequent membrane translocation to the cytosol (21 Records)
- Translocation of the anthrax toxin components (lethal factor and edema factor) through protective antigen-formed channels in planar phospholipid bilayer membranes to cytosol (31 Records)
- Binding of anthrax toxin lethal factor residues to receptor domains (48 Records)
- Crystal structures with beta barrels or beta sheets and binding domains (22 Records)
- Binding domains of host cell receptors, especially TEM8 and CMG2, for binding protective antigen and mediating toxicity (27 Records)
- Clostridium botulinum C2 toxin, emphasizing its enzyme component C2I, and the separated binding/translocation component C2II. (9 Records)
- Modified anthrax toxin lethal factor (LFn) fusion protein for translocating antigens, especially cytotoxic epitopes, across cell membranes for inducing antiviral immunity (32 Records)
- Furin's toxin activation by proteolytic cleavage, and replacement of furin protease cleavage sites in anthrax toxin protective antigen proteins by sequences selectively cleaved by matrix metalloproteinases for designing tumor cell-selective cytotoxins. (18 Records)
- Polyarginine-containing peptides for inhibiting furin, and reducing activation of toxins. (20 Records)

Category 8, ***Lethal toxin inactivation of macrophages and protein kinase*** (134):

(**Authors:** leppla, sh 14; montecucco, c 12; mock, m 12; duesbery, ns 9; moayeri, m 8; alibek, k 8; **Country:** usa 89; france 15; italy 12; south korea 8; germany 8; **Institution:** inst pasteur 14; univ padua 11; niaid 10; us army 9; van andel res inst 8; us fda 8; harvard univ 8)

- Mitogen-activated protein kinase, emphasizing its proteolytic inactivation by lethal factor by cleavage within the N-terminal region (51 Records)
- Lethal toxin neutralization by monoclonal antibodies reactive with anthrax protective antigen (17 Records)
- Suppression of macrophages and dendritic cells by anthrax lethal toxin, including necrosis in macrophages and apoptosis in activated macrophages. (41 Records)
- Stimulation of macrophages by low levels of anthrax lethal toxin to produce cytokines (interleukin-1 beta and tumor necrosis factor-alpha), which induce systemic shock and death. (25 Records)

Categories 1 and 2 are the bioterrorism-related categories. The topic is broad, and goes well beyond focused technical/ medical research issues. Consequently, the author base is much more eclectic than for the more technically-focused categories. The most prolific authors in Categories 1 and 2 have publication frequencies about three percent of the total category papers. Additionally, the USA has an order of magnitude dominance of these categories. For Category 1, the ratio of USA/ France publications is 14, and for Category 2, the ratio of USA/ England publications is 21.

Contrast these results with those of Categories 7 and 8, which concentrate on lethal toxin mechanisms and pathways. The topic is focused, and the author base is narrow relative to that of Categories 1 and 2. The most prolific authors in Categories 7 and 8 have publication frequencies 10-20 percent of the total papers in the categories. Additionally, while the USA still dominates these categories, it is substantially less than Categories 1 and 2. For Category 7, the ratio of USA/ India papers is seven, while for Category 8, the ratio of USA/ France papers is six.

There was minimal mention of theoretical biological studies, or computer modeling studies. Several factors could have limited retrieval of these categories. The theme terms may not have been listed in the Title or Abstract. The use of theoretical or computer modeling may not have been evident from either the Title or Abstract. Many of these types of studies could be classified, and would not be accessible by the SCI/ SSCI. Or, the

number of articles with these themes was sufficiently small that the themes were not identifiable from the cluster feature extraction capability.

None of the categories, or the Abstracts that were sampled, offered any evidence that findings from other disciplines were being imported into the anthrax studies. The approaches listed were highly experimental in nature. This correlates with the bibliometric findings of a smaller fraction of authors from universities than previous studies, and lack of citations external to the anthrax discipline. These conclusions apply to the database evaluated in this study, the open anthrax research literature as reflected by the SCI/ SSCI.

It might be highly informative to conduct similar text mining studies on the other well-known biowarfare agents (e.g., smallpox, plague, etc), or those described in Swanson's biowarfare agent prediction study (Swanson, 2001), to ascertain whether the other agents are similarly under-represented in the open literature.

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APPENDIX 1 - THE SEMINAL LITERATURE OF ANTHRAX RESEARCH

Overview

A chronically weak area in research papers, reports, and reviews is the complete identification of seminal background documents that formed the building blocks for these papers (MacRoberts and MacRoberts, 1989, 1996; Liu, 1993; Calne and Calne, 1992; Shadish et al, 1995; Moravcsik and Murugesan, 1975). A method for systematically determining these seminal references has been developed, and has been used to generate the background material for the anthrax study. Citation-Assisted Background (CAB) is based on the assumption that seminal documents tend to be highly cited. While CAB is a highly systematic approach for identifying seminal references, it is not a substitute for the judgement of the researchers, and serves as a supplement.

Introduction

The first part of this Appendix describes the CAB concept, and its application to the seminal anthrax research literature. The second part of this Appendix builds upon the anthrax CAB results, and provides an integrated review of the seminal anthrax literature.

Research is a method of systematically exploring the unknown to acquire knowledge and understanding. Efficient research requires awareness of all prior research and technology that could impact the research topic of interest, and builds upon these past advances to create discovery and new advances. The importance of this awareness of prior art is recognized throughout the research community. It is expressed in diverse ways, including requirements for Background sections in journal research articles, invited literature reviews in targeted research areas, and required descriptions of prior art in patent applications.

For the most part, development of Background material for any of the above applications is relatively slow and labor intensive, and limited in scope. Background material development usually involves some combination of manually sifting through outputs of massive computer searches, manually tracking references through multiple generations, and searching ones own records for personal references. The few studies that have been done on the

adequacy of Background material in documents show that only a modest fraction of relevant material is included (MacRoberts and MacRoberts, 1989, 1996; Liu, 1993; Calne and Calne, 1992; Shadish et al, 1995; Moravcsik and Murugesan, 1975).

In particular, an analysis of Medline papers on the haemodynamic response to orotracheal intubation showed that recognized deficiencies in research method were not acknowledged. The authors recommended that, when submitting work for publication, investigators should document how they searched for previous work (Smith and Goodman, 1997).

Another specific example was provided by MacRoberts and MacRoberts (1997). Replicating their earlier work in a journal on genetics which indicated that only 30% of influences evident in text are reflected in a paper's references, the text of an issue of the botany journal *Sida* was studied by the MacRoberts to extract influences of previous work evident therein. Influences they judged present in the text appeared in the references only 29% of the time.

Typically missing from standard Background section or review article development, as well as in the specific examples cited above, is a systematic approach for identifying the key documents and events that provided the groundwork for the research topic of interest. The present appendix presents such a systematic approach for identifying the key documents, called CAB, and applies the approach to the anthrax literature.

Concept Description

The CAB concept (Kostoff and Shlesinger, 2005f) identifies the seminal Background documents for a research area using citation analysis. CAB rests on the assumption that a document that is a significant building block for a specific research area will typically have been referenced by a substantial number of people who are active researchers in that specific area. Implementation of the CAB concept then requires the following steps:

- The research area of interest must be defined clearly
- The documents that define the area of interest must be identified and retrieved
- The references most frequently used in these documents must be identified and selected

- These critical references must be analyzed, and integrated in a cohesive narrative manner to form a comprehensive Background section or separate literature survey

Before presenting a specific implementation algorithm for the anthrax application, a few caveats will be discussed. First, listing and selection of the most highly cited references are dependent on the comprehensiveness and balance of the total records retrieved. Any imbalances (from skewed databases or incorrect queries) can influence the weightings of particular references, and result in some references exceeding the selection threshold where not warranted, and others falling below the threshold where not warranted.

Second, it is important that the query used for record retrieval be extensive (Khan and Khor, 2004; Harter and Hert, 1997; Kantor, 1994). The query needs to be checked for precision and recall, which becomes complicated when assumptions of binary relevance and binary retrieval are relaxed (Della Mea and Mizzaro, 2004). There are a multitude of issues to be considered when evaluating queries and their impact on precision and recall. A recent systems analytic approach to analyzing the information retrieval process concludes that, for completeness, the interaction of the environment and the information retrieval system must be considered in query development (Kagolovsky and Moehr, 2004). The first author's experiences (with the four ongoing studies using CAB, including the study reported in this paper) have shown that modest query changes may substitute some papers at the citation selection threshold, but the truly seminal papers have citations of such magnitude that they are invulnerable to modest query changes. For this reason, the cutoff threshold for citations has been, and should be, set slightly lower, to compensate for query uncertainties.

Third, there may be situations where at least minimal citation representation is desired from each of the major technical thrust areas in the documents retrieved. In this case, the retrieved documents could be clustered into the major technical thrust areas, and the CAB process could be performed additionally on the documents for each cluster. The additional references identified with the cluster-level CAB process, albeit with lower citations than from the aggregated non-clustered CAB process, would then be added to the list obtained with the aggregated CAB process. The first author has not found this cluster-level CAB process necessary for any of the disciplines studied with CAB so far.

Fourth, there may be errors in citation counts due to references errors, and the subsequent fragmenting of a reference's occurrence frequency metric into smaller metric values. Care needs to be taken in insuring that a given reference is not fissioned into multiple large fragments that are not subsequently combined.

Fifth, the CAB approach is most accurate for recent references, and its accuracy drops as the references recede into the distant past. This results from the tendency of authors to reference more recent documents and, given the restricted real estate in journals, not reference the original documents. To get better representation, and more accurate citation numbers, for early historical documents, the more recent references need to be retrieved, collected into a database, and have their references analyzed in a similar manner (essentially examining generation of citations).

Sixth, high citation frequencies are not unique to seminal documents only; different types of references can have high citation frequencies. Documents that contain critical research advances, and were readily accessible in the open literature, tend to be cited highly, and represent the foundation of the CAB approach. Application of CAB to three technical research areas so far (in addition to the present anthrax study) shows that this type of document is predominant in the highly cited references list. Books or review articles also appear on the highly cited references list. These documents do not usually represent new advances, but rather are summaries of the state of the art (and its Background) at the time the document was written. These types of documents are still quite useful as Background material. Finally, documents that receive large numbers of highly critical citations could be included in the list of highly cited documents. In three studies so far, the first author has not identified such papers in the detailed development of the Background.

Additionally, one of the three application studies concerns high speed compressible flow, a discipline in which the first author worked decades ago. Using the CAB approach, the first author found that all the key historical documents with which he was familiar were identified, and all the historical documents identified appeared to be important. Thus, for that data point at least, the weaknesses identified above (imbalances, undervaluing early historical references, unwanted highly cited documents) did not materialize. To insure that any critical documents were not missed because

of imbalance problems, the threshold was set a little bit lower to be more inclusive.

The converse problem to multiple types of highly cited references, some of which may not be the seminal documents desired, is influential references that do not have substantial citation frequencies. If the authors of these references did not publish them in widely and readily accessible forums, or if they do not contain appropriate verbiage for optimal query accessibility, then they might not have received large numbers of citations. Additionally, journal or book space tends to be limited, with limited space for references. In this zero-sum game for space, research authors tend to cite relatively recent records at the expense of the earlier historical records. Also, extremely recent but influential references have not had the time to accumulate sufficient citations to be listed above the selection threshold on the citation frequency table. Methods of including these influential records located at the wings of the temporal distribution will be described in the following implementation section. Inclusion of the references that were not widely available when published is more problemmatical, and tends to rely on the Background developers' personal knowledge of these documents, and their influence.

Concept Implementation

To identify the total candidate references for the Background section, a table containing all the references from the retrieved records was constructed. A threshold frequency for selection can be determined by arbitrary inspection (i.e., a Background section consisting of 150 key references is arbitrarily selected). The first author has found a dynamic selection process more useful. In this dynamic process, references are selected, analyzed, and grouped based on their order in the citation frequency table until the resulting Background is judged sufficiently complete by the Background developers.

To insure that the influential documents at the wings of the temporal distribution are included, the following total process was used. The reference frequency table is ordered by inverse frequency, as above, and a high value of the selection frequency threshold is selected initially. Then, the table is re-ordered chronologically. The early historical documents with citation frequencies substantially larger than those of their contemporaries are selected, as are the extremely recent documents with citation frequencies

substantially larger than those of their contemporaries. By contemporaries, we are referring to documents published in the same time frame, not limited to the same year. Then, the dynamic selection process defined above is applied to the early historical references, the intermediate time references (those falling under the high frequency threshold selection criterion), and the extremely recent references.

Table A-1 contains the final references selected for the anthrax Background survey. The first reference listed, Koch's 1876 paper, had many more citations (the right-most column - nine) than any papers published in the 1860s or 1870s. In fact, there were half a dozen papers published between 1528 and 1876 that had two citations each, and these were the closest to Koch's paper. This is a graphic example of how we interpret a paper's having substantially more citations than its contemporaries.

TABLE A-1 – SEMINAL DOCUMENTS SELECTED FOR INCLUSION IN BACKGROUND

AUTHOR	YEAR	JOURNAL	VOL	PAGE	#CITES
KOCH R	1876	BEITR BIOL PFLANZ	2	277	9
PASTEUR L	1881	C R ACAD SCI AGR BUL	92	429	9
STERNE M	1939	J VET SCI ANIM IND	13	307	23
GLADSTONE GP	1946	BR J EXP PATHOL	27	394	15
BARNES JM	1947	BR J EXP PATHOL	28	385	12
LOWRY OH	1951	J BIOL CHEM	193	265	12
DRUETT HA	1953	J HYG	51	359	16
BELTON FC	1954	BRIT J EXPT PATHOLOG	35	144	29
SMITH H	1954	NATURE	173	869	25
SMITH H	1955	BRIT J EXP PATHOL	36	460	19
HENDERSON DW	1956	J HYG	54	28	30
ROSS JM	1957	J PATHOL BACTERIOL	73	485	43
STANLEY JL	1961	J GEN MICROBIOL	26	49	50
BEALL FA	1962	J BACTERIOL	83	1274	60
BRACHMAN PS	1962	AM J PUBLIC HEALTH	52	632	58
PUZISS M	1963	APPL MICROBIOL	11	330	28
LAEMMLI UK	1970	NATURE	227	680	56
LEIGHTON TJ	1971	J BIOL CHEM	246	3189	20
MILLER JH	1972	EXPT MOL GENETICS			36
BRADFORD MM	1976	ANAL BIOCHEM	72	248	26
SANGER F	1977	P NATL ACAD SCI USA	74	5463	22
KANEKO T	1978	MICROBIOL IMMUNOL	22	639	43
BRACHMAN PS	1980	ANN NY ACAD SCI	353	83	43
LEPPLA SH	1982	P NATL ACAD SCI USA	79	3162	190
MIKESELL P	1983	INFECT IMMUN	39	371	97

VODKIN MH	1983	CELL	34	693	43
LEPPLA SH	1984	ADV CYCLIC NUCL PROT	17	189	45
EZZELL JW	1984	INFECT IMMUN	45	761	41
HAMBLETON P	1984	VACCINE	2	125	35
GREEN BD	1985	INFECT IMMUN	49	291	123
UCHIDA I	1985	J GEN MICROBIOL	131	363	52
FRIEDLANDER AM	1986	J BIOL CHEM	261	7123	178
WELKOS SL	1986	INFECT IMMUN	51	795	57
IVINS BE	1986	INFECT IMMUN	54	537	52
TURNBULL PCB	1986	INFECT IMMUN	52	356	52
LITTLE SF	1986	INFECT IMMUN	52	509	44
IVINS BE	1986	INFECT IMMUN	52	454	42
LEPPLA SH	1988	METHOD ENZYMOL	165	103	78
GORDON VM	1988	INFECT IMMUN	56	1066	75
WELKOS SL	1988	GENE	69	287	73
LITTLE SF	1988	INFECT IMMUN	56	1807	40
IVINS BE	1988	EUR J EPIDEMIOL	4	12	35
LEPPLA SH	1988	BACTERIAL PROTEIN TO		111	34
TURNBULL PCB	1988	MED MICROBIOL IMMUN	177	293	32
ROBERTSON DL	1988	GENE	73	363	31
MAKINO S	1988	MOL MICROBIOL	2	371	30
WELKOS SL	1988	MICROB PATHOG	5	127	30
SAMBROOK J	1989	MOL CLONING LAB MANU			105
BLAUSTEIN RO	1989	P NATL ACAD SCI USA	86	2209	72
SINGH Y	1989	J BIOL CHEM	264	19103	71
MAKINO S	1989	J BACTERIOL	171	722	64
BRAGG TS	1989	GENE	81	45	55
SINGH Y	1989	J BIOL CHEM	264	11099	47
BHATNAGAR R	1989	INFECT IMMUN	57	2107	37
CATALDI A	1990	MOL MICROBIOL	4	1111	39
IVINS BE	1990	INFECT IMMUN	58	303	31
NICHOLSON WL	1990	MOL BIOL METHODS BAC		391	30
PEZARD C	1991	INFECT IMMUN	59	3472	109
ASH C	1991	INT J SYST BACTERIOL	41	343	93
LEPPLA SH	1991	SOURCEBOOK BACTERIAL		277	87
ESCUYER V	1991	INFECT IMMUN	59	3381	64
TURNBULL PCB	1991	VACCINE	9	533	62
KOEHLER TM	1991	MOL MICROBIOL	5	1501	34
QUINN CP	1991	J BIOL CHEM	266	20124	34
SINGH Y	1991	J BIOL CHEM	266	15493	31
KLIMPEL KR	1992	P NATL ACAD SCI USA	89	10277	123
MOLLOY SS	1992	J BIOL CHEM	267	16396	54
TURNBULL PCB	1992	J APPL BACTERIOL	72	21	50
HANNA PC	1992	MOL BIOL CELL	3	1269	41
IVINS BE	1992	INFECT IMMUN	60	662	39
ASH C	1992	FEMS MICROBIOL LETT	94	75	35
ARORA N	1992	J BIOL CHEM	267	15542	31
HANNA PC	1993	P NATL ACAD SCI USA	90	10198	103
FRIEDLANDER AM	1993	J INFECT DIS	167	1239	76
ABRAMOVA FA	1993	P NATL ACAD SCI USA	90	2291	57

MILNE JC	1993	MOL MICROBIOL	10	647	57
ARORA N	1993	J BIOL CHEM	268	3334	47
DROBNIEWSKI FA	1993	CLIN MICROBIOL REV	6	324	45
UCHIDA I	1993	J BACTERIOL	175	5329	45
FRIEDLANDER AM	1993	INFECT IMMUN	61	245	44
PEZARD C	1993	J GEN MICROBIOL	139	2459	34
THORNE CB	1993	BACILLUS SUBTILIS OT		113	33
MILNE JC	1994	J BIOL CHEM	269	20607	121
MESELSON M	1994	SCIENCE	266	1202	112
KLIMPEL KR	1994	MOL MICROBIOL	13	1093	85
KOEHLER TM	1994	J BACTERIOL	176	586	52
HANNA PC	1994	MOL MED	1	7	50
SINGH Y	1994	J BIOL CHEM	269	29039	37
HENDERSON I	1994	INT J SYST BACTERIOL	44	99	35
THOMPSON JD	1994	NUCLEIC ACIDS RES	22	4673	34
CARLSON CR	1994	APPL ENVIRON MICROB	60	1719	32
HARRELL LJ	1995	J CLIN MICROBIOL	33	1847	51
MILNE JC	1995	MOL MICROBIOL	15	661	47
DAI ZH	1995	MOL MICROBIOL	16	1171	44
ETIENNETOUMELIN I	1995	J BACTERIOL	177	614	40
PEZARD C	1995	INFECT IMMUN	63	1369	31
LEPPLA SH	1995	BACTERIAL TOXINS VIR		543	30
LEPPLA SH	1995	HANDB NAT T	8	543	30
ANDERSEN GL	1996	J BACTERIOL	178	377	45
RAMISSE V	1996	FEMS MICROBIOL LETT	145	9	44
LITTLE SF	1996	MICROBIOL-UK 3	142	707	33
PETOSA C	1997	NATURE	385	833	146
KEIM P	1997	J BACTERIOL	179	818	66
FRANZ DR	1997	JAMA-J AM MED ASSOC	278	399	48
ALTSCHUL SF	1997	NUCLEIC ACIDS RES	25	3389	45
CHRISTOPHER GW	1997	JAMA-J AM MED ASSOC	278	412	42
KUNST F	1997	NATURE	390	249	39
LITTLE SF	1997	INFECT IMMUN	65	5171	38
JACKSON PJ	1997	APPL ENVIRON MICROB	63	1400	34
MESNAGE S	1997	MOL MICROBIOL	23	1147	33
KAUFMANN AF	1997	EMERG INFECT DIS	3	83	31
DUESBERY NS	1998	SCIENCE	280	734	196
VITALE G	1998	BIOCHEM BIOPH RES CO	248	706	94
BENSON EL	1998	BIOCHEMISTRY-US	37	3941	54
WESCHE J	1998	BIOCHEMISTRY-US	37	15737	53
IVINS BE	1998	VACCINE	16	1141	46
PATRA G	1998	J CLIN MICROBIOL	36	3412	41
HANNA P	1998	CURR TOP MICROBIOL	225	13	35
PILE JC	1998	ARCH INTERN MED	158	429	34
DIXON TC	1999	NEW ENGL J MED	341	815	173
INGLESBY TV	1999	JAMA-J AM MED ASSOC	281	1735	167
PELLIZZARI R	1999	FEBS LETT	462	199	80
GUIDIRONTANI C	1999	MOL MICROBIOL	31	9	64
HENDERSON DA	1999	JAMA-J AM MED ASSOC	281	2127	49
MILLER CJ	1999	BIOCHEMISTRY-US	38	10432	49

FRIEDLANDER AM	1999	JAMA-J AM MED ASSOC	282	2104	44
OKINAKA RT	1999	J BACTERIOL	181	6509	44
LEPPLA SH	1999	COMPREHENSIVE SOURCE		243	35
TURNBULL PCB	1999	J APPL MICROBIOL	87	237	33
SINGH Y	1999	INFECT IMMUN	67	1853	31
VARUGHESE M	1999	INFECT IMMUN	67	1860	31
HANNA PC	1999	TRENDS MICROBIOL	7	180	30
HELGASON E	2000	APPL ENVIRON MICROB	66	2627	121
KEIM P	2000	J BACTERIOL	182	2928	87
VITALE G	2000	BIOCHEM J 3	352	739	62
INGLESBY TV	2000	JAMA-J AM MED ASSOC	283	2281	47
DIXON TC	2000	CELL MICROBIOL	2	453	42
ELLIOTT JL	2000	BIOCHEMISTRY-US	39	6706	31
BROSSIER F	2000	INFECT IMMUN	68	1781	30
BRADLEY KA	2001	NATURE	414	225	121
JERNIGAN JA	2001	EMERG INFECT DIS	7	933	120
MOCK M	2001	ANNU REV MICROBIOL	55	647	111
PANNIFER AD	2001	NATURE	414	229	58
*CDCP	2001	MMWR-MORBID MORTAL W	50	909	46
PITT MLM	2001	VACCINE	19	4768	44
REUVENY S	2001	INFECT IMMUN	69	2888	41
WELKOS S	2001	MICROBIOL-SGM 6	147	1677	41
SWARTZ MN	2001	NEW ENGL J MED	345	1621	40
DENNIS DT	2001	JAMA-J AM MED ASSOC	285	2763	39
GRINBERG LM	2001	MODERN PATHOL	14	482	34
SELLMAN BR	2001	SCIENCE	292	695	34
BORIO L	2001	JAMA-J AM MED ASSOC	286	2554	32
BUSH LM	2001	NEW ENGL J MED	345	1607	31
GUIDIRONTANI C	2001	MOL MICROBIOL	42	931	31
*CDCP	2001	MMWR-MORBID MORTAL W	50	889	30
ERWIN JL	2001	INFECT IMMUN	69	1175	30
MOUREZ M	2001	NAT BIOTECHNOL	19	958	30
INGLESBY TV	2002	JAMA-J AM MED ASSOC	287	2236	113
READ TD	2002	SCIENCE	296	2028	53
PARK JM	2002	SCIENCE	297	2048	52
JERNIGAN DB	2002	EMERG INFECT DIS	8	1019	46
BARAKAT LA	2002	JAMA-J AM MED ASSOC	287	863	31
READ TD	2003	NATURE	423	81	96
IVANOVA N	2003	NATURE	423	87	73
SCOBIE HM	2003	P NATL ACAD SCI USA	100	5170	51
COLLIER RJ	2003	ANNU REV CELL DEV BI	19	45	47
MOAYERI M	2003	J CLIN INVEST	112	670	35
AGRAWAL A	2003	NATURE	424	329	31
RASKO DA	2004	NUCLEIC ACIDS RES	32	977	22
HOFFMASTER AR	2004	P NATL ACAD SCI USA	101	8449	20
MOAYERI M	2004	CURR OPIN MICROBIOL	7	19	16
TURK BE	2004	NAT STRUCT MOL BIOL	11	60	16
HELGASON E	2004	APPL ENVIRON MICROB	70	191	15
KIRBY JE	2004	INFECT IMMUN	72	430	15
BAILLIE L	2005	FEMS MICROBIOL LETT	245	33	4

DRYSDALE M	2005	EMBO J	24	221	4
RASKO DA	2005	FEMS MICROBIOL REV	29	303	4

These results were examined by the authors. They judged that all papers in the table were relevant for a Background section, or review paper. Due to space considerations, not all papers listed will be included in the historical narrative shown in the next section.

There are eight journals that are mentioned frequently in Table A-1. A temporal analysis of their frequency provided some interesting insights. Table A-2 contains the number of seminal papers published in these eight journals as a function of three time bands: 1980-89; 1990-99; 2000-05.

TABLE A-2 – TEMPORAL ANALYSIS OF JOURNALS CONTAINING MOST CITED PAPERS

JOURNAL	1980-89	1990-99	2000-05
INFECTION AND IMMUNITY	11	9	4
JOURNAL OF BIOLOGICAL CHEMISTRY	3	7	0
JOURNAL OF BACTERIOLOGY	1	6	1
MOLECULAR MICROBIOLOGY	1	8	1
JAMA	0	5	5
NATURE	0	2	5
SCIENCE	0	2	3
PROC NAT'L ACAD OF SCIENCES-USA	2	3	2

There are three distinct patterns in this table. Infection and Immunity has dominated publication of most cited anthrax articles for almost three decades. It completely dominated the decade of the 1980s. The specialty biology and biochemistry journals dominated the 1990s. The 2000s seem to be dominated by the multi-disciplinary journals.

The analysis and discussion above have focused on the contents of the Background; i.e., which documents should be included. In some cases, the Abstracts of the seminal references have been retrieved and clustered, to produce a structure for the Background. Thus, the CAB approach can be used to determine both the content and structure of the Background section. Again, CAB does not exclude content and structure determinations by the experts. CAB can be viewed as the starting point for content and structure determination, upon which the experts can build with their own insights and experience.

While the CAB approach is systematic, it is not automatic. Judgement is required to determine when an adequate number of references has been selected for the Background, and further judgement is required to analyze, group, and link the references to form a cohesive Background section. Additionally, the highly influential references that were not highly cited due to insufficient dissemination should be included by the Background developers, if they know of such documents. CAB is not meant to replace individual judgement or specification of Background material. CAB is meant to augment individual judgement and reference selection, as reflected in its name of Citation-Assisted.

ANTHRAX BACKGROUND LITERATURE

General

Anthrax is primarily a zoonotic disease caused by the spore-forming bacterium *Bacillus anthracis*. The ability to form spores permits the organism to survive environmental conditions that kill most other bacteria. Dormant spores present in the soil infect mainly herbivores (and carnivores that eat the herbivores). Spores can infect humans who come in contact with the infected animal or its products (e.g., meat, hides, wool, etc.) (Boutiba-Ben Boubaker and Ben Redejeb, 2001; Jedrzejas, 2002; Mock and Fouet, 2001).

Anthrax has had a long history. It was thought to be responsible for the 5th and 6th plagues in Egypt that were described in the Old Testament. Subsequently, there were numerous descriptions of a disease resembling anthrax in both animals and humans in the literature of the Greeks, Romans, and Hindus (Dirckx, 1981). In the Middle Ages, anthrax swept across Europe, killing large numbers of humans and animals (Turnbull, 2002). With the industrialization of Europe, smaller outbreaks of anthrax began to occur in factories where imported animal hides and hair were processed (Hugh-Jones, 1999). The association of anthrax with wool led to the name woolsorters disease.

The study of anthrax led to the development of modern bacteriology, serology, and immunology. The anthrax bacilli were first seen in 1863 by Davaine, who proved their infectivity. For an eloquent description of Davaine's discoveries, see the reply of Pasteur to a paper by Koch in an Extract from The Scientific Review Paris of 20 January 1883. In 1876, Robert Koch isolated the bacillus in pure culture in the vitreous of cow's eyes and established Koch's postulates (Koch, 1876). Shortly thereafter, Louis Pasteur demonstrated protection against anthrax following immunization of sheep with a live attenuated bacterial vaccine (Pasteur, 1881). It wasn't until 1954 that a toxin was shown to be responsible for the death of infected animals (Smith and Keppie, 1954).

Anthrax is still enzootic in most developing countries and it occurs sporadically in many other countries (Hugh-Jones, 1999). West Africa is the most affected area of the world (Davies, 1982; Hugh-Jones, 1999). Anthrax remains a significant problem in other parts of Africa, Central America,

Spain, Greece, Turkey, Albania, Romania, Central Asia, and the Middle East (Bales et al., 2002; Cieslak and Eitzen, 1999; Hugh-Jones, 1999; Kaya et al., 2002; Schmidt and Kaufman, 2002).

Between 20,000 and 100,000 cases of human anthrax are estimated to occur worldwide annually (Cieslak and Eitzen, 1999). Because anthrax remains a problem in developing countries, animal products imported from these areas continue to pose a risk. Human cases occur infrequently in economically advanced countries, where animal anthrax is under control. The incidence of infection has been reduced dramatically by vaccination of high-risk people and animals, along with improvements in industrial hygiene (Jefferson et al., 2000; Turner et al., 1999). For example, in the United States, there were about 120 cases per year in the early part of the 20th century, which declined to less than 1 case per year during the 1990s.

B. anthracis is an aerobic or facultatively anaerobic, large, square-ended Gram-positive rod with a centrally located ellipsoidal to cylindrical spore. Recent taxonomic studies indicate that *B. anthracis* is closely related to *Bacillus cereus* and *Bacillus thuringiensis* and that these three microorganisms should be considered a single species (Helagson et al., 2000). Furthermore, it is likely that *B. anthracis* is a lineage of *B. cereus*, which has implications for virulence and for horizontal gene transfer within this group of organisms (Helgason, 2000). Sporulation occurs in the soil and on culture medium but not in living tissue, unless exposed to air. Spores enter the human host through breaks in the skin, inhalation, or by ingestion, where they are ingulfed by macrophages or other phagocytic cells. The spores germinate within the phagocytic cell forming encapsulated vegetative cells that produce several extracellular protein toxins (Brossier et al., 1998; Brossier et al., 2000; Mourez et al., 2002).

There are different clinical forms of anthrax, which reflect the route by which the spores entered the host. The vast majority of cases of naturally acquired anthrax (ca. 95%) are the cutaneous form, followed by the inhalational, gastrointestinal and other rare forms. Cutaneous anthrax begins as a small, painless, but often pruritic papule. As the papule enlarges, it becomes vesicular and usually, within 2 days, ulcerates to form a distinctive black (hence the name of the disease anthracis: coal) eschar, with surrounding edema. The case fatality rate of the untreated cutaneous form can be as high as 25 per cent. Inhalational anthrax begins as an upper-respiratory flu-like syndrome, which after a few days takes a fulminant

course, manifested by dyspnea, cough, chills, and a high-grade bacteremia. Massive hilar adenopathy and mediastinal hemorrhage is evident in chest x-rays as a widening of the hilum, followed by massive widening of the mediastinum with clear and sharp borders (Vessal, 1975). If not recognized and treated early, nearly all patients with this disease will die within several days. Gastrointestinal anthrax probably occurs more frequently than realized. Most cases are recognized after death because the clinical diagnosis is extremely difficult. Many mild cases probably escape detection. In gastrointestinal anthrax there is mucosal ulceration, mesenteric adenitis, ascites, cholera-like diarrhea, and moderate to severe fever with chills relatively late in the illness as a sign of septicemia, leukocytosis and hemoconcentration. X-ray films may show signs of intestinal obstruction. The case fatality rate of untreated gastrointestinal anthrax is >50 per cent. Prompt clinical suspicion and rapid administration of effective antimicrobials are essential for the treatment of all forms of anthrax. If untreated, all forms of anthrax can lead to septicemia and death.

Research History

The major known virulence factors of *B. anthracis* are the antiphagocytic poly-γ-D-glutamic acid capsule and the toxin (Beall et al., 1962). Chains of virulent cells of *B.* anthracis are usually surrounded by a capsule; avirulent strains are often unencapsulated. Anthrax toxin consists of three proteins: protective antigen (PA), edema factor (EF), and lethal factor (LF). PA and EF comprise the edema toxin (ET) and PA and LF the lethal toxin (LT). Both of these toxins were shown to contribute to the virulence of *B. anthracis*; however, it is the LT that is thought to be responsible for the death of the infected host (Pezard et al., 1991). The genes responsible for capsular biosynthesis (Green, 1985) and the synthesis of LT and ET (Mikesell, 1983) are located on large plasmids designated pXO2 and pXO1, respectively. Welkos et al. (1988) determined the nucleotide sequence of the gene encoding PA.

A number of investigators have contributed to our understanding of how the toxin gains entry into the cell. The observation that purified PA blocked the action of anthrax toxin (Singh et al., 1989) suggested that they recognized a common receptor. It was subsequently shown that PA binds to the anthrax toxin receptor (ATR) (Bradley et al., 2001), is cleaved by a cell surface protease with the sequence specificity and catalytic properties of furin (Klimpel et al., 1992), and then binds LF and/or EF, facilitating internalization of these proteins into the cell (Singh et al., 1999; Friedlander, 1986). ATR is a type I membrane protein with an extracellular von Willebrand factor A domain that binds directly to PA (Bradley et al., 2001) The proteolytic activation of PA is a critical step in the membrane insertion of EF and LF (Milne et al., 1994). The activated PA forms a multi-subunit, ring-shaped heptameric oligomer during intoxication of mammalian cells (Milne et al., 1994). Using the crystal structure of the PA monomer and oligomer, a model of pH-dependent membrane insertion involving the formation of a porin-like, membrane-spanning beta-barrel was proposed (Petosa et al., 1997). The subsequent translocation of LF and EF across the cell membrane and into the cytosol is thought to occur by a pH- and voltage-dependent mechanism (Zhao et al., 1995; Wesche et al., 1998; Blaustein et al., 1989).

EF was shown to have adenyl cyclase activity and increase cyclic AMP concentrations in eukaryotic cells (Leppla, 1982). Inhibitors of receptor-

mediated endocytosis blocked the entry of EF, but not that of the *Bordetella pertussis* adenyl cyclase toxin (Gordon et al., 1988).

The purification of LT has facilitated studies on its biological activity (Leppla, 1988). The mechanism of action of LF inside the cell is beginning to be understood. Macrophages play a critical role in the pathophysiology of anthrax. Friedlander used an in vitro system to demonstrate that the lethality of macrophages to LT occurred through an acid-dependent process (Friedlander, 1986). Systemic shock and death of the host resulted primarily from the effects of high levels of cytokines, principally IL1, produced by macrophages that had been stimulated by LT (Hanna et al, 1993). LF possesses a zinc metalloprotease consensus sequence that is required for LT activity (Klimpel et al., 1994). LF cleaves the amino terminus of mitogen-activated protein kinase kinases (MAPKK/MEK), including MEK1, MEK2, MKK3, MKK4, MKK6, and MKK7 but not MKK5 inhibiting the MAPK signal transduction pathway (Duesbery et al., 1998; Pellizzari et al., 1999; Pellizzari et al., 2000; Vitale et al., 2000). In addition to cleavage of the N-terminus of MAPKKs, LF induced tyrosine/threonine phosphorylation of MAPKs in cultured macrophages (Vitale et al., 1998). However, the fact that LT-resistant and –sensitive cells show similar internalization of LF (Singh et al., 1989) and similar MEK cleavage in response to LF (Pellizzari et al., 1999; Pellizzari et al., 2000) suggests that these factors alone cannot account for differential susceptibility or resistance to LT. The completion of the genome sequence of *B. anthracis* (Read et al., 2002, 2003) will provide new insights into the pathogenesis of this microorganism.

Vaccines have played an important role in controlling anthrax. The veterinary vaccine that is currently in use in the U.S. is a spore suspension from an avirulent non-encapsulated strain (Sterne, 1939). The original human anthrax vaccine was developed by George Wright in the 1950s and first produced on a large scale by Merck. Brachman et al. (1962) examined the safety of this vaccine and concluded that individual reactions to the vaccine were relatively minor. The U.S military vaccinates at-risk personnel for anthrax in case of a biological attack. Friedlander et al. (1993) conducted a study to determine whether a prolonged course of post-exposure antibiotics, with or without vaccination, protected monkeys exposed to a lethal dose of anthrax spores when the antibiotic was discontinued. It was concluded that each regimen completely protected animals while on therapy and provided significant long-term protection upon discontinuance of the drug. The use of the current anthrax vaccine in U.S. military personnel has

become controversial due to reports of adverse reactions. A priority area for current research is the development of a better vaccine.

B. anthracis has many biological and virulence characteristics that have made it attractive as a bioweapon, In 1979, an accident occurred in a military microbiology facility in Sverdlovsk, USSR in which a small amount (less than 1 gram) of spores were released outside the facility generating an aerosol that resulted in numerous infections and at least 64 deaths (Abramova et al., 1993; Bezdenezhnykh and Nikiforov, 1980; Messelson et al., 1994). Recently, there has been considerable concern about the use of biological agents by terrorists. *B. anthracis* is one of the agents that has required enhanced preparedness efforts (Franz et al., 1997; Inglesby et al., 1999). The concern about bioterrorism has been heightened in the post-9/11 era. The mailings of letters containing spores of *B. anthracis* to the media and members of the U.S. Congress in September and October of 2001 resulted in 22 cases of anthrax (11 of these were inhalational) with 5 deaths (all inhalational), closed part of the U.S. government's operations, and terrorized the American public (Jernigan et al., 2001; Hsu et al., 2002, Morse et al., 2003). Aggressive treatment enabled many of those with inhalational anthrax to survive (Inglesby et al., 2002). The investigation of this attack used a molecular typing method (variable-number tandem repeat [VNTR] analysis) (Keim et al., 2000) to identify the strain of *B. anthracis* used in the attack. Additional forensic information was provided by whole genome sequencing (Read et al., 2002). Nevertheless, the perpetrator(s) of this attack remain at large.

APPENDIX 2 – CLUTO CLUSTERS

This Appendix contains the detailed data for the CLUTO clusters. The three-level hierarchical taxonomy is shown first in two different formats: thematically and by thematic cluster number. The latter schematic serves as a roadmap to the detailed structure that follows.

The bibliometrics are presented for each of the categories in the three-level hierarchy. Then, the bibliometrics are then presented for each of the elemental clusters in each third level category. The formats for the hierarchical categories and elemental clusters are similar. For each category/ cluster, a theme is generated, and shown at the beginning of the category/ cluster description, followed immediately by the number of records in the category/ cluster. For each category/ cluster, the category/ cluster syntax features (weighted terms, unweighted single/ double/ triple word phrases and their frequencies) and category/ cluster metrics (Authors, Sources, Keywords, Country, Institution) follow the number of records. For the 64 elemental cluster descriptions, sample titles of the records in the cluster are interjected between the cluster syntax features and the cluster metrics. Each category/ cluster is presented on a separate page.

ANTHRAX HIERARCHICAL TAXONOMY

Figure A-2-a is the three-level hierarchical taxonomy presented in the main text.

FIGURE A-2-a – THREE-LEVEL HIERARCHICAL TAXONOMY
(Category Headings)

Anthrax Clinical Medicine/ Animal Epidemiology; Bio-terrorism (461)	Anthrax Bio-terrorism (219)	Biological Agent Threat/ Attack/ Detection (97)
		Planning/ Surveillance/ Communication/ Preparedness/ Response For Bioterrorist Attacks (122)
	Anthrax Clinical Medicine/ Animal Epidemiology (242)	Evolution, transmission, and impact of infectious disease on animal populations(108)
		Inhalation and cutaneous anthrax, and anthrax meningitis and meningoencephalitis (134)
Anthrax Biology (1318)	Anthrax Detection/ Prevention (956)	Vaccination/ immunization and spore detection (498)
		Bacillus cereus/ anthracis strain identification (458)
	Toxin Lethality Pathways (362)	Binding of anthrax lethal toxin to host cell receptors (228)
		Lethal toxin inactivation of macrophages and protein kinase (134)

Figure A-2-b is the three level taxonomy with the themes replaced by the actual cluster numbers. All the categories and clusters that follow are headed by the actual CLUTO output cluster numbers, and the table should therefore serve as a roadmap/ guide to identifying the proper positioning of the categories/ clusters.

TABLE A-2-b – THREE-LEVEL HIERARCHICAL TAXONOMY
(Category/ Cluster Numbers)

CL. 121 (461 REC)	CL. 115 (219 REC) 121a	CL. 91 (97 REC) [121a1]
		CL. 103 (122 REC) [121a2]
	CL. 119 (242 REC) 121b	CL. 107 (108 REC) [121b1]
		CL. 101 (134 REC) [121b2]
CL. 125 (1318 REC)	CL 124 (956 REC) 125a	CL. 123 (498 REC) [125a1]
		CL. 122 (458 REC) [125a2]
	CL. 120 (362 REC) 125b	CL. 109 (228 REC) [125B1]
		CL. 108 (134 REC) [125B2]

The remainder of the Appendix presents the details of the clusters. The first part contains the details (syntax, metrics, theme) of the categories in the first four hierarchical levels. The second part contains the details of each of the 64 elemental clusters.

CLUSTER 126 (ROOT)
(1779 Records)

Cluster Syntax Features

Descriptive Terms
spore 2.4%, vaccin 1.8%, strain 1.6%, cell 1.6%, protein 1.5%, toxin 1.4%, anthrax 1.4%, anthraci 1.4%, gene 1.1%, cereu 1.0%, diseas 0.9%, activ 0.9%, detect 0.8%, protect 0.8%, (19.27%)

Single Word Terms
anthrax 1021, bacillu 985, anthraci 887, cell 524, protein 518, two 511, toxin 457, protect 449, activ 445, strain 426, factor 409, antigen 398, gene 379, spore 370, lethal 349

Double Word Terms
bacillu.anthraci 812, protect.antigen 343, lethal.factor 228, anthrax.toxin 178, bacillu.cereu 168, lethal.toxin 137, anthrax.vaccin 128, anthraci.spore 128, edema.factor 113, amino.acid 102, public.health 101, gram.posit 97, unit.state 97, anthrax.lethal 96, bacillu.subtili 94

Triple Word Terms
bacillu.anthraci.spore 77, anthrax.lethal.toxin 66, protect.antigen.lethal 54, antigen.lethal.factor 53, lethal.factor.edema 49, factor.edema.factor 49, mitogen.activ.protein 48, activ.protein.kinas 46, polymeras.chain.reaction 42, anthraci.protect.antigen 37, strain.bacillu.anthraci 37, compon.anthrax.toxin 37, bacillu.cereu.group 34, bacillu.cereu.bacillu 33, center.diseas.control 31

Cluster Metrics

Authors
mock, m 69; leppla, sh 65; collier, rj 56; fouet, a 32; keim, p 30; friedlander, am 27; bhatnagar, r 26; singh, y 24; little, sf 21; koehler, tm 21

Sources
infection and immunity 105; journal of bacteriology 67; applied and environmental microbiology 59; proceedings of the national academy of sciences of the united states of america 58; journal of biological chemistry 57; emerging infectious diseases 57; vaccine 50; journal of applied microbiology 46; journal of clinical microbiology 43; biochemical and biophysical research communications 39

Keywords
microbiology 247; biochemistry & molecular biology 241; microbiology 238; immunology 226; infectious diseases 196; bacillus-anthracis 180; biotechnology & applied microbiology 178; identification 150; bacillus-anthracis 143; anthrax 125

Country
usa 1082; france 134; england 105; germany 78; india 55; italy 49; canada 45; japan 37; south korea 32; israel 31

Institution
usa 109; inst pasteur 98; harvard univ 83; ctr dis control & prevent 72; univ texas 42; niaid 39; usn 33; no arizona univ 30; us fda 27; univ chicago 23

CLUSTER 121 (LEVEL 1)
Anthrax Clinical Medicine/ Bioterrorism (461 Records)

Cluster Syntax Features

Descriptive Terms
health 4.4%, diseas 4.2%, patient 3.3%, bioterror 3.1%, public 2.4%, case 2.4%, attack 2.4%, anthrax 2.1%, agent 1.7%, public.health 1.6%, biolog 1.3%, threat 1.2%, infect 1.1%, inform 1.1%, (32.98%)

Single Word Terms
anthrax 361, diseas 200, health 158, bioterror 154, case 141, agent 131, infect 129, public 123, attack 122, patient 115, biolog 112, bacillu 112, anthraci 110, clinic 100, state 92

Double Word Terms
bacillu.anthraci 104, public.health 92, unit.state 68, inhal.anthrax 57, infecti.diseas 41, cutan.anthrax 36, biolog.agent 35, anthrax.attack 34, biolog.weapon 31, terrorist.attack 30, anthrax.case 28, diseas.control 28, control.prevent 27, center.diseas 26, year.old 25

Triple Word Terms
center.diseas.control 26, diseas.control.prevent 25, case.inhal.anthrax 17, new.york.citi 13, weapon.mass.destruct 13, case.cutan.anthrax 12, foot.mouth.diseas 9, biolog.threat.agent 8, public.health.emerg 8, contact.infect.anim 8, agent.bacillu.anthraci 8, anthraci.yersinia.pesti 8, bacillu.anthraci.yersinia 8, acut.respiratori.syndrom 8, bacillu.anthraci.spore 8

Cluster Metrics

Authors
quinn, cp 9; ashford, da 9; popovic, t 8; perkins, ba 8; zaki, sr 7; turnbull, pcb 6; shieh, wj 6; jernigan, ja 6; hadler, jl 6; guarner, j 6

Sources
emerging infectious diseases 42; clinical infectious diseases 12; jama-journal of the american medical association 10; biosecurity and bioterrorism-biodefense strategy practice and science 9; american journal of public health 8; revue scientifique et technique de l office international des epizooties 7; proceedings of the national academy of sciences of the united states of america 7; journal of health communication 7; journal of applied microbiology 7; public health reports 5

Keywords
anthrax 64; infectious diseases 61; medicine, general & internal 59; immunology 57; public, environmental & occupational health 50; occupational health 50; public, environmental & 50; anthrax 44; bioterrorism 43; outbreak 40

Country
usa 275; turkey 21; england 21; germany 17; france 15; canada 10; australia 8; switzerland 6; russia 6; israel 6

Institution

ctr dis control & prevent 44; usa 14; stanford univ 10; harvard univ 10; johns hopkins univ 9; univ pittsburgh 8; us fda 7; emory univ 7; univ texas 6; univ oklahoma 6

CLUSTER 125
Anthrax Biology (1318 Records)

Cluster Syntax Features

Descriptive Terms
spore 3.0%, strain 2.3%, protein 2.2%, cell 2.2%, vaccin 2.1%, toxin 1.9%, gene 1.7%, anthraci 1.6%, cereu 1.4%, activ 1.2%, bind 1.1%, sequenc 1.1%, protect 1.0%, lethal 0.9%, (24.65%)

Single Word Terms
bacillu 873, anthraci 777, anthrax 660, protein 516, cell 504, two 436, toxin 427, activ 418, strain 418, protect 412, antigen 386, factor 378, gene 374, lethal 335, spore 318

Double Word Terms
bacillu.anthraci 708, protect.antigen 334, lethal.factor 225, anthrax.toxin 177, bacillu.cereu 163, lethal.toxin 135, anthrax.vaccin 119, anthraci.spore 115, edema.factor 113, amino.acid 102, anthrax.lethal 96, bacillu.subtili 94, escherichia.coli 89, gram.posit 83, anthraci.strain 80

Triple Word Terms
bacillu.anthraci.spore 69, anthrax.lethal.toxin 66, protect.antigen.lethal 51, antigen.lethal.factor 50, lethal.factor.edema 49, factor.edema.factor 49, mitogen.activ.protein 48, activ.protein.kinas 46, compon.anthrax.toxin 37, strain.bacillu.anthraci 37, polymeras.chain.reaction 35, bacillu.cereu.group 34, bacillu.cereu.bacillu 33, anthraci.protect.antigen 32, protein.kinas.kinas 31

Cluster Metrics

Authors
mock, m 68; leppla, sh 65; collier, rj 56; fouet, a 32; keim, p 29; bhatnagar, r 26; singh, y 24; friedlander, am 24; little, sf 21; koehler, tm 21

Sources
infection and immunity 105; journal of bacteriology 67; applied and environmental microbiology 59; journal of biological chemistry 57; proceedings of the national academy of sciences of the united states of america 51; vaccine 50; journal of clinical microbiology 40; journal of applied microbiology 39; biochemical and biophysical research communications 39; fems microbiology letters 35

Keywords
biochemistry & molecular biology 241; microbiology 232; microbiology 219; immunology 169; biotechnology & applied microbiology 168; bacillus-anthracis 157; identification 140; infectious diseases 135; bacillus-anthracis 118; toxin 114

Country
usa 807; france 119; england 84; germany 61; india 49; italy 46; japan 37; canada 35; south korea 30; israel 25

Institution
inst pasteur 97; usa 95; harvard univ 73; univ texas 36; niaid 33; no arizona univ 29; usn 28; ctr dis control & prevent 28; jawaharlal nehru univ 23; univ chicago 22

CLUSTER 115 (LEVEL 2 – 121a)
Anthrax Bioterrorism (219 Records)

Cluster Syntax Features

Descriptive Terms
health 7.7%, bioterror 5.6%, attack 5.6%, public 4.9%, agent 3.5%, public.health 3.2%, biolog 3.0%, threat 2.5%, inform 1.9%, weapon 1.5%, commun 1.3%, state 1.3%, diseas 1.0%, physician 1.0%, (44.81%)

Single Word Terms
anthrax 142, bioterror 109, health 106, attack 104, agent 103, biolog 95, public 91, diseas 74, threat 71, respons 68, state 62, system 56, potenti 56, inform 55, emerg 53

Double Word Terms
public.health 67, unit.state 43, bacillu.anthraci 35, biolog.agent 33, anthrax.attack 28, terrorist.attack 27, biolog.weapon 27, control.prevent 20, diseas.control 20, health.care 20, center.diseas 20, biolog.warfar 20, bioterrorist.attack 17, yersinia.pesti 16, bioterror.attack 16

Triple Word Terms
center.diseas.control 20, diseas.control.prevent 20, weapon.mass.destruct 13, agent.bacillu.anthraci 8, public.health.emerg 8, anthraci.yersinia.pesti 8, biolog.threat.agent 8, bacillu.anthraci.yersinia 8, public.health.respons 7, anthrax.unit.state 6, terrorist.attack.anthrax 6, public.health.infrastructur 6, viral.hemorrhag.fever 5, attack.unit.state 5, pathogen.detect.system 4

Cluster Metrics

Authors
kaplan, eh 4; evans, rg 4; clements, b 4; zilinskas, ra 3; wein, lm 3; wagner, mm 3; mcbride, mt 3; makarewicz, aj 3; kaufmann, af 3; hindson, bj 3

Sources
emerging infectious diseases 19; biosecurity and bioterrorism-biodefense strategy practice and science 9; journal of health communication 7; proceedings of the national academy of sciences of the united states of america 6; public health reports 5; jama-journal of the american medical association 5; risk analysis 4; american journal of public health 4; american journal of infection control 4; military medicine 3

Keywords
anthrax 41; public, environmental & occupational health 32; occupational health 32; public, environmental & 32; public-health management 30; medicine, general & internal 29; bioterrorism 29; infectious diseases 24; immunology 23; outbreak 23

Country
usa 174; england 8; france 6; germany 4; australia 4; israel 3; canada 3; italy 2; india 2; wales 1

Institution
ctr dis control & prevent 19; usa 11; stanford univ 8; univ pittsburgh 7; harvard univ 7; univ alabama 6; st louis univ 6; yale univ 5; univ oklahoma 5; johns hopkins univ 5

CLUSTER 119 (LEVEL 2 – 121b)

Anthrax Clinical Medicine/ Animal Epidemiology (242 Records)

Cluster Syntax Features

Descriptive Terms

patient 6.5%, diseas 6.4%, case 5.3%, anthrax 3.2%, cutan 2.1%, anim 2.1%, infect 2.0%, inhal 2.0%, inhal.anthrax 1.5%, nest 1.3%, clinic 1.1%, diagnosi 1.1%, cutan.anthrax 1.0%, outbreak 0.9%, (37.35%)

Single Word Terms

anthrax 219, diseas 126, case 109, infect 96, patient 85, bacillu 77, anthraci 74, anim 69, clinic 61, inhal 60, human 57, year 56, treatment 53, health 52, cutan 51

Double Word Terms

bacillu.anthraci 69, inhal.anthrax 52, cutan.anthrax 35, infecti.diseas 31, public.health 25, unit.state 25, year.old 23, anthrax.case 23, anthrax.spore 17, case.inhal 17, case.cutan 16, anthrax.rare 15, infect.anim 14, case.anthrax 14, gram.posit 13

Triple Word Terms

case.inhal.anthrax 15, case.cutan.anthrax 12, new.york.citi 9, contact.infect.anim 8, inhal.anthrax.case 7, gram.posit.rod 6, acut.respiratori.syndrom 6, diagnosi.inhal.anthrax 6, bacillu.anthraci.spore 6, center.diseas.control 6, spore.form.bacterium 6, foot.mouth.diseas 6, sever.acut.respiratori 5, bacterium.bacillu.anthraci 5, bioterror.inhal.anthrax 5

Cluster Metrics

Authors

quinn, cp 8; zaki, sr 7; perkins, ba 7; ashford, da 7; shieh, wj 6; popovic, t 6; jernigan, ja 6; hadler, jl 6; guarner, j 6; turnbull, pcb 5

Sources

emerging infectious diseases 23; clinical infectious diseases 10; revue scientifique et technique de l office international des epizooties 7; journal of applied microbiology 6; jama-journal of the american medical association 5; american journal of public health 4; presse medicale 3; magyar allatorvosok lapja 3; journal of the kansas entomological society 3; archives of internal medicine 3

Keywords

infectious diseases 37; immunology 34; veterinary sciences 31; medicine, general & internal 30; anthrax 27; anthrax 23; microbiology 22; bacillus-anthracis 19; public, environmental & occupational health 18; occupational health 18

Country

usa 101; turkey 21; germany 13; england 13; france 9; canada 7; switzerland 6; russia 6; brazil 6; india 4

Institution

ctr dis control & prevent 25; numune hosp 5; niaid 5; emory univ 5; who 4; us fda 4; nih 4; johns hopkins univ 4; connecticut dept publ hlth 4; usa 3

CLUSTER 124 (LEVEL 2 – 125a)
Anthrax Detection/ Prevention (956 Records)

Cluster Syntax Features

Descriptive Terms
spore 4.7%, strain 3.7%, vaccin 3.5%, cereu 2.5%, gene 2.3%, anthraci 2.1%, sequenc 1.5%, isol 1.4%, detect 1.2%, protein 1.2%, dna 1.2%, speci 1.2%, pcr 1.1%, bacillu 1.1%, (29.56%)

Single Word Terms
bacillu 716, anthraci 624, anthrax 405, strain 381, gene 322, two 319, spore 291, protein 269, sequenc 261, cell 250, detect 244, vaccin 227, cereu 220, on 215, activ 213

Double Word Terms
bacillu.anthraci 556, bacillu.cereu 161, protect.antigen 157, anthrax.vaccin 113, anthraci.spore 102, bacillu.subtili 91, anthraci.strain 78, bacillu.thuringiensi 74, gram.posit 71, cereu.group 70, escherichia.coli 70, strain.bacillu 63, amino.acid 62, cereu.thuringiensi 53, lethal.factor 53

Triple Word Terms
bacillu.anthraci.spore 61, bacillu.cereu.group 34, bacillu.cereu.bacillu 33, strain.bacillu.anthraci 33, polymeras.chain.reaction 32, open.read.frame 30, gram.posit.bacteria 26, anthraci.protect.antigen 25, bacillu.anthraci.bacillu 24, spore.bacillu.anthraci 24, anthrax.vaccin.adsorb 23, variabl.number.tandem 21, recombin.protect.antigen 21, protect.antigen.rpa 21, bacillu.anthraci.strain 21

Cluster Metrics

Authors
mock, m 47; fouet, a 32; keim, p 29; koehler, tm 19; friedlander, am 16; little, sf 14; ivins, be 14; turnbull, pcb 13; tang, wj 13; mesnage, s 13

Sources
journal of bacteriology 64; applied and environmental microbiology 59; infection and immunity 56; vaccine 49; journal of clinical microbiology 40; journal of applied microbiology 37; fems microbiology letters 30; proceedings of the national academy of sciences of the united states of america 21; molecular microbiology 17; journal of biological chemistry 16

Keywords
microbiology 212; microbiology 195; biotechnology & applied microbiology 152; identification 121; immunology 108; bacillus-anthracis 102; biochemistry & molecular biology 98; anthracis 92; infectious diseases 86; escherichia-coli 84

Country
usa 561; france 86; england 73; germany 32; japan 31; canada 27; italy 25; israel 24; india 21; south korea 20

Institution
usa 79; inst pasteur 67; univ texas 31; no arizona univ 29; ctr dis control & prevent 27; usn 26; univ maryland 17; univ chicago 17; israel inst biol res 16; harvard univ 15

CLUSTER 120 (LEVEL 2 – 125b)
Toxin Lethality Pathways (362 Records)

Cluster Syntax Features

Descriptive Terms
toxin 5.8%, cell 4.8%, bind 3.2%, lethal 2.9%, protein 2.7%, factor 2.2%, macrophag 2.0%, activ 2.0%, receptor 2.0%, kinas 1.5%, domain 1.3%, membran 1.2%, lethal.factor 1.1%, letx 1.1%, (34.76%)

Single Word Terms
toxin 276, anthrax 255, cell 254, protein 247, factor 231, lethal 225, activ 205, protect 199, antigen 180, bind 171, bacillu 157, anthraci 153, receptor 117, two 117, form 111

Double Word Terms
protect.antigen 177, lethal.factor 172, bacillu.anthraci 152, anthrax.toxin 129, lethal.toxin 108, anthrax.lethal 81, edema.factor 76, cell.surfac 59, activ.protein 51, mitogen.activ 50, protein.kinas 49, cell.line 41, amino.acid 40, kinas.kinas 39, compon.anthrax 37

Triple Word Terms
anthrax.lethal.toxin 60, mitogen.activ.protein 48, activ.protein.kinas 46, factor.edema.factor 34, lethal.factor.edema 34, antigen.lethal.factor 33, protect.antigen.lethal 33, protein.kinas.kinas 31, compon.anthrax.toxin 29, toxin.protect.antigen 24, factor.lethal.factor 24, protein.protect.antigen 23, edema.factor.lethal 23, cell.surfac.receptor 23, protect.antigen.compon 23

Cluster Metrics

Authors
leppla, sh 53; collier, rj 52; mock, m 21; singh, y 20; montecucco, c 18; bhatnagar, r 15; klimpel, kr 14; barth, h 11; arora, n 11; mogridge, j 10

Sources
infection and immunity 49; journal of biological chemistry 41; proceedings of the national academy of sciences of the united states of america 30; biochemical and biophysical research communications 23; biochemistry 14; molecular microbiology 8; cellular microbiology 8; biochemical journal 7; nature 6; journal of immunology 6

Keywords
biochemistry & molecular biology 143; lethal factor 64; immunology 61; protective antigen 60; macrophages 55; bacillus-anthracis 55; toxin 50; infectious diseases 49; adenylate-cyclase 48; bacillus-anthracis 45

Country
usa 246; france 33; germany 29; india 28; italy 21; england 11; south korea 10; canada 8; japan 6; switzerland 5

Institution
harvard univ 58; inst pasteur 30; niaid 22; nidr 18; univ padua 17; usa 16; nci 13; jawaharlal nehru univ 12; univ freiburg 11; us fda 10

CLUSTER 91 (LEVEL 3 – 121a1)

Biological Agent Threat/ Attack/ Detection (97 REC)
(97 Records)

Cluster Syntax Features

Descriptive Terms

biolog 9.7%, agent 8.8%, threat 6.8%, weapon 5.0%, attack 4.7%, bioterror 2.0%, biolog.weapon 1.8%, terror 1.5%, warfar 1.2%, terrorist 1.1%, smallpox 1.0%, biolog.agent 0.9%, biolog.warfar 0.9%, secur 0.9%, (46.95%)

Single Word Terms

agent 73, biolog 72, threat 50, anthrax 50, attack 41, potenti 36, bioterror 35, weapon 35, diseas 31, detect 28, anthraci 26, bacillu 26, warfar 24, system 23, terror 23

Double Word Terms

bacillu.anthraci 26, biolog.weapon 25, biolog.agent 24, biolog.warfar 19, yersinia.pesti 16, unit.state 14, public.health 13, threat.agent 12, weapon.mass 11, biolog.threat 11, mass.destruct 11, biolog.attack 10, agent.bioterror 9, terrorist.attack 9, agent.bacillu 8

Triple Word Terms

weapon.mass.destruct 11, biolog.threat.agent 8, agent.bacillu.anthraci 8, anthraci.yersinia.pesti 8, bacillu.anthraci.yersinia 8, autonom.pathogen.detect 4, pathogen.detect.system 4, threat.biolog.warfar 4, chemic.biolog.weapon 4, diseas.control.prevent 3, detect.system.apd 3, center.diseas.control 3, public.health.infrastructur 3, health.care.provid 3, biolog.chemic.weapon 3

Cluster Metrics

Authors

zilinskas, ra 3; mcbride, mt 3; makarewicz, aj 3; hindson, bj 3; henchal, ea 3; colston, bw 3; whitby, m 2; venkateswaran, ks 2; teska, jd 2; street, ac 2

Sources

proceedings of the national academy of sciences of the united states of america 4; emerging infectious diseases 4; biosecurity and bioterrorism-biodefense strategy practice and science 4; jama-journal of the american medical association 3; analytical chemistry 3; risk analysis 2; military medicine 2; medical journal of australia 2; journal of allergy and clinical immunology 2; infections in medicine 2

Keywords

anthrax 22; medicine, general & internal 17; bioterrorism 16; public-health management 14; outbreak 14; bacillus-anthracis 11; anthrax 9; bioterrorism 8; smallpox 8; plague 8

Country

usa 70; france 5; england 3; germany 2; canada 2; australia 2; south korea 1; saudi arabia 1; netherlands 1; india 1

Institution

usa 9; stanford univ 5; univ oklahoma 4; lawrence livermore natl lab 4; ctr dis control & prevent 4; us fda 3; univ pittsburgh 3; univ alabama 3; johns hopkins univ 3; yale univ 2

CLUSTER 103 (LEVEL 3 – 121a2)

Planning/ surveillance/ communication/ preparedness/ response for bioterrorist attacks (122 REC)

Cluster Syntax Features

Descriptive Terms

health 14.2%, public 8.5%, bioterror 6.6%, public.health 5.9%, attack 3.9%, inform 3.2%, commun 2.4%, prepared 1.7%, state 1.6%, emerg 1.3%, crisi 1.0%, care 1.0%, medic 1.0%, physician 1.0%, (54.04%)

Single Word Terms

anthrax 92, health 87, bioterror 74, public 71, attack 63, respons 46, inform 45, diseas 43, emerg 43, state 42, commun 39, respond 34, system 33, unit 31, care 31

Double Word Terms

public.health 54, unit.state 29, anthrax.attack 22, terrorist.attack 18, center.diseas 17, control.prevent 17, diseas.control 17, health.care 16, bioterror.attack 13, bioterrorist.attack 11, bacillu.anthraci 9, biolog.agent 9, attack.anthrax 8, health.commun 8, health.risk 7

Triple Word Terms

center.diseas.control 17, diseas.control.prevent 17, public.health.emerg 7, public.health.respons 6, viral.hemorrhag.fever 5, terrorist.attack.anthrax 5, public.health.medic 4, anthrax.unit.state 4, control.prevent.cdc 4, state.public.health 4, focu.group.conduct 3, primari.care.clinic 3, botul.viral.hemorrhag 3, public.health.prepared 3, health.care.system 3

Cluster Metrics

Authors

evans, rg 3; clements, b 3; wrigley, bj 2; wolfe, mi 2; wein, lm 2; wagner, mm 2; treadwell, ta 2; terndrup, t 2; tanielian, tl 2; szeto, h 2

Sources

emerging infectious diseases 15; journal of health communication 7; public health reports 5; biosecurity and bioterrorism-biodefense strategy practice and science 5; health affairs 3; american journal of public health 3; american journal of infection control 3; american journal of health-system pharmacy 3; academic emergency medicine 3; veterinary record 2

Keywords

public, environmental & occupational health 26; occupational health 26; public, environmental & 26; anthrax 19; infectious diseases 18; public-health management 16; immunology 16; bioterrorism 14; bioterrorism 13; medicine, general & internal 12

Country

usa 104; england 5; israel 3; italy 2; germany 2; australia 2; wales 1; new zealand 1; mexico 1; india 1

Institution

ctr dis control & prevent 15; harvard univ 7; univ pittsburgh 4; st louis univ 4; yale univ 3; univ utah 3; univ maryland 3; univ calif san francisco 3; univ alabama 3; stanford univ 3

CLUSTER 107 (LEVEL 3 – 121b1)

Evolution, transmission, and impact of infectious disease on animal populations(108 REC)

Cluster Syntax Features

Descriptive Terms

diseas 11.2%, nest 5.0%, anim 3.4%, epidem 1.9%, outbreak 1.8%, anthrax 1.7%, area 1.6%, control 1.5%, infecti 1.4%, infect 1.3%, veterinari 1.1%, bison 1.0%, park 1.0%, infecti.diseas 1.0%, (35.79%)

Single Word Terms

anthrax 97, diseas 67, anim 44, infect 39, health 31, control 30, area 27, human 26, number 26, outbreak 24, case 24, two 22, infecti 22, popul 22, epidem 21

Double Word Terms

infecti.diseas 16, public.health 15, bacillu.anthraci 9, anim.diseas 9, anthrax.outbreak 9, diseas.anthrax 9, outbreak.anthrax 7, foot.mouth 7, anthrax.spore 6, unit.state 6, mouth.diseas 6, diseas.prevent 6, west.nile 5, case.anthrax 5, caus.agent 5

Triple Word Terms

foot.mouth.diseas 6, acut.respiratori.syndrom 5, sever.acut.respiratori 5, respiratori.syndrom.sar 4, west.nile.viru 4, wood.buffalo.park 3, hot.wet.season 3, classic.swine.fever 3, bacillu.anthraci.caus 3, lake.manyara.park 3, bovin.spongiform.encephalopathi 3, two.case.anthrax 2, medic.public.health 2, caus.agent.anthrax 2, cutan.form.diseas 1

Cluster Metrics

Authors

turnbull, pcb 5; martins, rp 4; dragon, dc 4; elkin, bt 3; turner, aj 2; sournia, jc 2; rubira, rj 2; prins, hht 2; morens, dm 2; matthews, rw 2

Sources

revue scientifique et technique de l office international des epizooties 7; journal of applied microbiology 6; emerging infectious diseases 4; american journal of public health 4; journal of the kansas entomological society 3; onderstepoort journal of veterinary research 2; military medicine 2; medecine et maladies infectieuses 2; magyar allatorvosok lapja 2; journal of zoology 2

Keywords

veterinary sciences 29; anthrax 14; public, environmental & occupational health 13; occupational health 13; public, environmental & 13; entomology 9; anthrax 9; microbiology 9; zoology 8; biotechnology & applied microbiology 7

Country

usa 23; england 9; canada 7; germany 6; france 6; brazil 6; switzerland 4; russia 3; new zealand 3; netherlands 3

Institution

niaid 4; who 3; univ sao paulo 3; louisiana state univ 3; univ groningen 2; univ georgia 2; univ alberta hosp 2; publ hlth lab serv 2; minist hlth 2; govt nw terr 2

CLUSTER 101 (LEVEL 3 – 121b2)

Inhalation and cutaneous anthrax, and anthrax meningitis and meningoencephalitis (134 REC)

Cluster Syntax Features

Descriptive Terms

patient 12.7%, case 7.5%, cutan 4.0%, inhal 3.9%, inhal.anthrax 3.0%, anthrax 2.6%, cutan.anthrax 2.1%, diagnosi 1.5%, clinic 1.5%, infect 1.5%, diseas 1.5%, lesion 1.4%, skin 0.9%, ill 0.8%, (45.73%)

Single Word Terms

anthrax 122, case 85, patient 82, bacillu 67, anthraci 64, diseas 59, inhal 58, infect 57, cutan 49, clinic 48, diagnosi 37, bioterror 36, year 36, exposur 35, treatment 35

Double Word Terms

bacillu.anthraci 60, inhal.anthrax 52, cutan.anthrax 35, year.old 22, anthrax.case 21, unit.state 19, case.inhal 17, case.cutan 16, infecti.diseas 15, gram.posit 13, anthrax.rare 13, anthrax.patient 11, differenti.diagnosi 11, new.york 11, anthrax.spore 11

Triple Word Terms

case.inhal.anthrax 15, case.cutan.anthrax 12, new.york.citi 9, contact.infect.anim 8, inhal.anthrax.case 7, gram.posit.rod 6, diagnosi.inhal.anthrax 6, bacillu.anthraci.spore 6, cutan.anthrax.case 5, diseas.control.prevent 5, center.diseas.control 5, intens.care.unit 5, anthrax.infecti.diseas 5, bioterror.inhal.anthrax 5, cutan.inhal.anthrax 5

Cluster Metrics

Authors

quinn, cp 8; zaki, sr 7; perkins, ba 7; ashford, da 7; shieh, wj 6; popovic, t 6; jernigan, ja 6; hadler, jl 6; guarner, j 6; swerdlow, dl 5

Sources

emerging infectious diseases 19; clinical infectious diseases 10; jama-journal of the american medical association 5; presse medicale 3; archives of internal medicine 3; annals of plastic surgery 3; scandinavian journal of infectious diseases 2; lancet 2; laboratory investigation 2; journal of infectious diseases 2

Keywords

immunology 30; infectious diseases 30; medicine, general & internal 24; bacillus-anthracis 18; anthrax 18; bioterrorism 14; outbreak 13; microbiology 13; management 13; dermatology 12

Country

usa 78; turkey 19; germany 7; england 4; russia 3; france 3; switzerland 2; israel 2; india 2; wales 1

Institution

ctr dis control & prevent 23; numune hosp 5; us fda 4; emory univ 4; connecticut dept publ hlth 4; usa 3; univ wisconsin 3; nyu 3; nih 3; new york city dept hlth 3

CLUSTER 123 (LEVEL 3 – 125a1)

Vacinnation/ immunization and spore detection (498 REC)

Cluster Syntax Features

Descriptive Terms

spore 12.5%, vaccin 9.1%, immun 2.3%, detect 1.8%, protect 1.8%, antibodi 1.5%, anthrax.vaccin 1.4%, anthraci 1.2%, antigen 1.0%, sampl 0.9%, assai 0.8%, anthrax 0.8%, mice 0.8%, rpa 0.8%, (37.64%)

Single Word Terms

bacillu 335, anthraci 305, anthrax 293, spore 261, vaccin 205, protect 186, antigen 169, detect 154, cell 132, time 127, two 125, protein 123, immun 118, antibodi 118, strain 118

Double Word Terms

bacillu.anthraci 273, protect.antigen 136, anthrax.vaccin 108, anthraci.spore 96, anthrax.spore 48, lethal.factor 47, spore.bacillu 45, bacillu.subtili 40, vaccin.anthrax 37, immun.respons 37, guinea.pig 35, bacillu.cereu 34, bacteri.spore 33, protect.immun 33, anthrax.toxin 32

Triple Word Terms

bacillu.anthraci.spore 59, spore.bacillu.anthraci 23, anthraci.protect.antigen 22, anthrax.vaccin.adsorb 22, recombin.protect.antigen 21, protect.antigen.rpa 20, strain.bacillu.anthraci 18, vaccin.adsorb.ava 17, biolog.warfar.agent 17, bacillu.anthraci.protect 17, link.immunosorb.assai 16, enzym.link.immunosorb 16, protect.antigen.lethal 15, antigen.lethal.factor 15, factor.edema.factor 13

Cluster Metrics

Authors

mock, m 14; little, sf 14; ivins, be 14; friedlander, am 13; bhatnagar, r 11; williamson, ed 10; leppla, sh 9; fellows, pf 9; shafferman, a 8; pittman, pr 8

Sources

vaccine 46; infection and immunity 41; applied and environmental microbiology 24; journal of bacteriology 15; analytical chemistry 14; journal of applied microbiology 13; biochemical and biophysical research communications 11; proceedings of the national academy of sciences of the united states of america 10; letters in applied microbiology 10; emerging infectious diseases 10

Keywords

microbiology 79; immunology 78; infectious diseases 64; biotechnology & applied microbiology 62; immunology 57; medicine, research & experimental 54; bacillus-anthracis 52; toxin 52; anthrax 50; veterinary sciences 47

Country

usa 351; england 41; france 22; india 18; israel 16; germany 14; canada 11; japan 8; south korea 6; netherlands 6

Institution

usa 61; usn 22; ctr dis control & prevent 18; inst pasteur 15; israel inst biol res 14; univ maryland 12; harvard univ 12; jawaharlal nehru univ 11; univ texas 9; univ alabama 9

CLUSTER 122 (LEVEL 3 – 125a2)

Bacillus cereus/ anthracis strain identification (458 Records)

Cluster Syntax Features

Descriptive Terms

strain 6.7%, cereu 5.4%, gene 4.8%, sequenc 3.0%, isol 2.9%, anthraci 1.9%, thuringiensi 1.7%, plasmid 1.6%, speci 1.6%, pcr 1.6%, dna 1.4%, group 1.3%, genom 1.3%, bacillu 1.1%, (37.25%)

Single Word Terms

bacillu 381, anthraci 319, strain 263, gene 247, sequenc 213, two 194, cereu 166, isol 163, dna 148, protein 146, speci 132, on 131, cell 118, group 117, similar 115

Double Word Terms

bacillu.anthraci 283, bacillu.cereu 127, cereu.group 64, anthraci.strain 62, bacillu.thuringiensi 61, gram.posit 56, bacillu.subtili 51, escherichia.coli 49, amino.acid 46, cereu.thuringiensi 45, strain.bacillu 40, gene.encod 38, anthraci.isol 37, strain.cereu 36, cereu.bacillu 36

Triple Word Terms

bacillu.cereu.group 32, bacillu.cereu.bacillu 30, open.read.frame 27, gram.posit.bacteria 23, polymeras.chain.reaction 21, number.tandem.repeat 20, variabl.number.tandem 20, fragment.length.polymorph 18, bacillu.anthraci.strain 18, bacillu.anthraci.isol 17, 16.rrna.gene 17, amino.acid.sequenc 16, cereu.bacillu.thuringiensi 16, bacillu.anthraci.bacillu 16, strain.bacillu.anthraci 15

Cluster Metrics

Authors

mock, m 33; fouet, a 31; keim, p 28; koehler, tm 19; tang, wj 13; kolsto, ab 13; mesnage, s 12; patra, g 11; smith, kl 10; jackson, pj 10

Sources

journal of bacteriology 49; journal of clinical microbiology 35; applied and environmental microbiology 35; fems microbiology letters 25; journal of applied microbiology 24; molecular microbiology 15; infection and immunity 15; journal of biological chemistry 13; antimicrobial agents and chemotherapy 12; proceedings of the national academy of sciences of the united states of america 11

Keywords

microbiology 166; microbiology 116; biotechnology & applied microbiology 90; identification 90; biochemistry & molecular biology 74; anthracis 69; thuringiensis 64; escherichia-coli 62; bacillus-anthracis 61; cereus 53

Country

usa 210; france 64; england 32; japan 23; italy 21; germany 18; norway 17; canada 16; south korea 14; taiwan 9

Institution

inst pasteur 52; no arizona univ 28; univ texas 22; usa 18; univ chicago 17; univ oslo 13; univ milan 13; louisiana state univ 11; los alamos natl lab 10; inst genom res 10

CLUSTER 109 (LEVEL 3 – 125b1)

Binding of anthrax lethal toxin to host cell receptors (228 Records)

Cluster Syntax Features

Descriptive Terms

bind 5.4%, toxin 4.3%, cell 3.6%, protein 3.0%, receptor 2.4%, domain 2.4%, transloc 2.1%, membran 2.0%, pore 1.6%, factor 1.6%, residu 1.5%, anthrax.toxin 1.4%, cytosol 1.2%, channel 1.2%, (34.74%)

Single Word Terms

toxin 171, protein 171, cell 159, anthrax 157, bind 150, protect 148, antigen 146, factor 136, lethal 120, activ 113, form 99, two 94, membran 92, receptor 89, domain 88

Double Word Terms

protect.antigen 143, lethal.factor 114, anthrax.toxin 112, edema.factor 65, bacillu.anthraci 63, cell.surfac 50, amino.acid 39, mammalian.cell 34, compon.anthrax 33, proteolyt.activ 31, fusion.protein 30, factor.edema 29, anthrax.lethal 26, lethal.toxin 25, antigen.compon 23

Triple Word Terms

lethal.factor.edema 29, factor.edema.factor 29, compon.anthrax.toxin 27, protect.antigen.compon 23, toxin.protect.antigen 21, factor.lethal.factor 21, cell.surfac.receptor 20, edema.factor.lethal 20, anthrax.toxin.protect 19, cytosol.mammalian.cell 18, antigen.compon.anthrax 18, protect.antigen.lethal 17, antigen.lethal.factor 17, anthrax.lethal.toxin 16, chines.hamster.ovari 16

Cluster Metrics

Authors

collier, rj 49; leppla, sh 39; singh, y 17; klimpel, kr 13; barth, h 11; arora, n 11; lacy, db 10; aktories, k 10; mock, m 9; liu, sh 9

Sources

journal of biological chemistry 35; infection and immunity 24; proceedings of the national academy of sciences of the united states of america 21; biochemistry 14; biochemical and biophysical research communications 13; protein expression and purification 5; molecular microbiology 5; structure 4; nature biotechnology 4; nature 4

Keywords

biochemistry & molecular biology 110; lethal factor 55; mammalian-cells 42; protective antigen 39; adenylate-cyclase 37; crystal-structure 36; toxin 29; biophysics 29; receptor 28; macrophages 28

Country

usa 157; india 22; germany 21; france 18; italy 9; england 9; switzerland 5; canada 5; belgium 5; norway 3

Institution

harvard univ 50; nidr 17; inst pasteur 16; niaid 12; univ freiburg 11; ctr biochem technol 9; natl inst dent & craniofacial res 8; jawaharlal nehru univ 8; usa 7; univ wurzburg 7

CLUSTER 108 (LEVEL 3 – 125b2)

Lethal toxin inactivation of macrophages and protein kinase (134 Records)

Cluster Syntax Features

Descriptive Terms

macrophag 7.6%, kinas 5.8%, letx 4.8%, lethal 4.4%, toxin 4.0%, cell 3.3%, lethal.toxin 3.1%, activ 2.4%, induc 1.8%, factor 1.5%, inhibitor 1.4%, anthrax.lethal 1.3%, protein.kinas 1.2%, cytokin 1.1%, (44.67%)

Single Word Terms

toxin 105, lethal 105, anthrax 98, factor 95, cell 95, activ 92, bacillu 91, anthraci 89, protein 76, macrophag 76, induc 64, kinas 61, protect 51, inhibit 50, infect 48

Double Word Terms

bacillu.anthraci 89, lethal.toxin 83, lethal.factor 58, anthrax.lethal 55, mitogen.activ 46, activ.protein 45, protein.kinas 45, kinas.kinas 35, protect.antigen 34, cell.line 25, virul.factor 22, toxin.letx 21, macrophag.cell 20, anthraci.lethal 17, anthrax.toxin 17

Triple Word Terms

mitogen.activ.protein 44, anthrax.lethal.toxin 44, activ.protein.kinas 42, protein.kinas.kinas 27, lethal.toxin.letx 21, macrophag.cell.line 17, antigen.lethal.factor 16, protect.antigen.lethal 16, kinas.kinas.mapkk 14, anthraci.lethal.toxin 14, bacillu.anthraci.lethal 12, anthrax.lethal.factor 11, necrosi.factor.alpha 10, tumor.necrosi.factor 10, protein.kinas.mapk 9

Cluster Metrics

Authors

leppla, sh 14; montecucco, c 12; mock, m 12; duesbery, ns 9; moayeri, m 8; alibek, k 8; bhatnagar, r 7; vitale, g 5; karin, m 5; guidi-rontani, c 5

Sources

infection and immunity 25; biochemical and biophysical research communications 10; proceedings of the national academy of sciences of the united states of america 9; journal of immunology 6; journal of biological chemistry 6; cellular microbiology 6; journal of infectious diseases 4; molecular microbiology 3; febs letters 3; cell biology and toxicology 3

Keywords

immunology 35; biochemistry & molecular biology 33; macrophages 27; bacillus-anthracis 27; infectious diseases 25; bacillus-anthracis 23; toxin 21; protective antigen 21; lethal toxin 21; cells 21

Country

usa 89; france 15; italy 12; south korea 8; germany 8; india 6; taiwan 3; japan 3; canada 3; england 2

Institution

inst pasteur 14; univ padua 11; niaid 10; usa 9; van andel res inst 8; us fda 8; harvard univ 8; univ calif san diego 7; nci 7; george mason univ 6

LEVEL 3 FLAT TAXONOMY – EIGHT CATEGORIES

CATEGORY 1 – 121a1
CATEGORY 2 – 121a2
CATEGORY 3 – 121b1
CATEGORY 4 – 121b2
CATEGORY 5 – 125a1
CATEGORY 6 – 125a2
CATEGORY 7 – 125b1
CATEGORY 8 – 125b2

CLUSTERS UNDER EACH CATEGORY

CATEGORY 1 – 121a1

Biological Agent Threat/ Attack/ Detection (97 REC)

- Biological Agent Detection (31 Records)
- Biological Agent Threat (28 Records)
- Biological Agent Threat/ Attack (38 Records)

- CLUSTER 61
  Biological Agent Detection (31 Records)

Cluster Syntax Features

Descriptive Terms

agent 9.6%, biolog 3.0%, biolog.threat 2.9%, detect 2.8%, pesti 2.4%, yersinia 2.0%, threat 1.9%, threat.agent 1.8%, biolog.threat.agent 1.8%, bioterror 1.5%, system 1.4%, bioweapon 1.4%, sampl 1.4%, yersinia.pesti 1.3%, suicid 1.1%

Discriminating Terms

agent 5.0%, biolog.threat 2.4%, spore 2.1%, pesti 1.7%, yersinia 1.5%, biolog.threat.agent 1.5%, threat.agent 1.4%, strain 1.4%, cell 1.3%, protein 1.3%, bioweapon 1.1%, anthrax 1.0%, biolog 1.0%, suicid 0.9%, apd 0.9%

Single Word Terms

agent 27, detect 21, biolog 20, bacillu 18, anthraci 18, threat 13, yersinia 13, pesti 13, pathogen 12, time 12, system 12, sampl 11, current 10, diseas 10, two 10

Double Word Terms

bacillu.anthraci 18, yersinia.pesti 13, biolog.threat 9, threat.agent 8, biolog.agent 7, anthraci.yersinia 6, agent.bacillu 6, detect.system 5, fals.posit 4, francisella.tularensi 4, pathogen.detect 4, autonom.pathogen 4, biolog.warfar 4, agent.bioterror 4, human.diseas 3

Triple Word Terms

biolog.threat.agent 7, bacillu.anthraci.yersinia 6, agent.bacillu.anthraci 6, anthraci.yersinia.pesti 6, autonom.pathogen.detect 4, pathogen.detect.system 4, detect.system.apd 3, real.time.pcr 2, polymeras.chain.reaction 2, yersinia.pesti.bacillu 2, francisella.tularensi.yersinia 2, staphylococc.enterotoxin.seb 2, coloni.form.unit 2, clostridium.botulinum.toxin 2, venezuelan.equin.enceph 2

Term Cliques

40.00% detect pesti yersinia yersinia.pesti suicid
41.94% agent bioterror bioweapon
57.26% agent biolog detect bioweapon
48.39% agent biolog detect pesti yersinia threat biolog.threat.agent system sampl yersinia.pesti
45.88% agent biolog biolog.threat detect threat threat.agent biolog.threat.agent system sampl

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Sample Cluster Record Titles

Rapid viability assessment of biological threat agents

Principles for emergency response to bioterrorism

Detection of biological threat agents by immunomagnetic microsphere-based solid phase fluorogenic- and electro-chemiluminescence

Coccidioides immitis as a Select Agent of bioterrorism

Vaccines, biological warfare, and bioterrorism

Biological agents: Weapons of warfare and bioterrorism

Cluster Metrics

Authors

mcbride, mt 3; makarewicz, aj 3; hindson, bj 3; colston, bw 3; venkateswaran, ks 2; raoult, d 2; metz, tr 2; masquelier, d 2; kaplan, eh 2; gutierrez, dm 2

Sources

proceedings of the national academy of sciences of the united states of america 4; analytical chemistry 3; biosensors & bioelectronics 2; biosecurity and bioterrorism-biodefense strategy practice and science 2; waste management & research 1; primary care 1; molecular diagnosis 1; mayo clinic proceedings 1; lab animal 1; journal of molecular diagnostics 1

Keywords

dna 6; bacillus-anthracis 5; anthrax 5; multidisciplinary sciences 4; chemistry, analytical 4; identification 4; environmental sciences 4; public, environmental & occupational health 3; occupational health 3; anthrax 3

Country

usa 25; france 3; germany 1; finland 1; england 1; canada 1

Institution

usa 5; lawrence livermore natl lab 4; us fda 3; yale univ 2; walter reed army inst res 2; ctr dis control & prevent 2; xavier univ 1; wellcome trust sanger inst 1; veridian engn 1; usn 1

- # CLUSTER 21
  Biological Agent Threat (28 Records)

Cluster Syntax Features

Descriptive Terms
weapon 21.0%, biolog 11.2%, biolog.weapon 7.2%, threat 3.0%, terror 2.6%, weapon.mass 2.0%, agent 1.8%, weapon.mass.destruct 1.7%, mass.destruct 1.7%, chemic 1.6%, destruct 1.6%, warfar 1.2%, secur 1.0%, biolog.warfar 1.0%, mass 0.8%

Discriminating Terms
weapon 13.3%, biolog 5.3%, biolog.weapon 4.6%, spore 1.6%, terror 1.4%, weapon.mass 1.3%, threat 1.2%, weapon.mass.destruct 1.1%, strain 1.1%, mass.destruct 1.1%, cell 1.1%, protein 1.0%, vaccin 1.0%, destruct 1.0%, anthraci 0.8%

Single Word Terms
weapon 27, biolog 27, anthrax 18, agent 17, threat 14, terror 13, potenti 13, mass 12, attack 11, destruct 11, diseas 10, chemic 9, medic 9, unit 9, warfar 9

Double Word Terms
biolog.weapon 20, weapon.mass 11, mass.destruct 11, unit.state 7, biolog.warfar 7, chemic.weapon 7, public.health 6, biolog.agent 5, bacillu.anthraci 4, chemic.biolog 4, weapon.threat 4, infecti.diseas 4, biolog.chemic 4, weapon.convent 4, agent.weapon 4

Triple Word Terms
weapon.mass.destruct 11, chemic.biolog.weapon 4, biolog.weapon.convent 3, biolog.weapon.threat 3, biolog.chemic.weapon 3, anthrax.biolog.weapon 2, biolog.weapon.smallpox 2, agent.bacillu.anthraci 2, threat.pose.biolog 2, biolog.weapon.mass 2, bacillu.anthraci.yersinia 2, anthraci.yersinia.pesti 2, public.health.system 1, unit.state.medic 1, medic.infecti.diseas 1

Term Cliques
67.86% weapon biolog terror chemic
66.43% weapon biolog terror agent warfar
50.97% weapon biolog threat weapon.mass agent weapon.mass.destruct mass.destruct destruct warfar biolog.warfar mass
65.00% weapon biolog biolog.weapon terror secur
74.29% weapon biolog biolog.weapon terror agent
75.00% weapon biolog biolog.weapon threat agent

Sample Cluster Record Titles

The new threat of mass destruction

Anthrax as a biological weapon - Medical and public health management

The threat of bioterrorism: A reason to learn more about anthrax and smallpox

The poison center role in biological and chemical terrorism

Hospital preparedness for victims of chemical or biological terrorism

Bioterrorism: A threat for which we are ill prepared

Current laboratory methods for biological threat agent identification

Rethinking bioterrorism

Cluster Metrics

Authors

zilinskas, ra 2; henchal, ea 2; bronze, ms 2; binder, p 2; wilhelmsen, c 1; white, l 1; whitby, m 1; wetter, dc 1; voskuhl, gw 1; vidal, d 1

Sources

jama-journal of the american medical association 3; foreign affairs 2; american journal of the medical sciences 2; veterinary and human toxicology 1; third world quarterly 1; science and engineering ethics 1; osiris 1; national medical journal of india 1; minerva 1; medical journal of australia 1

Keywords

medicine, general & internal 8; outbreak 8; public-health management 7; anthrax 7; bioterrorism 6; international relations 4; biological weapon 4; yersinia-pestis 3; future 3; contamination 3

Country

usa 16; france 2; south korea 1; india 1; germany 1; england 1; australia 1

Institution

usa 3; univ oklahoma 2; washington state univ 1; us dept hhs 1; univ washington 1; univ pittsburgh 1; univ med & dent new jersey 1; univ florida 1; univ exeter 1; univ alabama 1

- # CLUSTER 60
  Biological Agent Threat/ Attack (38 Records)

Cluster Syntax Features

Descriptive Terms
attack 10.2%, threat 8.4%, agent 6.9%, biolog 4.4%, terrorist 2.4%, bioterror 1.9%, smallpox 1.8%, awar 1.6%, scenario 1.3%, physician 1.2%, biolog.agent 1.2%, releas 0.9%, plagu 0.9%, warfar 0.9%, potenti 0.9%

Discriminating Terms
attack 5.6%, threat 5.1%, agent 3.0%, biolog 1.7%, terrorist 1.4%, spore 1.4%, cell 1.3%, strain 1.2%, protein 1.1%, awar 1.1%, smallpox 1.0%, anthraci 1.0%, scenario 0.9%, gene 0.9%, cereu 0.8%

Single Word Terms
agent 29, anthrax 27, biolog 25, threat 23, attack 22, bioterror 18, potenti 14, releas 13, terrorist 12, diseas 11, state 10, treatment 10, warfar 10, articl 9, respons 9

Double Word Terms
biolog.agent 12, biolog.warfar 8, unit.state 7, biolog.attack 7, terrorist.attack 6, intent.releas 6, public.health 5, bacillu.anthraci 4, diseas.physician 4, threat.bioterror 4, biolog.weapon 4, smallpox.anthrax 4, bioterrorist.attack 4, agent.smallpox 4, anthrax.attack 4

Triple Word Terms
threat.biolog.warfar 3, agent.smallpox.anthrax 3, public.health.infrastructur 2, health.care.provid 2, letter.anthrax.spore 2, attack.unit.state 2, releas.biolog.agent 2, death.inhal.anthrax 1, anthrax.plagu.tularemia 1, biolog.agent.anthrax 1, emerg.medic.servic 1, medic.servic.em 1, concentr.anthrax.spore 1, state.postal.system 1, unit.state.postal 1

Term Cliques
42.43% agent biolog bioterror smallpox biolog.agent releas plagu potenti
43.86% agent biolog terrorist awar releas potenti
42.86% agent biolog terrorist smallpox biolog.agent releas potenti
47.37% threat agent biolog physician releas warfar
46.93% threat agent biolog awar releas warfar
48.12% threat agent biolog bioterror physician biolog.agent releas
45.86% threat agent biolog bioterror scenario physician releas
48.50% threat agent biolog bioterror awar releas potenti
45.49% threat agent biolog bioterror awar scenario releas
47.04% threat agent biolog bioterror smallpox biolog.agent releas potenti
43.61% attack agent biolog physician releas plagu warfar
46.71% attack agent biolog bioterror biolog.agent releas plagu potenti
44.74% attack agent biolog bioterror physician biolog.agent releas plagu
45.49% attack agent biolog bioterror scenario physician releas
47.74% attack agent biolog terrorist biolog.agent releas potenti

Sample Cluster Record Titles

Bioterrorism as a public health threat

Biologic weapons: What infectious disease practitioners need to know

Anthrax threats: A report of two incidents from Salt Lake City

Biological terrorism: Understanding the threat, preparation, and medical response

Immunization against potential biological warfare agents

Bioterrorism preparedness: What practitioners need to know

Bioterrorism: Relevance to allergy and immunology in clinical practice

Biological agents as weapons 1: smallpox and botulism

Cluster Metrics

Authors

relman, da 2; olson, je 2; franz, dr 2; zilinskas, ra 1; zajtchuk 1; zaitchuk, r 1; wiener, sl 1; whitley, rj 1; whitby, m 1; werchniak, ae 1

Sources

emerging infectious diseases 3; risk analysis 2; military medicine 2; journal of allergy and clinical immunology 2; infections in medicine 2; dm disease-a-month 2; tijdschrift voor diergeneeskunde 1; social work 1; postgraduate medicine 1; neurologic clinics 1

Keywords

anthrax 10; bioterrorism 9; medicine, general & internal 7; public-health management 6; immunology 5; smallpox 5; outbreak 5; infectious diseases 5; infectious diseases 4; bioterrorism 4

Country

usa 29; saudi arabia 1; netherlands 1; england 1; canada 1; byelarus 1; australia 1

Institution

stanford univ 3; univ oklahoma 2; univ alabama 2; oregon dept environm qual 2; johns hopkins univ 2; yeshiva univ albert einstein coll med 1; wilford hall usaf med ctr 1; usn 1; usa 1; univ washington 1

CATEGORY 2 – 121a2

Planning/ surveillance/ communication/ preparedness/ response for bioterrorist attacks (122 REC)

- Bioterrorism surveillance and Web-based informatics (25 Records)
- Bioterrorist attack preparedness/ response (42 Records)
- Public communication of bioterrorism-related health information (19 Records)
- Public health planning/ response to terrorism (36 Records)

- CLUSTER 47
  Bioterrorism surveillance and Web-based informatics (25 Records)

Cluster Syntax Features

Descriptive Terms
surveil 9.6%, web 8.3%, bioterror 6.8%, inform 6.6%, diseas 2.1%, detect 1.9%, updat 1.8%, system 1.8%, emerg 1.8%, medic 1.7%, syndrom 1.4%, syndrom.surveil 1.2%, web.site 1.1%, articl 1.1%, page 0.9%

Discriminating Terms
surveil 6.2%, web 6.0%, inform 3.4%, bioterror 2.9%, spore 1.8%, updat 1.3%, strain 1.2%, cell 1.2%, vaccin 1.1%, protein 1.1%, toxin 1.0%, anthraci 1.0%, syndrom.surveil 0.9%, gene 0.9%, web.site 0.8%

Single Word Terms
bioterror 20, anthrax 14, inform 14, emerg 12, system 12, diseas 12, detect 10, agent 10, new 9, surveil 9, health 9, case 9, first 8, time 8, web 8

Double Word Terms
web.site 6, unit.state 5, syndrom.surveil 5, surveil.system 4, health.care 3, inform.emerg 3, wide.web 3, biolog.agent 3, diseas.control 3, viral.hemorrhag 3, control.prevent 3, bioterror.web 3, world.wide 3, hemorrhag.fever 3, tularemia.viral 3

Triple Word Terms
center.diseas.control 3, diseas.control.prevent 3, world.wide.web 3, viral.hemorrhag.fever 2, public.health.depart 1, anthrax.unit.state 1, earli.detect.bioterror 1, botul.viral.hemorrhag 1, diseas.public.health 1, public.health.medic 1, anthrax.plagu.tularemia 1, health.care.profession 1, agent.unit.state 1, primari.care.clinic 1, releas.biolog.agent 1

Term Cliques
46.67% bioterror detect articl
43.20% bioterror inform updat emerg articl
44.67% bioterror inform diseas updat emerg web.site
29.00% web inform web.site page
48.00% web bioterror inform emerg medic
42.00% web bioterror inform updat emerg web.site
45.00% surveil bioterror detect medic
42.86% surveil bioterror diseas detect system syndrom syndrom.surveil

48.80% surveil bioterror inform emerg medic
53.60% surveil bioterror inform diseas emerg

Sample Cluster Record Titles

The A, B, C, of anthrax for health care personnel.

Diagnosis and management of suspected cases of bioterrorism: A pediatric perspective

The space race and biodefense: Lessons from NASA about big science and the role of medical informatics

Bioterrorism and biodefence

Future challenges in preparing for and responding to bioterrorism events

Syndromic analysis of computerized emergency department patients' chief complaints: An opportunity for bioterrorism and influenza surveillance

Endemic, notifiable bioterrorism-related diseases, United States, 1992-1999

Bioterrorism Web site resources for infectious disease clinicians and epidemiologists

Cluster Metrics

Authors
platt, r 2; kleinman, k 2; yoon, ss 1; yen, g 1; wu, z 1; wolfe, mi 1; weissman, n 1; wagner, mm 1; valdespino-gomez, jl 1; trigg, lj 1

Sources
emerging infectious diseases 6; academic emergency medicine 3; scientometrics 1; salud publica de mexico 1; risk analysis 1; presse medicale 1; pediatrics 1; journal of urban health-bulletin of the new york academy of medicine 1; journal of the american society for information science and technology 1; journal of the american medical informatics association 1

Keywords
public-health management 7; immunology 7; infectious diseases 7; smallpox 6; bioterrorism 6; emergency medicine 5; biological weapon 5; anthrax 5; inhalational anthrax 4; bioterrorism 3

Country
usa 21; australia 2; mexico 1; israel 1; germany 1; france 1; england 1

Institution
ctr dis control & prevent 4; harvard univ 3; usa 2; univ calif san francisco 2; univ alabama 2; kaiser permanente 2; healthpartners res fdn 2; wayne state univ 1; va palo alto healthcare syst 1; univ washington 1

- # CLUSTER 49
  Bioterrorist attack preparedness/ response (42 Records)

Cluster Syntax Features

Descriptive Terms
attack 10.4%, bioterror 6.0%, prepared 3.5%, health 3.5%, train 3.2%, care 3.1%, crisi 2.7%, physician 2.4%, hospit 2.2%, terrorist 1.7%, respond 1.5%, survei 1.3%, emerg 1.3%, medic 1.3%, commun 1.2%

Discriminating Terms
attack 5.6%, bioterror 2.6%, prepared 2.3%, train 2.1%, care 1.8%, crisi 1.8%, spore 1.6%, physician 1.3%, strain 1.2%, cell 1.2%, hospit 1.2%, vaccin 1.2%, protein 1.1%, toxin 1.1%, anthraci 1.0%

Single Word Terms
anthrax 36, attack 32, bioterror 25, health 25, state 21, respons 20, care 19, terrorist 18, emerg 18, unit 17, commun 16, respond 16, medic 16, public 15, prepared 15

Double Word Terms
unit.state 16, terrorist.attack 13, anthrax.attack 11, bioterror.attack 9, public.health 9, health.care 9, bioterrorist.attack 7, diseas.control 6, attack.anthrax 6, center.diseas 6, control.prevent 6, bioterror.prepared 6, biolog.agent 5, primari.care 5, emerg.respons 4

Triple Word Terms
diseas.control.prevent 6, center.diseas.control 6, terrorist.attack.anthrax 3, bioterror.unit.state 2, anthrax.unit.state 2, health.care.personnel 2, anthrax.bioterror.attack 2, attack.unit.state 2, risk.anthrax.exposur 2, world.trade.center 2, health.care.worker 2, health.center.diseas 2, weapon.mass.destruct 2, emerg.medic.servic 2, public.health.respons 2

Term Cliques
28.57% crisi terrorist survei commun
33.33% prepared train care physician respond survei commun
38.89% prepared health train care physician respond emerg medic commun
35.37% bioterror prepared train physician respond survei commun
40.48% bioterror prepared health train physician respond emerg medic commun
42.86% attack prepared care terrorist respond survei commun
41.16% attack prepared train care respond survei commun
47.32% attack prepared health care terrorist respond emerg commun
44.97% attack prepared health train care respond emerg medic commun
43.92% attack prepared health train care hospit emerg medic commun
43.20% attack bioterror prepared train respond survei commun
46.56% attack bioterror prepared health train respond emerg medic commun

Sample Cluster Record Titles

Citywide pharmaceutical preparation for bioterrorism

See this goop? It kills anthrax

Early statistical detection of anthrax outbreaks by tracking over-the-counter medication sales

Responding to chemical, biological, or nuclear terrorism: The indirect and long-term health effects may present the greatest challenge

A perspective: Risk analysis as a tool for reducing the risks of terrorism

On the front lines: Family physicians. preparedness for bioterrorism

Bioterrorism-related anthrax: International response by the Centers for Disease Control and Prevention

Call-tracking data and the public health response to bioterrorism-related anthrax

Cluster Metrics

Authors

wrigley, bj 2; wein, lm 2; shadel, bn 2; salmon, ct 2; rebmann, t 2; park, hs 2; kaplan, eh 2; evans, rg 2; craft, dl 2; clements, b 2

Sources

emerging infectious diseases 5; american journal of health-system pharmacy 3; public relations review 2; proceedings of the national academy of sciences of the united states of america 2; american journal of infection control 2; veterinary clinics of north america-food animal practice 1; veterinary and human toxicology 1; risk analysis 1; public health reports 1; psychological reports 1

Keywords

public, environmental & occupational health 8; occupational health 8; public, environmental & 8; bioterrorism 6; infectious diseases 6; anthrax 6; public-health management 5; medicine, general & internal 5; immunology 5; management 4

Country

usa 35; israel 2; new zealand 1; germany 1; england 1

Institution

ctr dis control & prevent 5; yale univ 2; univ utah 2; stanford univ 2; st louis univ 2; michigan state univ 2; wisconsin div publ hlth 1; washington state univ 1; warfighting concepts & architecture integrat div 1; victoria univ wellington 1

- # CLUSTER 13
  Public communication of bioterrorism-related health information (19 Records)

Cluster Syntax Features

Descriptive Terms
commun 11.5%, health 9.2%, inform 8.7%, public 7.8%, cdc 4.8%, public.health 3.4%, messag 2.0%, risk 2.0%, internet 2.0%, focu.group 1.8%, crisi 1.8%, focu 1.5%, sourc 1.1%, attack 1.1%, survei 1.1%

Discriminating Terms
commun 6.5%, inform 4.3%, health 3.5%, public 3.5%, cdc 3.0%, spore 1.6%, public.health 1.3%, messag 1.3%, internet 1.3%, vaccin 1.2%, focu.group 1.2%, strain 1.1%, cell 1.1%, protein 1.0%, crisi 1.0%

Single Word Terms
health 18, anthrax 16, public 15, commun 14, inform 13, attack 13, risk 10, respons 10, new 9, media 8, crisi 8, sourc 8, conduct 7, bioterror 6, focu 6

Double Word Terms
public.health 11, anthrax.attack 7, focu.group 5, terrorist.attack 4, new.media 4, risk.commun 4, sourc.inform 3, health.care 3, group.conduct 3, health.commun 3, diseas.control 3, control.prevent 3, center.diseas 3, health.crisi 3, prevent.cdc 2

Triple Word Terms
focu.group.conduct 3, diseas.control.prevent 3, center.diseas.control 3, public.health.commun 2, health.care.system 2, control.prevent.cdc 2, public.health.emerg 2, anthraci.caus.agent 1, sever.acut.respiratori 1, bacillu.anthraci.caus 1, public.health.infrastructur 1, caus.agent.anthrax 1, bioterrorist.anthrax.attack 1, world.trade.center 1, person.expos.anthrax 1

Term Cliques
47.37% public risk internet focu.group sourc attack
42.98% public messag internet focu.group sourc attack
47.37% public cdc messag sourc attack
57.89% health inform public risk crisi sourc attack survei
54.61% health inform public risk internet sourc attack survei
59.40% health inform public cdc crisi sourc attack
44.74% commun risk internet focu.group focu attack
40.35% commun messag internet focu.group focu attack
52.63% commun public risk internet focu.group attack
48.25% commun public messag internet focu.group attack
54.39% commun public cdc public.health messag attack
58.55% commun health inform public risk internet attack survei
61.40% commun health inform public public.health risk crisi attack survei
63.16% commun health inform public cdc public.health crisi attack

Sample Cluster Record Titles

Dealing with the dangers of fear: The role of risk communication

The biosecurity trust

Uncertain science and certain deadlines: CDC responses to the media during the anthrax attacks of 2001

Communication monitoring: Shaping CDC's emergency risk communication efforts

Communicating anthrax in 2001: A comparison of CDC information and print media accounts

Using opinion surveys to track the public's response to a bioterrorist attack

Public perceptions of information sources concerning bioterrorism before and after anthrax attacks: An analysis of national survey data

September 11 and the history of hazard

Communicating health information to an alarmed public facing a threat such as a bioterrorist attack

Theoretical perspectives on public communication preparedness for terrorist attacks

The Internet as a vehicle to communicate health information during a public health emergency: A survey analysis involving the anthrax scare of 2001

Cluster Metrics

Authors

tanielian, tl 2; stein, bd 2; hobbs, j 2; blanchard, jc 2; bates, dw 2; young, sd 1; wray, rj 1; wray, r 1; winett, lb 1; westerhaus, et 1

Sources

journal of health communication 6; biosecurity and bioterrorism-biodefense strategy practice and science 4; journal of the history of medicine and allied sciences 1; journal of nervous and mental disease 1; journal of medical internet research 1; health affairs 1; harvard international journal of press-politics 1; family & community health 1; epidemiology and infection 1; bioscience 1

Keywords

communication 8; public, environmental & occupational health 7; occupational health 7; public, environmental & 7; information science & library science 6; anthrax 5; international relations 4; health care sciences & services 3; bioterrorism 3; public health 3

Country

usa 18; england 1

Institution

ctr dis control & prevent 3; st louis univ 2; rand corp 2; harvard univ 2; brigham & womens hosp 2; washington univ 1; univ pittsburgh 1; univ oklahoma 1; univ n carolina 1; univ maryland 1

- # CLUSTER 24
  Public health planning/ response to terrorism (36 Records)

Cluster Syntax Features

Descriptive Terms
health 25.6%, public 18.5%, public.health 17.5%, bioterror 4.0%, state 2.6%, outbreak 0.8%, prepared 0.8%, forens 0.6%, respons 0.6%, law 0.5%, commun 0.4%, diseas 0.4%, model 0.4%, attack 0.3%, prevent 0.3%

Discriminating Terms
health 14.3%, public 10.9%, public.health 10.9%, bioterror 1.4%, protein 1.1%, state 1.1%, strain 1.1%, spore 1.1%, toxin 1.0%, cell 1.0%, vaccin 0.9%, gene 0.8%, anthraci 0.7%, cereu 0.7%, bind 0.5%

Single Word Terms
health 35, public 35, anthrax 26, bioterror 23, diseas 14, state 14, respons 13, attack 12, control 9, prepared 9, commun 9, prevent 8, releas 8, popul 8, agent 8

Double Word Terms
public.health 32, bacillu.anthraci 6, unit.state 6, state.local 6, center.diseas 5, respons.bioterror 5, diseas.control 5, control.prevent 5, health.emerg 4, health.risk 4, health.protect 3, health.respons 3, health.offici 3, anthraci.spore 3, intent.releas 3

Triple Word Terms
diseas.control.prevent 5, center.diseas.control 5, public.health.emerg 4, public.health.offici 3, public.health.protect 3, public.health.respons 3, state.public.health 3, public.health.infrastructur 2, public.health.medic 2, bacillu.anthraci.spore 2, public.health.law 2, public.health.prepared 2, public.health.risk 2, viral.hemorrhag.fever 2, whole.genom.sequenc 1

Term Cliques
55.16% health public public.health forens respons diseas prevent
47.84% health public public.health outbreak respons law commun diseas prevent
43.06% health public public.health outbreak prepared respons law commun model prevent
55.16% health public public.health state forens respons prevent
44.19% health public public.health state prepared respons law commun model attack prevent
65.28% health public public.health bioterror forens diseas
54.51% health public public.health bioterror outbreak law commun diseas
48.46% health public public.health bioterror outbreak prepared law commun model
65.28% health public public.health bioterror state forens
49.17% health public public.health bioterror state prepared law commun model attack

Sample Cluster Record Titles

The public science of Louis pasteur: The experiment on anthrax vaccine in the popular press of the time

The Department of Defense Birth Defects Registry: Overview of a new surveillance system

The case for more active policy attention to health promotion

After September 11: Rethinking public health federalism

Perceptions of state public health officers and state veterinarians regarding risks of bioterrorism in the United States

Confronting bioterrorism: Physicians on the front line

The Model State Emergency Health Powers Act - Planning for and response to bioterrorism and naturally occurring infectious diseases

Coordinated response to reports of possible anthrax contamination, Idaho, 2001

Collaboration between public health and law enforcement: New paradigms and partnerships for bioterrorism planning and response

Epidemiologic response to anthrax outbreaks: Field investigations, 1950-2001

Public health and national security: The critical role of increased federal support

Emergency response planning for anthrax outhreaks in bison herds of northern Canada - A balance between policy and science

Cluster Metrics

Authors

ashford, da 2; zarcadoolas, c 1; williams-russo, p 1; williams, dr 1; whitney, eas 1; wesley, gc 1; weir, s 1; watz, cg 1; wagner, mm 1; vincent, rl 1

Sources

public health reports 4; emerging infectious diseases 4; veterinary record 2; jama-journal of the american medical association 2; health affairs 2; teratology 1; public health nursing 1; medical decision making 1; mayo clinic proceedings 1; journal of the american veterinary medical association 1

Keywords

public, environmental & occupational health 9; occupational health 9; public, environmental & 9; medicine, general & internal 5; public-health management 4; immunology 4; health care sciences & services 4; preparedness 4; infectious diseases 4; health policy & services 4

Country

usa 30; italy 2; england 2; wales 1; india 1; canada 1

Institution

ctr dis control & prevent 3; cdcp 3; mt sinai sch med 2; johns hopkins univ 2; yale univ 1; utah dept hlth 1; usn 1; univ utah 1; univ trent 1; univ pittsburgh 1

CATEGORY 3 – 121b1

Evolution, transmission, and impact of infectious disease on animal populations (108 REC)

- Infectious diseases, emphasizing epidemics and zoonoses (33 Records)
- Animal-based infectious disease outbreaks (39 Records)
- Infectious disease ecological impacts on wild animal populations (19 Records)
- Nesting biology of insects and their anthrax parasitism (17 Records)

- CLUSTER 56
  Infectious diseases, emphasizing epidemics and zoonoses (33 Records)

Cluster Syntax Features

Descriptive Terms

diseas 12.6%, infecti 4.7%, infecti.diseas 3.7%, epidem 2.3%, control 2.2%, zoonos 2.0%, health 2.0%, world 1.6%, emerg 1.4%, peopl 1.3%, veterinari 1.1%, centuri 1.1%, public 1.0%, prevent 1.0%, epidemiolog 1.0%

Discriminating Terms

diseas 5.6%, infecti 2.7%, infecti.diseas 2.3%, spore 1.6%, zoonos 1.4%, epidem 1.3%, strain 1.2%, cell 1.2%, protein 1.1%, toxin 1.1%, anthraci 1.0%, world 0.9%, vaccin 0.9%, gene 0.9%, control 0.8%

Single Word Terms

anthrax 28, diseas 24, health 18, public 16, infecti 15, control 14, treatment 10, prevent 10, world 10, anim 10, bioterror 9, infect 9, emerg 9, potenti 9, agent 9

Double Word Terms

public.health 12, infecti.diseas 12, acut.respiratori 5, diseas.anthrax 5, diseas.prevent 5, respiratori.syndrom 5, west.nile 5, sever.acut 5, anim.diseas 4, control.zoonos 4, nile.viru 4, syndrom.sar 4, prevent.control 3, yellow.fever 3, bioterrorist.attack 3

Triple Word Terms

sever.acut.respiratori 5, acut.respiratori.syndrom 5, west.nile.viru 4, respiratori.syndrom.sar 4, foot.mouth.diseas 2, emerg.infecti.diseas 1, public.health.profession 1, focu.group.conduct 1, potenti.biolog.weapon 1, lake.manyara.park 1, medic.public.health 1, attack.unit.state 1, nucleic.acid.sequenc 1, case.fatal.rate 1, center.diseas.control 1

Term Cliques

31.31% control peopl prevent
28.28% control peopl veterinari
33.84% control zoonos health veterinari public epidemiolog
31.82% control zoonos health emerg prevent epidemiolog
34.85% control zoonos health emerg public epidemiolog
40.40% infecti emerg public

34.09% diseas zoonos veterinari centuri
37.88% diseas zoonos world prevent
36.36% diseas zoonos world centuri
36.97% diseas zoonos health veterinari epidemiolog
36.87% diseas zoonos health emerg prevent epidemiolog
32.73% diseas epidem peopl veterinari centuri
37.88% diseas epidem world centuri
38.18% diseas epidem health veterinari epidemiolog
42.42% diseas infecti.diseas world prevent
39.90% diseas infecti.diseas health emerg prevent epidemiolog
38.64% diseas infecti.diseas epidem peopl
40.91% diseas infecti.diseas epidem world
38.89% diseas infecti.diseas epidem health emerg epidemiolog
41.21% diseas infecti infecti.diseas peopl prevent
42.42% diseas infecti infecti.diseas emerg prevent

Sample Cluster Record Titles

World Health Organization activities on anthrax surveillance and control

A brief historical overview of zoonoses

Prevalence and control of zoonotic diseases: collaboration between public health workers and veterinarians in Burkina Faso

Control of zoonoses in Cyprus

Medical plans for taking charge of bioterrorism

Epidemic anthrax in the eighteenth century, the Americas

Sacer ignis, quam pustulam vocant pastores: Anthrax - cultural historical traces of a zoonose

Bioterrorism: Points for physicians to be aware of

The epidemiologic pyramid of bioterrorism

Scientific triumphalism and learning from facts: Bacteriology and the 'Spanish flu' challenge of 1918

Characterizing a "New" disease: Epizootic and epidemic anthrax, 1769-1780

Control and prevention of emerging zoonoses

Cluster Metrics

Authors

turnbull, pcb 2; morens, dm 2; fauci, as 2; yameogo, kr 1; wolde-yohannes, l 1; westerhaus, et 1; walton, c 1; vythilingam, m 1; tuchili, lm 1; treadwell, ta 1

Sources

american journal of public health 4; revue scientifique et technique de l office international des epizooties 3; military medicine 2; emerging infectious diseases 2; bulletin of the world health organization 2; social

studies of science 1; social history of medicine 1; schweizer archiv fur tierheilkunde 1; revista panamericana de salud publica-pan american journal of public health 1; occupational medicine-oxford 1

Keywords

public, environmental & occupational health 8; occupational health 8; public, environmental & 8; anthrax 7; veterinary sciences 6; bioterrorism 4; smallpox 4; medicine, general & internal 3; history & philosophy of science 3; zoonoses 3

Country

usa 13; switzerland 4; england 3; norway 2; france 2; sweden 1; italy 1; israel 1; ethiopia 1; cyprus 1

Institution

niaid 4; who 2; ctr dis control & prevent 2; agr univ norway 2; washington univ 1; usaf 1; us ctr dis control & prevent 1; univ sassari 1; univ oklahoma 1; univ med & dent new jersey 1

- # CLUSTER 63
  Animal-based infectious disease outbreaks (39 Records)

Cluster Syntax Features

Descriptive Terms
diseas 10.7%, anim 7.7%, outbreak 3.3%, cattl 3.0%, infect 2.7%, farm 2.6%, feed 2.1%, meat 1.7%, veterinari 1.6%, anthrax 1.5%, area 1.4%, control 1.1%, case 1.1%, countri 1.0%, epidem 1.0%

Discriminating Terms
diseas 4.6%, anim 3.8%, cattl 2.1%, farm 1.9%, outbreak 1.6%, feed 1.5%, strain 1.2%, cell 1.2%, protein 1.2%, meat 1.2%, spore 1.1%, veterinari 1.0%, gene 0.9%, toxin 0.9%, anthraci 0.8%

Single Word Terms
anthrax 37, diseas 31, anim 27, infect 24, human 15, vaccin 14, case 14, outbreak 13, cattl 13, epidemiolog 13, control 13, health 11, area 11, farm 10, veterinari 10

Double Word Terms
anthrax.outbreak 6, bacillu.anthraci 6, spongiform.encephalopathi 5, anim.diseas 5, anthrax.vaccin 4, control.measur 4, clinic.sign 4, outbreak.anthrax 4, foot.mouth 4, sick.anim 3, public.health 3, diseas.spite 3, bovin.tuberculosi 3, anim.feed 3, infect.anim 3

Triple Word Terms
foot.mouth.diseas 3, bovin.spongiform.encephalopathi 3, classic.swine.fever 3, bacillu.anthraci.caus 2, two.case.anthrax 2, form.bacterium.bacillu 1, anim.human.anthrax 1, anthraci.bacillu.speci 1, immun.anthrax.vaccin 1, anthrax.bacillu.anthraci 1, antigen.lethal.factor 1, caus.agent.anthrax 1, medic.public.health 1, protect.antigen.lethal 1, lethal.factor.oedema 1

Term Cliques
38.89% outbreak meat anthrax area case countri
44.44% outbreak infect meat anthrax case countri
43.59% anim outbreak meat veterinari anthrax area case
33.33% anim outbreak feed meat area case
45.79% anim outbreak farm anthrax area control case
34.43% anim outbreak farm feed area control case
52.14% anim outbreak infect meat anthrax case
38.89% anim outbreak infect feed meat case
50.55% anim outbreak infect farm anthrax control case
39.19% anim outbreak infect farm feed control case
43.22% anim outbreak cattl meat veterinari anthrax area
45.42% anim outbreak cattl farm anthrax area control
52.14% diseas infect anthrax control countri epidem
46.89% diseas outbreak anthrax area control case countri
51.65% diseas outbreak infect anthrax control case countri
50.00% diseas anim outbreak veterinari anthrax area control case
42.12% diseas anim outbreak feed area control case
58.24% diseas anim outbreak infect anthrax control case
46.89% diseas anim outbreak infect feed control case
49.68% diseas anim outbreak cattl veterinari anthrax area control

Sample Cluster Record Titles

1996-97 global anthrax report

A national register of historic and contemporary anthrax foci

Anthrax explodes in an Australian summer

Experiences with vaccination and epidemiological investigations on an anthrax outbreak in Australia in 1997

Infections and intoxications associated with animal feed and forage which may present a hazard to human health

Human behavioural factors implicated in outbreaks of human anthrax in the Tamale municipality of northern Ghana

Molecular epidemiology of serogroup a meningitis in Moscow, 1969-1997

Infectious zoonoses of livestock.

Anthrax. Epidemiologic study of the disease in France.

Cluster Metrics

Authors

turner, aj 2; sournia, jc 2; rubira, rj 2; ganiere, jp 2; galvin, jw 2; zurth, k 1; zhu, px 1; yampolskaya, o 1; wilks, cr 1; weissengruber, ge 1

Sources

revue scientifique et technique de l office international des epizooties 4; journal of applied microbiology 4; medecine et maladies infectieuses 2; emerging infectious diseases 2; canadian veterinary journal-revue veterinaire canadienne 2; berliner und munchener tierarztliche wochenschrift 2; wiener tierarztliche monatsschrift 1; veterinary journal 1; turkish journal of veterinary & animal sciences 1; tropical animal health and production 1

Keywords

veterinary sciences 19; biotechnology & applied microbiology 5; anthrax 4; tropical medicine 4; microbiology 4; infectious diseases 4; public, environmental & occupational health 3; occupational health 3; medicine, general & internal 3; public, environmental & 3

Country

usa 5; germany 4; france 4; russia 3; new zealand 3; australia 3; turkey 2; ethiopia 2; england 2; canada 2

Institution

louisiana state univ 2; dept nat resources & environm 2; zool garten leipzig 1; whangaruru 1; western coll vet med 1; wayne state univ 1; victorian inst anim sci 1; ural state univ 1; univ otago 1; univ leipzig 1

- # CLUSTER 31
  Infectious disease ecological impacts on wild animal populations (19 Records)

Cluster Syntax Features

Descriptive Terms
bison 10.9%, park 7.9%, popul 4.5%, wild 3.8%, mortal 3.7%, dog 3.6%, year 1.9%, area 1.8%, outbreak 1.5%, adult 1.3%, epizoot 1.3%, eleph 1.3%, zebra 1.2%, etosha 1.2%, northern 1.2%

Discriminating Terms
bison 6.9%, park 4.9%, dog 2.2%, popul 2.1%, mortal 2.0%, wild 2.0%, spore 1.1%, cell 1.0%, strain 1.0%, protein 1.0%, toxin 0.9%, vaccin 0.9%, epizoot 0.8%, eleph 0.8%, zebra 0.8%

Single Word Terms
anthrax 17, popul 13, mortal 11, number 11, park 10, diseas 10, year 9, area 8, outbreak 8, high 7, low 7, anim 7, on 6, increas 6, adult 6

Double Word Terms
outbreak.anthrax 3, wood.buffalo 3, bacillu.anthraci 3, northwest.territori 3, area.park 3, buffalo.park 3, anthrax.spore 3, anthrax.epidem 2, long.term 2, adult.mortal 2, outbreak.diseas 2, caus.agent 2, etosha.park 2, anthrax.mortal 2, sudden.death 2

Triple Word Terms
wood.buffalo.park 3, lake.manyara.park 2, hot.wet.season 1, concentr.anthrax.spore 1, caus.agent.anthrax 1, soil.sampl.collect 1, human.infect.contact 1, long.term.monitor 1, bacillu.anthraci.caus 1, plai.central.role 1, contamin.bacillu.anthraci 1, bacillu.anthraci.isol 1, kruger.park.south 1, park.south.africa 1, gulf.war.veteran 0

Term Cliques
29.47% dog year outbreak adult epizoot
38.95% mortal year outbreak adult zebra
38.95% mortal year outbreak adult epizoot
25.26% wild dog year adult epizoot
44.21% popul mortal year adult zebra
35.79% popul wild dog year adult
26.32% park eleph zebra etosha
36.84% park outbreak eleph northern
34.21% park outbreak eleph zebra
35.53% park outbreak adult zebra
36.84% park area eleph northern
32.89% park area eleph etosha
35.79% park popul adult zebra etosha
43.42% park popul area etosha
27.63% bison outbreak epizoot northern
35.53% bison mortal outbreak epizoot
36.84% bison park outbreak northern
36.84% bison park area northern

Sample Cluster Record Titles

Seroepidemiological survey of sympatric domestic and wild dogs (Lycaon pictus) in Tsumkwe District, north-eastern Namibia

Establishing the causes of the roan antelope decline in the Kruger National Park, South Africa

A review of anthrax in Canada and implications for research on the disease in northern bison

Movements and group structure of giraffe (Giraffa camelopardalis) in Lake Manyara National Park, Tanzania

An overview of early anthrax outbreaks in northern Canada: Field reports of the Health of Animals Branch, agriculture Canada, 1962-71

Some ecological characteristics of southern marginal wild boar population in Ukraine

Anthrax kills wild chimpanzees in a tropical rainforest

Testing hypotheses of bison population decline (1970-1999) in Wood Buffalo National Park: synergism between exotic disease and predation

Cluster Metrics

Authors

elkin, bt 3; dragon, dc 3; turnbull, pcb 2; prins, hht 2; volokh, am 1; viljoen, pc 1; vigilant, l 1; vanderjeugd, hp 1; van vuuren, mj 1; van heerden, j 1

Sources

onderstepoort journal of veterinary research 2; journal of zoology 2; canadian journal of zoology-revue canadienne de zoologie 2; arctic 2; zoologichesky zhurnal 1; zhurnal mikrobiologii epidemiologii i immunobiologii 1; veterinary record 1; nature 1; journal of ecology 1; journal of applied microbiology 1

Keywords

zoology 5; veterinary sciences 4; anthrax 4; environmental sciences 3; disease 3; tanzania 2; public, environmental & occupational health 2; occupational health 2; geography, physical 2; buffalo-national-park 2

Country

canada 5; england 4; south africa 2; netherlands 2; namibia 2; zambia 1; usa 1; ukraine 1; tanzania 1; sweden 1

Institution

univ groningen 2; univ alberta hosp 2; govt nw terr 2; wildlife management projects 1; who 1; uppsala univ 1; univ witwatersrand 1; univ saskatchewan 1; univ pretoria 1; univ manchester 1

- # CLUSTER 6
  Nesting biology of insects and their anthrax parasitism (17 Records)

Cluster Syntax Features

Descriptive Terms
nest 45.2%, bee 8.0%, rear 3.5%, parasit 2.6%, mud 2.4%, host 2.0%, season 1.4%, parasitoid 1.4%, femal 1.4%, pollen 1.3%, egg 1.2%, adult 1.0%, male 1.0%, megachil 0.9%, fli 0.9%

Discriminating Terms
nest 25.1%, bee 4.5%, rear 1.9%, parasit 1.4%, mud 1.3%, spore 1.3%, vaccin 0.9%, strain 0.9%, protein 0.9%, toxin 0.8%, parasitoid 0.8%, anthraci 0.8%, season 0.7%, pollen 0.7%, gene 0.7%

Single Word Terms
anthrax 15, nest 11, bee 9, speci 9, two 8, parasit 8, season 7, first 6, male 6, rear 6, mortal 6, femal 6, cell 6, plug 5, adult 5

Double Word Terms
trap.nest 5, first.time 3, leucospi.genali 3, bee.nest 3, femal.male 2, mortal.rate 2, wet.season 2, hot.wet 2, densiti.depend 1, male.femal 1, label.biotin 1, three.speci 1, wide.variabl 1, anthrax.speci 1, cell.cell 1

Triple Word Terms
hot.wet.season 2, foot.mouth.diseas 1, viral.hemorrhag.fever 0, site.direct.mutagenesi 0, anthrax.plagu.tularemia 0, botul.viral.hemorrhag 0, cholesterol.depend.cytolysin 0, protect.anthrax.infect 0, aerosol.anthraci.spore 0, attack.unit.state 0, biolog.weapon.threat 0, receipt.anthrax.vaccin 0, gulf.war.veteran 0, bacillu.anthraci.speci 0, medic.infecti.diseas 0

Term Cliques
25.88% rear mud parasitoid adult megachil
24.71% rear mud host parasitoid megachil
32.94% bee rear pollen adult megachil
32.94% bee rear parasitoid adult megachil
31.76% bee rear host parasitoid fli
31.76% bee rear host parasitoid megachil
36.47% bee rear parasit pollen fli
36.47% bee rear parasit pollen megachil
32.35% nest mud parasitoid adult male megachil
35.29% nest mud parasitoid femal adult male
38.24% nest bee pollen adult male megachil
38.24% nest bee parasitoid adult male megachil
39.22% nest bee parasitoid femal male fli
38.24% nest bee season femal pollen egg adult male
38.24% nest bee season parasitoid femal egg adult male
41.18% nest bee parasit pollen male megachil
40.34% nest bee parasit femal pollen male fli
43.70% nest bee parasit season femal pollen male

Sample Cluster Record Titles

Nesting biology in Centris (Hemisiella) vittata Lepeletier in southeastern Brazil (Hymenoptera, Apidae,

Centridini)

Parasitism of neotropical tiger beetles (Coleoptera : Carabidae : Cicindelinae) by Anthrax (Diptera : Bombyliidae)

Green beams

Variability in egg-to-adult development time in the bee Ptilothrix plumata and its parasitoids

Inverse density-dependent and density-independent parasitism in a solitary ground-nesting bee in Southeast Brazil

Nesting biology of Zeta argillaceum (Hymenoptera : Vespidae : Eumeninae) in Southern Florida, US

Resource use and nesting behavior of Megachile prosopidis and M-chilopsidis with notes on M-discorhina (Hymenoptera : Megachilidae)

Cluster Metrics

Authors

martins, rp 4; matthews, rw 2; gonzalez, jm 2; camillo, e 2; antonini, y 2; vicens, n 1; thiruvenkadan, ak 1; strickler, k 1; serrano, jc 1; scott, vl 1

Sources

journal of the kansas entomological society 3; florida entomologist 2; zootaxa 1; tropical zoology 1; studies on neotropical fauna and environment 1; revista de biologia tropical 1; proceedings of the entomological society of washington 1; journal of pharmaceutical sciences 1; journal of applied entomology-zeitschrift fur angewandte entomologie 1; indian journal of animal sciences 1

Keywords

entomology 9; mortality 4; bombyliidae 4; biology 4; zoology 3; sphecidae 3; megachilidae 3; anthophoridae 3; parasitoids 2; parasitism 2

Country

brazil 5; usa 4; india 1; germany 1

Institution

univ sao paulo 3; univ georgia 2; vet coll & res inst 1; univ texas 1; univ fed minas gerais 1; univ arizona 1; ufmg 1; museu nacl 1; anhalt univ appl sci 1

CATEGORY 4 – 121b2

Inhalation and cutaneous anthrax, and anthrax meningitis and meningoencephalitis (134 REC)

- Inhalational anthrax, emphasizing patient care and postal worker exposure (42 Records)
- Cutaneous anthrax: exposure, transmission, symptoms, and treatment (41 Records)
- Anthrax etiology, pathology, and treatment, with emphasis on hemorrhaging during anthrax pathogenesis, especially thoracic lymph node hemorrhaging, and hemorrhagic mediastinitis, from inhalational anthrax (24 Records)
- Anthrax memingitis and meningoencephalitis: diagnoses and treatment (27 Records)

- CLUSTER 38

  Inhalational anthrax, emphasizing patient care and postal worker exposure (42 Records)

Cluster Syntax Features

Descriptive Terms

patient 11.7%, inhal 10.4%, inhal.anthrax 9.2%, case 3.9%, postal 2.0%, anthrax 1.9%, worker 1.8%, mail 1.7%, clinic 1.5%, cutan 1.5%, physician 1.4%, exposur 1.3%, symptom 1.1%, ill 1.0%, case.inhal 1.0%

Discriminating Terms

inhal 6.5%, patient 6.4%, inhal.anthrax 6.2%, case 1.4%, postal 1.3%, strain 1.3%, protein 1.2%, cell 1.1%, vaccin 1.1%, worker 1.1%, toxin 1.0%, mail 0.9%, gene 0.9%, spore 0.9%, cereu 0.8%

Single Word Terms

anthrax 40, inhal 37, patient 30, case 26, bioterror 24, clinic 20, bacillu 20, anthraci 19, mail 18, postal 18, exposur 17, diseas 16, symptom 16, facil 15, spore 15

Double Word Terms

inhal.anthrax 36, bacillu.anthraci 19, case.inhal 15, unit.state 11, anthrax.case 10, anthrax.spore 8, cutan.anthrax 8, anthraci.spore 7, cutan.inhal 7, contamin.mail 7, postal.worker 7, postal.facil 7, new.york 7, york.citi 6, public.health 6

Triple Word Terms

case.inhal.anthrax 14, new.york.citi 6, inhal.anthrax.case 6, inhal.anthrax.patient 5, bacillu.anthraci.spore 5, diagnosi.inhal.anthrax 5, cutan.inhal.anthrax 5, center.diseas.control 4, diseas.control.prevent 4, bioterror.inhal.anthrax 4, case.cutan.inhal 3, unit.state.case 3, process.distribut.center 3, anthraci.protect.antigen 3, case.bioterror.inhal 3

Term Cliques

59.52% inhal inhal.anthrax case anthrax worker mail cutan exposur
53.06% patient case anthrax exposur symptom ill case.inhal
52.38% patient case anthrax worker exposur ill case.inhal
60.71% patient inhal anthrax clinic physician symptom
59.92% patient inhal anthrax mail physician symptom
63.89% patient inhal postal anthrax clinic symptom
60.05% patient inhal inhal.anthrax postal anthrax mail exposur symptom case.inhal
59.52% patient inhal inhal.anthrax postal anthrax worker mail exposur case.inhal
62.17% patient inhal inhal.anthrax case anthrax mail exposur symptom case.inhal
61.64% patient inhal inhal.anthrax case anthrax worker mail exposur case.inhal

Sample Cluster Record Titles

Bioterrorism-related inhalational anthrax: The first 10 cases reported in the United States

Clinical presentation of inhalational anthrax following bioterrorism exposure - Report of 2 surviving patients

Death due to bioterrorism-related inhalational anthrax - Report of 2 patients

2001 anthrax crisis in Washington, DC: Clinic for persons exposed to contaminated mail

2001 anthrax crisis in Washington, DC: Pharmacists' role in screening patients and selecting prophylaxis

Management of anthrax

Investigation of bioterrorism-related anthrax, United States, 2001: Epidemiologic findings

First case of bioterrorism-related inhalational anthrax in the United States, Palm Beach County, Florida, 2001

First case of bioterrorism-related inhalational anthrax, Florida, 2001: North Carolina investigation

Cluster Metrics

Authors

quinn, cp 7; perkins, ba 5; hadler, jl 5; swerdlow, dl 4; schuchat, a 4; jernigan, ja 4; ashford, da 4; stephens, ds 3; semenova, va 3; romero-steiner, s 3

Sources

emerging infectious diseases 15; clinical infectious diseases 5; jama-journal of the american medical association 2; archives of internal medicine 2; annals of family medicine 2; american journal of health-system pharmacy 2; pharmacoepidemiology and drug safety 1; medical hypotheses 1; journal of urban health-bulletin of the new york academy of medicine 1; journal of the national medical association 1

Keywords

immunology 20; infectious diseases 20; medicine, general & internal 9; bacillus-anthracis 8; management 7; united-states 5; outbreak 5; microbiology 5; diagnosis 5; anthrax 5

Country

usa 40; israel 1; england 1

Institution

ctr dis control & prevent 17; connecticut dept publ hlth 4; us fda 3; new jersey dept hlth & senior serv 3; inova fairfax hosp 3; emory univ 3; us phs 2; univ wisconsin 2; palm beach cty dept publ hlth 2; nih 2

- # CLUSTER 39
  Cutaneous anthrax: exposure, transmission, symptoms, and treatment (41 Records)

Cluster Syntax Features

Descriptive Terms
cutan 10.4%, patient 8.4%, cutan.anthrax 6.5%, case 4.5%, lesion 3.3%, diseas 2.9%, eyelid 2.6%, diagnosi 2.0%, anthrax 2.0%, infect 1.8%, anim 1.6%, ulcer 1.5%, contact 1.4%, clinic 1.3%, eschar 1.1%

Discriminating Terms
cutan 6.8%, cutan.anthrax 4.5%, patient 4.0%, lesion 2.1%, eyelid 1.9%, case 1.7%, vaccin 1.2%, cell 1.1%, spore 1.1%, strain 1.1%, protein 1.1%, ulcer 1.0%, toxin 1.0%, diagnosi 0.9%, contact 0.9%

Single Word Terms
anthrax 41, cutan 32, case 29, diseas 28, patient 25, infect 25, anthraci 21, bacillu 21, lesion 19, form 19, clinic 19, diagnosi 18, treatment 16, anim 15, human 15

Double Word Terms
cutan.anthrax 24, bacillu.anthraci 21, case.cutan 10, infect.anim 9, contact.infect 9, anthrax.rare 7, gram.posit 7, form.diseas 7, infecti.diseas 6, patient.diagnos 6, differenti.diagnosi 6, skin.lesion 5, year.old 5, spore.form 5, diseas.bacillu 5

Triple Word Terms
case.cutan.anthrax 9, contact.infect.anim 8, spore.form.bacterium 5, diseas.bacillu.anthraci 5, bacterium.bacillu.anthraci 4, gram.posit.rod 4, cutan.anthrax.case 4, form.bacterium.bacillu 4, anthrax.infecti.diseas 4, black.necrot.eschar 4, cutan.anthrax.patient 4, patient.treat.penicillin 3, form.diseas.case 3, infect.contact.infect 3, bacillu.anthraci.diseas 3

Term Cliques
47.23% patient case lesion eyelid diagnosi anthrax infect anim ulcer contact eschar
51.22% patient case lesion diseas eyelid diagnosi anthrax infect anim contact eschar
56.98% patient cutan.anthrax case lesion diseas diagnosi anthrax infect anim contact clinic
53.05% cutan patient cutan.anthrax case lesion diagnosi anthrax infect anim ulcer contact eschar
56.71% cutan patient cutan.anthrax case lesion diseas diagnosi anthrax infect anim contact eschar

Sample Cluster Record Titles

Cutaneous manifestations of anthrax in rural Haiti

Surgical management of cutaneous anthrax

Ulnar nerve lesion due to cutaneous anthrax

Anthrax as the cause of preseptal cellulitis and cicatricial ectropion

Toxemic shock, hematuria, hypokalemia, and hypoproteinemia in a case of cutaneous anthrax

Cutaneous anthrax in Eastern Turkey

Cluster Metrics

Authors
zaki, sr 3; terzioglu, a 2; singleton, j 2; perez-perez, g 2; paddock, cd 2; meyer, h 2; koss, t 2; esmerligil, s 2; celebi, s 2; caksen, h 2

Sources
presse medicale 2; emerging infectious diseases 2; british journal of dermatology 2; annals of plastic surgery 2; acta ophthalmologica scandinavica 2; terapevticheskii arkhiv 1; southern medical journal 1; scandinavian journal of infectious diseases 1; rickettsiology: present and future directions 1; pediatric dermatology 1

Keywords
ophthalmology 7; medicine, general & internal 7; dermatology 7; anthrax 7; bacillus-anthracis 6; cutaneous anthrax 5; bacillus anthracis 5; outbreak 4; bioterrorism 4; surgery 3

Country
turkey 13; usa 10; germany 3; france 2; england 2; wales 1; tx 1; thailand 1; switzerland 1; slovakia 1

Institution
numune hosp 4; ctr dis control & prevent 3; yuzuncu yil univ 2; univ munich 2; nyu 2; firat univ 2; cumhuriyet univ 2; columbia univ coll phys & surg 2; cdcp 2; wrexham maelor hosp 1

CLUSTER 41

Anthrax etiology, pathology, and treatment, with emphasis on hemorrhaging during anthrax pathogenesis, especially thoracic lymph node hemorrhaging, and hemorrhagic mediastinitis, from inhalational anthrax (24 Records)

Cluster Syntax Features

Descriptive Terms

hemorrhag 5.3%, mediastin 5.1%, inhal 3.8%, patient 3.8%, inhal.anthrax 3.0%, pneumonia 2.6%, respiratori 2.3%, children 2.3%, chest 2.2%, lymph 2.0%, lymph.node 2.0%, node 2.0%, antibiot 2.0%, ciprofloxacin 1.9%, pleural 1.4%

Discriminating Terms

mediastin 3.6%, hemorrhag 3.5%, inhal 1.7%, pneumonia 1.6%, children 1.5%, chest 1.5%, inhal.anthrax 1.5%, spore 1.5%, lymph.node 1.4%, lymph 1.4%, respiratori 1.4%, node 1.3%, vaccin 1.2%, patient 1.2%, protein 1.1%

Single Word Terms

anthrax 21, inhal 16, patient 15, mediastin 13, anthraci 11, hemorrhag 10, bacillu 10, infect 10, treatment 9, exposur 9, antibiot 9, model 8, lymph 8, case 8, node 8

Double Word Terms

inhal.anthrax 16, bacillu.anthraci 10, lymph.node 8, pleural.effus 7, year.old 5, chest.radiograph 4, mediastin.lymph 3, human.inhal 3, hemorrhag.mediastin 3, commun.pneumonia 3, antibiot.treatment 3, treatment.anthrax 3, unit.state 3, mediastin.widen 3, blood.cultur 3

Triple Word Terms

mediastin.lymph.node 3, main.outcom.measur 2, model.inhal.anthrax 2, bacillu.anthraci.cell 2, dose.bacillu.anthraci 2, inhal.anthrax.bioterror 2, year.old.woman 2, patient.inhal.anthrax 2, monkei.model.inhal 2, human.inhal.anthrax 2, intens.care.unit 2, anthrax.plagu.tularemia 2, anthraci.cell.wall 2, bacillu.anthraci.secret 1, anthrax.fatal.infect 1

Term Cliques

23.61% children antibiot ciprofloxacin
31.94% pneumonia respiratori antibiot
36.46% patient respiratori children antibiot
46.88% inhal inhal.anthrax antibiot ciprofloxacin
50.00% inhal inhal.anthrax pneumonia antibiot
38.33% hemorrhag patient respiratori chest pleural
36.67% hemorrhag mediastin respiratori chest pleural
36.67% hemorrhag mediastin pneumonia respiratori pleural
47.92% hemorrhag mediastin inhal inhal.anthrax chest pleural
43.06% hemorrhag mediastin inhal inhal.anthrax pneumonia lymph.node lymph node pleural

Sample Cluster Record Titles

The pathology of experimental anthrax in rabbits exposed by inhalation and subcutaneous inoculation

Risks and prevention of nosocomial transmission of rare zoonotic diseases

Quantitative pathology of inhalational anthrax I: Quantitative microscopic findings

Inhalational anthrax after bioterrorism exposure: Spectrum of imaging findings in two surviving patients

Anthrax: Safe treatment for children

Fatal inhalational anthrax with unknown source of exposure in a 61-year-old woman in New York city

Fatal inhalational anthrax in a 94-year-old Connecticut woman

Pathology and pathogenesis of bioterrorism-related inhalational anthrax

Pathology of inhalation anthrax in cynomoigus monkeys (Macaca fascicularis)

Cluster Metrics

Authors

zaki, sr 3; shieh, wj 3; guarner, j 3; yampolskaya, ov 2; walker, dh 2; stephens, ds 2; popovic, t 2; pitt, mlm 2; mandl, kd 2; jernigan, ja 2

Sources

clinical infectious diseases 3; laboratory investigation 2; jama-journal of the american medical association 2; schweizerische medizinische wochenschrift 1; radiology 1; proceedings of the national academy of sciences of the united states of america 1; pediatric emergency care 1; modern pathology 1; lancet 1; journal of the american medical informatics association 1

Keywords

pathology 6; medicine, general & internal 5; bacillus-anthracis 5; immunology 4; microbiology 4; management 4; infectious diseases 4; medicine, research & experimental 3; management 3; anthrax 3

Country

usa 21; russia 2; germany 2; switzerland 1; india 1; czechoslovakia 1

Institution

ctr dis control & prevent 3; usa 2; univ texas 2; hosp 40 2; harvard univ 2; childrens hosp 2; botkin hosp 2; usn 1; usamriid 1; us fda 1

- # CLUSTER 52
  Anthrax memingitis and meningoencephalitis: diagnoses and treatment (27 Records)

Cluster Syntax Features

Descriptive Terms
case 9.9%, mening 3.7%, skin 2.7%, patient 2.5%, year 2.2%, meningoenceph 2.0%, old 1.6%, fluid 1.3%, diagnosi 1.3%, cerebrospin.fluid 1.3%, cerebrospin 1.3%, therapi 1.3%, year.old 1.3%, report.case 1.2%, hospit 1.2%

Discriminating Terms
case 4.6%, mening 2.5%, spore 1.7%, skin 1.5%, meningoenceph 1.4%, strain 1.2%, vaccin 1.2%, protein 1.1%, toxin 1.0%, year 1.0%, old 1.0%, cerebrospin 0.9%, cerebrospin.fluid 0.9%, report.case 0.9%, cell 0.9%

Single Word Terms
case 22, anthrax 20, bacillu 16, year 14, anthraci 13, patient 12, report 12, old 11, infect 11, dai 11, posit 9, therapi 9, skin 9, hospit 9, first 9

Double Word Terms
bacillu.anthraci 10, year.old 9, report.case 7, gram.posit 5, bacillu.cereu 5, cerebrospin.fluid 5, human.anthrax 5, anthrax.case 4, case.year 4, first.case 4, bacillu.speci 4, blood.cultur 4, anthrax.meningoenceph 3, old.boi 3, infect.bacillu 3

Triple Word Terms
human.anthrax.case 3, report.year.old 3, gram.posit.bacilli 3, infect.bacillu.anthraci 2, anthraci.bacillu.speci 2, case.year.old 2, year.old.femal 2, anthraxin.skin.test 2, non.anthrax.bacillu 2, anthrax.bacillu.speci 2, year.old.boi 2, isol.bacillu.anthraci 1, anthraci.causal.agent 1, bacillu.anthraci.infect 1, posit.endospor.form 1

Term Cliques
34.57% patient year meningoenceph therapi year.old hospit
30.37% mening patient meningoenceph therapi hospit
25.40% mening patient meningoenceph fluid cerebrospin.fluid cerebrospin hospit
41.27% case year old diagnosi year.old report.case hospit
43.06% case patient year old therapi year.old report.case hospit
43.83% case skin year old diagnosi year.old
38.89% case mening old diagnosi report.case hospit
35.45% case mening patient fluid cerebrospin.fluid cerebrospin hospit
41.27% case mening patient old therapi report.case hospit
38.10% case mening patient old cerebrospin.fluid cerebrospin hospit
41.48% case mening skin old diagnosi

Sample Cluster Record Titles

Ventricular shunt infection and meningitis due to Bacillus cereus

Fatal meningoencephalitis due to Bacillus anthracis

Anthrax: an unusual escarrotic lesion

Injectional anthrax in a heroin skin-popper

Bacillus cereus meningitis complicating cerebrospinal fluid fistula repair and spinal drainage

CT and MR findings of anthrax meningoencephalitis: Report of two cases and review of the literature

Anthrax meningoencephalitis

A case of anthrax meningitis

Cluster Metrics

Authors

rubinstein, e 2; wong, sn 1; werfel, u 1; vannier, j 1; van velthoven, v 1; tugrul, m 1; thompson, gh 1; tekeli, e 1; tastan, r 1; sumerkan, b 1

Sources

emerging infectious diseases 2; yonsei medical journal 1; veterinary and human toxicology 1; scandinavian journal of infectious diseases 1; presse medicale 1; pharmacotherapy 1; neuropediatrics 1; neurology 1; magyar allatorvosok lapja 1; laryngo-rhino-otologie 1

Keywords

anthrax 5; medicine, general & internal 3; infectious diseases 3; immunology 3; clinical neurology 3; bacillus-anthracis 3; microbiology 3; infectious diseases 3; bioterrorism 3; public, environmental & occupational health 2

Country

usa 7; turkey 6; germany 2; sweden 1; south korea 1; oh 1; norway 1; jordan 1; hong kong 1; france 1

Institution

washington poison ctr 1; vet affairs med ctr 1; univ wisconsin 1; univ lyon 1 1; univ kocaeli 1; univ hosp 1; univ gothenburg 1; univ essen gesamthsch klinikum 1; univ ankara 1; univ adelaide 1

CATEGORY 5 – 125a1

Vacinnation/ immunization and spore detection (498 REC)

THRUST 1
(Vaccination and immunization for anthrax protection)

- Anthrax vaccine absorption, emphasizing determination of IGG antibodies to anthrax protective antigen (26 Records)
- Human anthrax vaccines, including clinical trials (36 Records)
- Adverse reactions to anthrax vaccine, especially among Gulf War veterans (30 Records)
- Recombinant protective antigen against anthrax (26 Records)
- Purification of anthrax protective antigen from multiple sources (20 Records)
- Protection and immunity against anthrax by vaccinations that produce protective antigen (51 Records)
- Antibody responses to anthrax protective antigen (35 Records)

TWO MAIN LEVEL 4 THRUSTS IN THIS CATEGORY. THE FIRST THRUST IS ENCLOSED IN BRACKETS, AND FOLLOWED BY BULLETS UNDER THAT THRUST. THE SAME STRUCTURE WILL BE USED FOR THE SECOND LEVEL 4 THRUST.

THRUST 1
(Vaccination and immunization for anthrax protection)

(Descriptive Terms

vaccin 23.9%, immun 5.6%, protect 4.0%, anthrax.vaccin 3.6%, antibodi 2.6%, antigen 2.2%, rpa 2.2%, mice 1.5%, recombin 1.2%, anthrax 1.1%, anti 1.0%, respons 0.9%, toxin 0.9%, ava 0.9%, (52.33%)

Single Word Terms

vaccin 188, anthrax 182, protect 154, antigen 142, anthraci 118, bacillu 115, immun 106, antibodi 90, toxin 80, lethal 79, respons 77, recombin 72, activ 71, protein 70, mice 65

Double Word Terms

protect.antigen 123, bacillu.anthraci 109, anthrax.vaccin 105, lethal.factor 42, immun.respons 36, vaccin.anthrax 35, guinea.pig 33, protect.immun 32, anthrax.toxin 29, lethal.toxin 23, recombin.protect 23, vaccin.adsorb 21, antigen.rpa 20, anthraci.protect 19, neutral.antibodi 18

Triple Word Terms

anthrax.vaccin.adsorb 21, recombin.protect.antigen 21, protect.antigen.rpa 20, anthraci.protect.antigen 19, vaccin.adsorb.ava 16, bacillu.anthraci.protect 15, protect.antigen.lethal 15, antigen.lethal.factor 15, factor.edema.factor 13, lethal.factor.edema 13, link.immunosorb.assai 12, enzym.link.immunosorb 12, human.anthrax.vaccin 12, vaccin.anthrax.vaccin 11, strain.bacillu.anthraci 11)

- # CLUSTER 19
  Anthrax vaccine absorption, emphasizing determination of IGG antibodies to anthrax protective antigen (26 Records)

Cluster Syntax Features

Descriptive Terms
ava 15.5%, vaccin 8.5%, igg 4.0%, anthrax.vaccin 3.3%, dose 3.3%, week 3.1%, anti 2.4%, adsorb 2.3%, anthrax.vaccin.adsorb 2.1%, vaccin.adsorb 2.1%, cohort 1.7%, vaccin.adsorb.ava 1.4%, adsorb.ava 1.4%, anti.igg 1.4%, antibodi 1.3%

Discriminating Terms
ava 10.8%, igg 2.4%, vaccin 2.0%, week 2.0%, dose 1.6%, adsorb 1.5%, vaccin.adsorb 1.5%, anthrax.vaccin.adsorb 1.5%, anthrax.vaccin 1.5%, cohort 1.1%, cell 1.1%, strain 1.1%, anti 1.0%, protein 1.0%, adsorb.ava 1.0%

Single Word Terms
anthrax 26, vaccin 24, ava 19, adsorb 19, protect 17, antigen 15, anti 14, human 14, licens 14, dose 14, anthraci 12, two 12, antibodi 12, immun 11, bacillu 11

Double Word Terms
anthrax.vaccin 24, vaccin.adsorb 18, adsorb.ava 15, protect.antigen 14, bacillu.anthraci 10, dose.ava 7, inject.site 6, dose.anthrax 6, link.immunosorb 6, anti.igg 6, immunosorb.assai 6, enzym.link 6, licens.anthrax 6, licens.human 6, igg.antibodi 6

Triple Word Terms
anthrax.vaccin.adsorb 18, vaccin.adsorb.ava 15, licens.anthrax.vaccin 6, enzym.link.immunosorb 6, link.immunosorb.assai 6, dose.anthrax.vaccin 6, anti.protect.antigen 5, inject.site.reaction 5, bacillu.anthraci.protect 4, immunosorb.assai.elisa 4, anthraci.protect.antigen 4, licens.human.anthrax 4, human.anthrax.vaccin 4, ava.licens.human 3, first.two.dose 3

Term Cliques
38.46% dose cohort antibodi
57.14% vaccin igg anthrax.vaccin dose anti anti.igg antibodi
59.34% vaccin igg anthrax.vaccin dose week anti antibodi
47.44% ava dose cohort
65.93% ava vaccin anthrax.vaccin dose anti adsorb anti.igg
66.43% ava vaccin anthrax.vaccin dose week anti adsorb vaccin.adsorb anthrax.vaccin.adsorb vaccin.adsorb.ava adsorb.ava
60.99% ava vaccin igg anthrax.vaccin dose anti anti.igg
63.19% ava vaccin igg anthrax.vaccin dose week anti

Sample Cluster Record Titles

Comparative efficacy of experimental anthrax vaccine candidates against inhalation anthrax in rhesus macaques

Human immune responses to the UK human anthrax vaccine

Anthrax vaccine: increasing intervals between the first two doses enhances antibody response in humans

Efficacy of a human anthrax vaccine in guinea pigs, rabbits, and rhesus macaques against challenge by Bacillus anthracis isolates of diverse geographical origin

In vitro correlate of immunity in a rabbit model of inhalational anthrax

Anthrax vaccine: short-term safety experience in humans

Anthrax vaccine: immunogenicity and safety of a dose-reduction, route-change comparison study in humans

Anthrax vaccine efficacy in golden Syrian hamsters

Cluster Metrics

Authors

pittman, pr 8; friedlander, am 7; ivins, be 6; little, sf 4; gibbs, ph 4; gibbs, p 4; pitt, mlm 3; fellows, pf 3; xie, h 2; striley, caf 2

Sources

vaccine 10; clinical and diagnostic laboratory immunology 3; pharmacoepidemiology and drug safety 2; journal of occupational and environmental medicine 2; proceedings of the national academy of sciences of the united states of america 1; occupational and environmental medicine 1; journal of pharmaceutical and biomedical analysis 1; journal of infectious diseases 1; journal of immunological methods 1; journal of applied microbiology 1

Keywords

immunology 11; medicine, research & experimental 10; veterinary sciences 10; vaccine 7; toxin 6; protective antigen 5; immunology 5; microbiology 5; infectious diseases 5; immunity 5

Country

usa 25; venezuela 1; england 1; canada 1

Institution

usa 15; ctr dis control & prevent 5; us fda 3; walter reed army inst res 2; womack army med ctr 1; walter reed army med ctr 1; vical inc 1; usn 1; stanford univ 1; sri int 1

- # CLUSTER 53
  Human anthrax vaccines, including clinical trials (36 Records)

Cluster Syntax Features

Descriptive Terms
vaccin 47.4%, immun 1.5%, diseas 1.3%, trial 1.0%, protect 0.9%, anthrax.vaccin 0.8%, live 0.7%, human 0.7%, anim 0.6%, histori 0.6%, administr 0.6%, exposur 0.6%, product 0.5%, antibiot 0.5%, infect 0.5%

Discriminating Terms
vaccin 28.5%, protein 1.2%, strain 1.0%, toxin 1.0%, spore 0.9%, cell 0.9%, cereu 0.9%, gene 0.8%, trial 0.8%, anthraci 0.8%, detect 0.7%, sequenc 0.7%, activ 0.6%, bind 0.6%, isol 0.5%

Single Word Terms
vaccin 36, anthrax 28, protect 19, diseas 18, human 14, immun 14, model 12, anim 12, live 10, infect 9, on 9, level 8, anthraci 8, product 8, bacillu 8

Double Word Terms
anthrax.vaccin 13, bacillu.anthraci 7, vaccin.anthrax 6, vaccin.protect 5, vaccin.vaccin 4, guinea.pig 4, diseas.vaccin 4, immun.respons 4, protect.antigen 4, vaccin.common 3, vaccin.administ 3, clinic.trial 3, live.attenu 3, protect.immun 3, antibiot.prophylaxi 3

Triple Word Terms
human.anthrax.vaccin 2, venezuelan.equin.enceph 2, anthraci.protect.antigen 2, attack.bacillu.anthraci 1, post.exposur.prophylaxi 1, anthrax.vaccin.candid 1, licens.human.vaccin 1, attenu.bacillu.anthraci 1, veterinari.vaccin.anthrax 1, anthrax.protect.antigen 1, humor.immun.respons 1, bacillu.anthraci.protect 1, data.anthrax.vaccin 1, monophosphoryl.lipid.mpl 1, protect.antigen.bacillu 1

Term Cliques
43.33% vaccin anthrax.vaccin human administr product
39.35% vaccin anthrax.vaccin live anim histori product
41.67% vaccin protect exposur antibiot infect
46.67% vaccin protect anthrax.vaccin live exposur
51.11% vaccin protect anthrax.vaccin live human
34.13% vaccin trial anthrax.vaccin live histori exposur product
40.74% vaccin trial anthrax.vaccin live human product
50.00% vaccin diseas anim histori
48.89% vaccin diseas protect exposur infect
40.56% vaccin diseas trial histori exposur
52.08% vaccin immun anthrax.vaccin anim
51.11% vaccin immun protect human infect
47.69% vaccin immun protect anthrax.vaccin human administr
49.44% vaccin immun diseas anim infect
53.33% vaccin immun diseas protect infect

Sample Cluster Record Titles

Cyclosporine induced autoimmunity in newborns prevented by early immunization

The effectiveness and safety of vaccines against human anthrax: a systematic review

Monitoring temperature-sensitive vaccines and immunologic drugs, including anthrax vaccine

History of vaccine development in Ancient Orient time

The probability of severe disease in zoonotic and commensal infections

Biological consequences of multiple vaccine and pyridostigmine pretreatment in the guinea pig

Vaccinal prevention of bioterrorism.

Cluster Metrics

Authors

rubinstein, e 3; shlyakhov, e 2; ivins, b 2; zwart, d 1; yu, jm 1; wu, jj 1; williamson, ed 1; wessely, sc 1; wein, lm 1; vanderzanden, l 1

Sources

vaccine 8; current opinion in molecular therapeutics 2; berliner und munchener tierarztliche wochenschrift 2; veterinary microbiology 1; small ruminant research 1; revue scientifique et technique de l office international des epizooties 1; revue de medecine veterinaire 1; proceedings of the royal society of london series b-biological sciences 1; nature 1; military medicine 1

Keywords

medicine, research & experimental 11; veterinary sciences 9; immunology 9; veterinary sciences 7; anthrax 6; bacillus-anthracis 5; toxin 5; immunology 4; guinea-pigs 4; bacillus anthracis 4

Country

usa 20; england 5; netherlands 2; italy 2; germany 2; france 2; namibia 1; mexico 1; mali 1; israel 1

Institution

usa 4; usn 2; stanford univ 2; wageningen univ agr 1; vical inc 1; usa med materiel ctr europe usammce 1; us fda 1; univ toronto 1; univ texas 1; univ teheran 1

- # CLUSTER 27
  Adverse reactions to anthrax vaccine, especially among Gulf War veterans (30 Records)

Cluster Syntax Features

Descriptive Terms
vaccin 25.2%, anthrax.vaccin 13.2%, advers 5.6%, gulf 3.5%, veteran 3.0%, militari 2.4%, gulf.war 1.7%, war 1.5%, anthrax 1.5%, reaction 1.5%, militari.personnel 1.4%, personnel 1.2%, immun 0.9%, advers.reaction 0.7%, patient 0.6%

Discriminating Terms
vaccin 10.6%, anthrax.vaccin 7.7%, advers 3.6%, gulf 2.4%, veteran 2.1%, spore 1.5%, militari 1.4%, gulf.war 1.1%, strain 1.1%, protein 1.0%, toxin 1.0%, militari.personnel 1.0%, cell 1.0%, war 0.9%, anthraci 0.9%

Single Word Terms
vaccin 30, anthrax 29, advers 16, militari 14, case 11, personnel 10, patient 10, year 10, report 10, on 9, risk 9, gulf 9, system 9, reaction 9, safeti 8

Double Word Terms
anthrax.vaccin 24, militari.personnel 8, gulf.war 7, war.veteran 5, reaction.anthrax 5, vaccin.anthrax 5, year.old 4, dose.anthrax 4, persian.gulf 4, biolog.warfar 4, vaccin.advers 4, vaccin.militari 4, current.anthrax 4, advers.reaction 4, warfar.agent 4

Triple Word Terms
gulf.war.veteran 5, reaction.anthrax.vaccin 5, advers.reaction.anthrax 4, current.anthrax.vaccin 3, vaccin.anthrax.vaccin 3, dose.anthrax.vaccin 3, biolog.warfar.agent 3, safeti.anthrax.vaccin 3, year.old.male 3, vaccin.militari.personnel 3, receipt.anthrax.vaccin 3, investig.new.drug 2, food.drug.administr 2, center.diseas.control 2, gulf.war.syndrom 2

Term Cliques
41.67% vaccin militari gulf.war war reaction immun
54.00% vaccin veteran anthrax reaction immun
36.67% vaccin veteran gulf.war war reaction immun
60.00% vaccin gulf militari anthrax immun
41.67% vaccin gulf militari gulf.war war immun
54.00% vaccin gulf veteran anthrax immun
36.67% vaccin gulf veteran gulf.war war immun
54.44% vaccin advers anthrax reaction advers.reaction patient
56.67% vaccin advers anthrax reaction immun patient
52.86% vaccin advers militari anthrax militari.personnel personnel advers.reaction
54.76% vaccin advers militari anthrax militari.personnel personnel immun
53.33% vaccin advers militari anthrax reaction personnel advers.reaction
55.24% vaccin advers militari anthrax reaction personnel immun
64.67% vaccin anthrax.vaccin veteran anthrax reaction
64.67% vaccin anthrax.vaccin gulf veteran anthrax
62.22% vaccin anthrax.vaccin advers anthrax reaction advers.reaction

Sample Cluster Record Titles

Delayed life-threatening reaction to anthrax vaccine

Optic neuritis after anthrax vaccination

Absence of mycoplasma contamination in the anthrax vaccine

Risk factors for multisymptom illness in US army veterans of the Gulf War

Relationship between prepregnancy anthrax vaccination and pregnancy and birth outcomes among US army women

Anthrax vaccination and joint related adverse reactions in light of biological warfare scenarios

Self-reported changes in subjective health and anthrax vaccination as reported by over 900 Persian Gulf War era veterans

Monitoring anthrax vaccine safety in US military service members on active duty: surveillance of 1998 hospitalizations in temporal association with anthrax immunization

Cluster Metrics

Authors

webb, fj 2; schumm, wr 2; jurich, ap 2; geier, mr 2; geier, da 2; bollman, sr 2; zell, er 1; wolfe, j 1; williams, r 1; williams, i 1

Sources

vaccine 5; military medicine 3; psychological reports 2; emerging infectious diseases 2; scandinavian journal of statistics 1; revue neurologique 1; ophthalmology 1; neuroendocrine immune basis of the rheumatic diseases ii, proceedings 1; medical hypotheses 1; mayo clinic proceedings 1

Keywords

health 7; medicine, research & experimental 6; medicine, general & internal 6; anthrax vaccine 5; veterinary sciences 5; immunology 5; anthrax vaccine 5; immunology 3; safety 3; protective antigen 3

Country

usa 26; england 2; australia 2; germany 1; france 1

Institution

usn 3; usa 3; walter reed army med ctr 2; medcon inc 2; kansas state univ 2; harvard univ 2; genet ctr amer 2; darnall army community hosp 2; ctr dis control & prevent 2; wright patterson med ctr 1

- # CLUSTER 14
  Recombinant protective antigen against anthrax (26 Records)

Cluster Syntax Features

Descriptive Terms
rpa 38.5%, adjuv 3.2%, vaccin 2.3%, protect 2.0%, antigen.rpa 1.8%, antigen 1.8%, aluminum 1.8%, immun 1.7%, protect.antigen.rpa 1.7%, recombin 1.7%, recombin.protect.antigen 1.6%, recombin.protect 1.6%, anti 0.8%, antibodi 0.8%, microencapsul 0.8%

Discriminating Terms
rpa 26.5%, adjuv 2.1%, antigen.rpa 1.3%, aluminum 1.2%, protect.antigen.rpa 1.1%, recombin.protect.antigen 1.1%, recombin.protect 1.0%, spore 0.9%, cereu 0.7%, gene 0.7%, strain 0.7%, diseas 0.6%, recombin 0.6%, detect 0.6%, toxin 0.6%

Single Word Terms
protect 26, antigen 25, recombin 24, rpa 23, anthraci 21, bacillu 20, vaccin 19, anthrax 18, antibodi 15, respons 13, mice 13, anti 12, neutral 11, protein 10, cell 10

Double Word Terms
protect.antigen 25, bacillu.anthraci 20, antigen.rpa 17, recombin.protect 16, anthrax.vaccin 13, guinea.pig 7, recombin.rpa 5, immun.respons 5, aluminum.hydroxid 5, neutral.antibodi 5, protect.anthrax 5, anti.rpa 5, antibodi.respons 5, rpa.vaccin 5, rpa.bacillu 4

Triple Word Terms
protect.antigen.rpa 17, recombin.protect.antigen 16, antigen.rpa.bacillu 4, mpl.tdm.cw 4, vaccin.guinea.pig 3, strain.bacillu.anthraci 3, rpa.bacillu.anthraci 3, fraction.cultur.supernat 3, anion.exchang.chromatographi 3, aluminum.hydroxid.adjuv 3, rpa.igg.elisa 3, quantit.anti.rpa 3, anti.rpa.igg 3, vaccin.anthrax.vaccin 3, bone.marrow.deriv 3

Term Cliques
65.93% protect antigen.rpa antigen protect.antigen.rpa recombin.protect.antigen recombin.protect microencapsul
67.83% rpa vaccin protect antigen aluminum immun recombin recombin.protect.antigen recombin.protect anti antibodi
66.86% rpa adjuv vaccin protect antigen.rpa antigen aluminum immun protect.antigen.rpa recombin recombin.protect.antigen recombin.protect antibodi

Sample Cluster Record Titles

Production and purification of recombinant protective antigen and protective efficacy against Bacillus anthracis

Protective efficacy of a recombinant protective antigen against Bacillus anthracis challenge and assessment of immunological markers

Attenuated nontoxinogenic and nonencapsulated recombinant Bacillus anthracis spore vaccines protect against anthrax

Passive transfer of protection against Bacillus anthracis infection in a murine model

Mucosal or parenteral administration of microsphere-associated Bacillus anthracis protective antigen protects against anthrax infection in mice

Production, recovery and immunogenicity of the protective antigen from a recombinant strain of Bacillus anthracis

Use of a promoter trap system in Bacillus anthracis and Bacillus subtilis for the development of recombinant protective antigen-based vaccines

Cluster Metrics

Authors

williamson, ed 8; little, sf 5; miller, j 4; ivins, be 3; flick-smith, hc 3; eyles, je 3; baillie, lwj 3; andrews, gp 3; webster, wm 2; waters, el 2

Sources

vaccine 8; infection and immunity 6; journal of biological chemistry 2; fems immunology and medical microbiology 2; scandinavian journal of immunology 1; proceedings of the national academy of sciences of the united states of america 1; microbial pathogenesis 1; letters in applied microbiology 1; journal of industrial microbiology & biotechnology 1; journal of immunology 1

Keywords

immunology 11; toxin 11; vaccine 9; medicine, research & experimental 8; veterinary sciences 8; infectious diseases 8; immunology 8; efficacy 7; immunization 6; bacillus-anthracis 6

Country

usa 14; england 11; south korea 3; israel 2; venezuela 1

Institution

usa 6; def sci & technol lab 5; univ newcastle upon tyne 3; dstl 3; publ hlth lab serv 2; nih 2; nidcr 2; nichhd 2; niaid 2; israel inst biol res 2

CLUSTER 34

Purification of anthrax protective antigen from multiple sources (20 Records)

Cluster Syntax Features

Descriptive Terms

vaccin 5.4%, chloroplast 4.1%, express 4.0%, recombin 3.5%, antigen 2.8%, protect 2.6%, protein 2.3%, protect.antigen 2.1%, purifi 2.1%, batch 1.9%, vaccin.anthrax 1.9%, plant 1.7%, stabil 1.5%, antigen.express 1.1%, anthrax.vaccin 1.0%

Discriminating Terms

chloroplast 3.4%, recombin 1.9%, spore 1.6%, express 1.5%, batch 1.5%, vaccin.anthrax 1.3%, purifi 1.1%, plant 1.1%, stabil 0.9%, vaccin 0.9%, antigen.express 0.9%, strain 0.9%, cereu 0.8%, antigen 0.8%, protect.antigen 0.7%

Single Word Terms

antigen 19, protect 19, vaccin 16, protein 16, bacillu 15, anthrax 15, anthraci 15, express 14, recombin 14, activ 13, gene 11, factor 11, lethal 10, product 10, purifi 9

Double Word Terms

protect.antigen 19, bacillu.anthraci 13, lethal.factor 10, vaccin.anthrax 9, anthrax.vaccin 8, biolog.activ 7, protein.purifi 6, anthraci.protect 5, antigen.express 5, yield.purifi 4, affin.chromatographi 4, edema.factor 4, purifi.homogen 3, express.system 3, gel.electrophoresi 3

Triple Word Terms

anthraci.protect.antigen 5, bacillu.anthraci.protect 4, lethal.factor.edema 3, protect.antigen.express 3, express.fusion.protein 3, macrophag.lysi.assai 3, recombin.vaccin.anthrax 3, factor.edema.factor 3, protein.purifi.homogen 3, molecular.mass.kda 3, transcript.regul.promot 3, bacillu.anthraci.express 3, protect.antigen.gene 3, structur.gene.kda 3, protect.antigen.lethal 2

Term Cliques

66.43% express antigen protect protect.antigen purifi vaccin.anthrax plant
73.57% express recombin antigen protect protect.antigen purifi vaccin.anthrax
59.29% chloroplast express antigen protect protect.antigen plant antigen.express
62.14% chloroplast express antigen protect protect.antigen vaccin.anthrax plant
67.86% vaccin antigen protect protect.antigen purifi vaccin.anthrax plant
72.14% vaccin antigen protect protein protect.antigen batch anthrax.vaccin
72.86% vaccin antigen protect protein protect.antigen purifi batch
58.33% vaccin recombin stabil
75.63% vaccin recombin antigen protect protein protect.antigen purifi vaccin.anthrax
36.00% vaccin chloroplast plant stabil anthrax.vaccin
58.13% vaccin chloroplast antigen protect protect.antigen plant antigen.express anthrax.vaccin
63.57% vaccin chloroplast antigen protect protect.antigen vaccin.anthrax plant

Sample Cluster Record Titles

Expression and purification of the recombinant lethal factor of Bacillus anthracis

Fermentation, purification, and characterization of protective antigen from a recombinant, avirulent strain

of Bacillus anthracis

A heat-inducible Bacillus subtilis bacteriophage Phi 105 expression system for the production of the protective antigen of Bacillus anthracis

Soluble expression and one-step purification of recombinant Bacillus anthracis protective antigen

Expression and purification of the recombinant protective antigen of Bacillus anthracis

Constitutive expression of protective antigen gene of Bacillus anthracis in Escherichia coli

Enhanced expression of the recombinant lethal factor of Bacillus anthracis by fed-batch culture

Rapid purification of recombinant anthrax-protective antigen under nondenaturing conditions

Expression of protective antigen in transgenic plants: a step towards edible vaccine against anthrax

Cluster Metrics

Authors

bhatnagar, r 9; singh, s 5; aziz, ma 4; waheed, sm 3; gupta, p 3; singh, a 2; rijpkema, s 2; leppla, sh 2; kumar, pa 2; koya, v 2

Sources

biochemical and biophysical research communications 6; vaccine 4; protein expression and purification 2; infection and immunity 2; protein and peptide letters 1; letters in applied microbiology 1; fems microbiology letters 1; faseb journal 1; biotechnology and bioengineering 1; applied and environmental microbiology 1

Keywords

biochemistry & molecular biology 8; toxin 7; expression 7; gene 6; biophysics 6; biotechnology & applied microbiology 5; protective antigen 5; escherichia-coli 5; medicine, research & experimental 4; bacillus-anthracis 4

Country

india 9; usa 5; england 3; germany 1

Institution

jawaharlal nehru univ 9; univ cent florida 2; niaid 2; natl inst biol stand & controls 2; indian agr res inst 2; usa 1; univ houston 1; tech univ carolo wilhelmina braunschweig 1; tech univ 1; publ hlth lab serv 1

- # CLUSTER 59
  Protection and immunity against anthrax by vaccinations that produce protective antigen (51 Records)

Cluster Syntax Features

Descriptive Terms
immun 13.2%, vaccin 5.8%, mice 5.3%, protect 4.1%, antigen 2.8%, recombin 1.9%, toxin 1.8%, strain 1.8%, respons 1.7%, lethal 1.4%, live 1.2%, protein 1.2%, express 1.2%, vector 1.2%, immun.respons 1.0%

Discriminating Terms
immun 9.8%, mice 3.5%, protect 1.5%, vaccin 1.4%, spore 1.1%, cereu 1.0%, recombin 1.0%, antigen 1.0%, mice.immun 0.9%, vector 0.9%, immun.respons 0.8%, live 0.8%, protect.immun 0.8%, isol 0.7%, health 0.7%

Single Word Terms
protect 41, immun 41, antigen 41, vaccin 41, anthrax 37, anthraci 34, bacillu 34, protein 33, mice 32, respons 32, toxin 30, lethal 29, strain 26, recombin 25, cell 22

Double Word Terms
bacillu.anthraci 33, protect.antigen 33, immun.respons 18, protect.immun 18, lethal.factor 16, anthrax.toxin 14, mice.immun 11, guinea.pig 11, anthrax.vaccin 11, antigen.lethal 10, lethal.toxin 9, factor.edema 8, edema.factor 8, anthraci.strain 8, protect.mice 8

Triple Word Terms
protect.antigen.lethal 10, antigen.lethal.factor 10, lethal.factor.edema 7, factor.edema.factor 7, protect.immun.respons 7, protein.protect.antigen 5, anthrax.protect.antigen 5, anthraci.protect.antigen 4, bacillu.anthraci.protect 4, protect.mice.lethal 4, balb.mice.immun 4, toxin.compon.construct 3, cytotox.lymphocyt.ctl 3, protect.antigen.bacillu 3, antigen.bacillu.anthraci 3

Term Cliques
64.27% vaccin mice protect antigen toxin strain lethal protein express
66.45% vaccin mice protect antigen toxin strain respons lethal protein
58.39% vaccin mice protect antigen recombin strain lethal express vector
63.18% vaccin mice protect antigen recombin strain lethal protein express
60.57% vaccin mice protect antigen recombin strain respons lethal vector
65.36% vaccin mice protect antigen recombin strain respons lethal protein
63.53% immun vaccin mice protect antigen toxin strain live protein express
65.49% immun vaccin mice protect antigen toxin strain respons live protein
59.26% immun vaccin mice protect antigen recombin express vector immun.respons
64.05% immun vaccin mice protect antigen recombin protein express immun.respons
61.44% immun vaccin mice protect antigen recombin respons vector immun.respons
66.23% immun vaccin mice protect antigen recombin respons protein immun.respons
58.24% immun vaccin mice protect antigen recombin strain live express vector
62.55% immun vaccin mice protect antigen recombin strain live protein express
60.20% immun vaccin mice protect antigen recombin strain respons live vector
64.51% immun vaccin mice protect antigen recombin strain respons live protein

Sample Cluster Record Titles

Intracytoplasmic delivery of listeriolysin O by a vaccinal strain of Bacillus anthracis induces CD8-mediated protection against Listeria monocytogenes

Study of immunization against anthrax with the purified recombinant protective antigen of Bacillus anthracis

Protection against anthrax toxin by vaccination with a DNA plasmid encoding anthrax protective antigen

Vaccination against anthrax with attenuated recombinant strains of Bacillus anthracis that produce protective antigen

Cytotoxic T-lymphocyte epitopes fused to anthrax toxin induce protective antiviral immunity

Recombinant vaccinia viruses protect against Clostridium perfringens alpha-toxin

Cluster Metrics

Authors

mock, m 11; sirard, jc 6; leppla, sh 4; brossier, f 4; weber-levy, m 3; velan, b 3; shafferman, a 3; pezard, c 3; lu, yc 3; gat, o 3

Sources

infection and immunity 18; vaccine 8; journal of immunology 2; journal of applied microbiology 2; biochemical and biophysical research communications 2; zhurnal mikrobiologii epidemiologii i immunobiologii 1; viral immunology 1; proteomics 1; proceedings of the national academy of sciences of the united states of america 1; neoplasma 1

Keywords

immunology 23; infectious diseases 20; immunology 12; bacillus-anthracis 11; protective antigen 11; medicine, research & experimental 10; veterinary sciences 8; immunity 8; virulence 7; vaccine 7

Country

usa 21; france 10; england 6; israel 5; india 4; germany 3; japan 2; senegal 1; netherlands 1; australia 1

Institution

inst pasteur 10; harvard univ 5; usa 4; israel inst biol res 4; univ hohenheim 3; us fda 2; univ maryland 2; saitama med sch 2; ohio state univ 2; nidr 2

- # CLUSTER 58
  Antibody responses to anthrax protective antigen (35 Records)

Cluster Syntax Features

Descriptive Terms
antibodi 13.0%, protect 5.1%, vaccin 3.1%, toxin 2.8%, anti 2.4%, mab 2.4%, antigen 2.1%, assai 2.1%, immun 2.1%, neutral 1.9%, serum 1.6%, sera 1.3%, memori 1.3%, titer 1.2%, lethal 1.1%

Discriminating Terms
antibodi 9.4%, protect 2.0%, mab 1.8%, anti 1.4%, neutral 1.4%, memori 1.2%, serum 1.1%, sera 1.0%, cereu 1.0%, protein 0.9%, titer 0.9%, gene 0.8%, sequenc 0.8%, spore 0.7%, assai 0.7%

Single Word Terms
antigen 33, antibodi 31, protect 31, anthrax 29, anthraci 25, bacillu 24, vaccin 22, toxin 21, lethal 21, immun 18, activ 18, serum 16, assai 15, neutral 15, infect 15

Double Word Terms
protect.antigen 28, bacillu.anthraci 23, anthrax.vaccin 12, lethal.factor 11, anthrax.toxin 9, guinea.pig 9, monoclon.antibodi 8, lethal.toxin 8, anti.antibodi 7, anthrax.infect 7, link.immunosorb 5, immunosorb.assai 5, enzym.link 5, gamma.glutam 5, glutam.acid 5

Triple Word Terms
link.immunosorb.assai 5, enzym.link.immunosorb 5, protect.antigen.compon 4, protect.antigen.vaccin 4, poli.gamma.glutam 4, gamma.glutam.acid 4, compon.anthrax.toxin 3, bacillu.anthraci.spore 3, strain.bacillu.anthraci 3, monoclon.antibodi.mab 3, antigen.bacillu.anthraci 3, protect.antigen.bacillu 3, bacillu.anthraci.lethal 2, macrophag.cell.line 2, virul.factor.bacillu 2

Term Cliques
57.14% antibodi protect vaccin anti antigen immun serum sera titer lethal
54.60% antibodi protect vaccin anti antigen immun neutral memori titer
59.14% antibodi protect vaccin anti antigen immun neutral serum titer lethal
56.29% antibodi protect vaccin anti antigen assai serum sera titer lethal
53.65% antibodi protect vaccin anti antigen assai neutral memori titer
58.29% antibodi protect vaccin anti antigen assai neutral serum titer lethal
58.29% antibodi protect vaccin anti mab antigen immun neutral serum lethal
57.43% antibodi protect vaccin anti mab antigen assai neutral serum lethal
63.81% antibodi protect vaccin toxin antigen immun serum sera lethal
60.86% antibodi protect vaccin toxin mab antigen immun neutral serum lethal

Sample Cluster Record Titles

Search for correlates of protective immunity conferred by anthrax vaccine

The role of antibodies to Bacillus anthracis and anthrax toxin components in inhibiting the early stages of infection by anthrax spores

Application of recovery tests in the validation of immunoassays for assessing the immunogenicity of B. anthracis PA vaccine

Efficiency of protection of guinea pigs against infection with Bacillus anthracis spores by passive immunization

Discovery of the anthrax toxin: the beginning of studies of virulence determinants regulated in vivo

Protection against anthrax toxin by recombinant antibody fragments correlates with antigen affinity

Mapping of antibody responses to the protective antigen of Bacillus anthracis by flow cytometric analysis

Cluster Metrics

Authors

little, sf 4; reuveny, s 3; friedlander, am 3; fellows, pf 3; wang, tt 2; wang, jy 2; velan, b 2; shafferman, a 2; roehrl, mh 2; patterson, jl 2

Sources

infection and immunity 7; vaccine 3; proceedings of the national academy of sciences of the united states of america 3; journal of immunological methods 2; fems immunology and medical microbiology 2; analytical biochemistry 2; zhurnal mikrobiologii epidemiologii i immunobiologii 1; pda journal of pharmaceutical science and technology 1; nature biotechnology 1; molecular therapy 1

Keywords

immunology 13; toxin 11; bacillus-anthracis 10; infectious diseases 10; antibodies 9; immunity 8; anthrax 6; mice 6; immunology 6; guinea-pigs 6

Country

usa 22; israel 4; germany 2; england 2; ussr 1; sweden 1; russia 1; netherlands 1; italy 1; india 1

Institution

usa 9; israel inst biol res 4; usn 2; univ texas 2; harvard univ 2; univ new mexico 1; univ nevada 1; univ munich 1; univ montpellier 2 1; univ minnesota 1

THRUST 2
(Bacillus anthracis spore detection)

- Irradiation of bacillus anthracis spores; postexposure prophylaxis against anthrax (24 Records)
- Decontamination and cleanup of biological warfare agents (22 Records)
- Sampling for anthrax spores in potentially contaminated sites, including nasal swabs in humans (27 Records)
- Germination of bacillus anthracis spores and endospores (19 Records)
- Bacillus anthracis exosporium, especially the major BclA glycoprotein layer coating the spore surface (17 Records)
- Inactivation of bacillus anthracis spores (45 Records)
- Detection and identification of bacillus anthracis spores using mass spectrometry, especially MALDI TOF, with some emphasis on small, acid-soluble protein bio-markers (16 Records)
- Detection of pathogenic bacteria by mass spectrometric profiling of fatty acids, with emphasis on pyrolysis mass spectrometry (13 Records)
- Detection of anthrax spores with Raman spectroscopy, emphasizing signal detection from dipicolinic acid in spores (19 Records)
- Biosensor detection of bacillus anthracis spores (33 Records)
- Polymerase Chain Reaction for detection of bacillus anthracis spores (39 Records)

(Descriptive Terms

spore 25.0%, detect 3.6%, sampl 1.8%, germin 1.6%, anthraci.spore 1.4%, anthraci 1.2%, min 0.9%, time 0.8%, bacillu 0.7%, pcr 0.7%, anthrax.spore 0.6%, speci 0.6%, surfac 0.6%, dna 0.6%, (40.74%)

Single Word Terms

bacillu 220, spore 209, anthraci 187, detect 124, anthrax 111, time 84, sampl 79, cell 69, bacteri 65, speci 64, sensit 63, two 62, strain 60, acid 60, surfac 59

Double Word Terms

bacillu.anthraci 164, anthraci.spore 78, spore.bacillu 43, anthrax.spore 38, bacillu.subtili 34, bacillu.cereu 34, bacteri.spore 33, veget.cell 25, anthraci.stern 25, mass.spectrometri 24, real.time 22, bacillu.speci 21, bacillu.spore 18, agent.anthrax 17, dipicolin.acid 17

Triple Word Terms

bacillu.anthraci.spore 52, spore.bacillu.anthraci 21, dipicolin.acid.dpa 13, polymeras.chain.reaction 11, real.time.pcr 11, biolog.warfar.agent 11, caus.agent.anthrax 10, bacillu.anthraci.stern 10, detect.bacillu.anthraci 10, laser.desorpt.ioniz 9, matrix.laser.desorpt 9, veget.cell.spore 9, bacillu.subtili.spore 8, anthraci.caus.agent 8, bacillu.anthraci.bacillu 8)

- # CLUSTER 40
  Irradiation of bacillus anthracis spores; postexposure prophylaxis against anthrax (24 Records)

Cluster Syntax Features

Descriptive Terms
irradi 15.1%, dose 9.0%, spore 3.6%, surviv 2.7%, anim 2.4%, mice 2.3%, infect 1.9%, inocul 1.9%, inhal 1.4%, kgy 1.3%, treat 1.1%, risk 1.1%, antibiot 1.1%, respir 1.0%, exposur 1.0%

Discriminating Terms
irradi 11.2%, dose 5.6%, surviv 1.5%, inocul 1.3%, protein 1.2%, vaccin 1.1%, kgy 1.0%, strain 0.9%, cell 0.9%, toxin 0.9%, gene 0.8%, mice 0.8%, cereu 0.8%, gamma.irradi 0.7%, incub.period 0.7%

Single Word Terms
spore 20, dose 19, bacillu 18, anthraci 16, anthrax 16, infect 14, inhal 11, surviv 10, time 10, exposur 10, anim 10, treat 10, dai 9, treatment 9, irradi 8

Double Word Terms
bacillu.anthraci 16, inhal.anthrax 6, lethal.dose 5, anthrax.spore 5, anthraci.stern 5, stern.spore 4, gamma.irradi 4, anthraci.spore 4, treat.anim 4, unit.state 4, postal.system 3, incub.period 3, infect.anim 3, high.dose 3, irradi.mice 3

Triple Word Terms
anthraci.stern.spore 4, incub.period.distribut 3, bacillu.anthraci.spore 3, model.incub.period 3, dose.inhal.spore 3, bacillu.anthraci.stern 3, stern.spore.dai 2, spore.bacillu.anthraci 2, bacillu.anthraci.am 2, bacillu.anthraci.infect 2, outbreak.inhal.anthrax 2, anthrax.unit.state 2, dose.bacillu.anthraci 1, anthrax.spore.sent 1, exposur.anthrax.spore 1

Term Cliques
40.63% anim inhal treat antibiot
46.88% anim infect inhal treat
39.58% surviv anim mice infect inocul treat
48.33% spore surviv anim treat antibiot
43.75% spore surviv anim mice inocul treat
39.17% dose inhal risk respir exposur
44.17% dose inhal risk antibiot exposur
47.92% dose infect inhal respir
50.00% dose anim inhal antibiot
56.25% dose anim infect inhal
45.83% dose surviv anim mice infect inocul
46.67% dose spore risk respir exposur
51.67% dose spore risk antibiot exposur
55.83% dose spore surviv antibiot exposur
55.83% dose spore surviv anim antibiot
50.00% dose spore surviv anim mice inocul
46.67% irradi spore surviv mice treat
52.08% irradi dose spore kgy
54.17% irradi dose spore surviv mice

Sample Cluster Record Titles

Risk-based selection of respirators against infectious aerosols: Application to anthrax spores

On the risk of mortality to primates exposed to anthrax spores

Anthrax: Biology of Bacillus anthracis

Postexposure prophylaxis against anthrax: Evaluation of various treatment regimens in intranasally infected guinea pigs

Antimicrobial therapy for Bacillus anthracis-induced polymicrobial infection in Co-60 gamma-irradiated mice

A risk analysis approach to selecting respiratory protection against airborne pathogens used for bioterrorism

Cluster Metrics

Authors

shoemaker, mo 3; elliott, tb 3; brookmeyer, r 3; brook, i 3; thakar, jh 2; nicas, m 2; ledney, gd 2; johnson, e 2; jackson, we 2; giraldo, de 2

Sources

infection and immunity 3; journal of antimicrobial chemotherapy 2; antimicrobial agents and chemotherapy 2; aiha journal 2; statistics in medicine 1; risk analysis 1; proceedings of the national academy of sciences of the united states of america 1; letters in applied microbiology 1; laboratory animal science 1; journal of veterinary medicine series b-zentralblatt fur veterinarmedizin reihe b-infectious diseases and veterinary public health 1

Keywords

anthrax 5; microbiology 5; susceptibility 4; pharmacology & pharmacy 4; bioterrorism 4; public, environmental & occupational health 3; occupational health 3; microbiology 3; infectious diseases 3; immunology 3

Country

usa 20; israel 1; india 1; england 1

Institution

armed forces radiobiol res inst 4; usa 3; univ calif berkeley 2; johns hopkins bloomberg sch publ hlth 2; vet adm med ctr 1; us secret serv 1; univ new mexico 1; univ nebraska 1; univ michigan 1; univ louisville 1

- # CLUSTER 48
  Decontamination and cleanup of biological warfare agents (22 Records)

Cluster Syntax Features

Descriptive Terms
decontamin 9.6%, warfar 4.0%, warfar.agent 4.0%, agent 3.8%, biolog 3.6%, biolog.warfar.agent 3.5%, biolog.warfar 2.9%, cleanup 2.7%, spore 2.6%, environment 2.0%, materi 1.6%, simul 1.5%, sampl 1.4%, letter 1.3%, chemic 1.2%

Discriminating Terms
decontamin 6.8%, warfar.agent 2.8%, biolog.warfar.agent 2.5%, warfar 2.5%, cleanup 1.9%, biolog.warfar 1.8%, vaccin 1.4%, biolog 1.2%, agent 1.1%, cell 1.1%, protein 1.0%, strain 1.0%, environment 0.9%, toxin 0.9%, gene 0.9%

Single Word Terms
biolog 16, agent 16, spore 13, anthrax 12, bacillu 11, warfar 10, environment 9, anthraci 9, sampl 8, time 8, potenti 8, decontamin 8, simul 7, chemic 6, materi 6

Double Word Terms
biolog.warfar 9, bacillu.anthraci 9, warfar.agent 8, anthraci.spore 5, agent.simul 4, biolog.agent 4, bacteri.spore 3, spore.biolog 3, bacillu.subtili 3, chemic.biolog 3, unit.state 3, contamin.letter 2, homeland.secur 2, atrophaeu.bacillu 2, spore.simul 2

Triple Word Terms
biolog.warfar.agent 8, bacillu.anthraci.spore 5, bacillu.atrophaeu.bacillu 2, warfar.agent.bacillu 1, simul.bacillu.anthraci 1, format.bacillu.anthraci 1, long.term.monitor 1, bacillu.subtili.spore 1, clostridium.botulinum.toxin 1, time.resolv.fluoresc 1, caus.agent.anthrax 1, am.strain.spore 1, anthrax.contamin.letter 1, agent.bacillu.anthraci 1, surrog.bacillu.anthraci 1

Term Cliques
24.24% materi letter chemic
47.27% agent biolog materi sampl chemic
46.36% agent biolog materi simul chemic
56.36% agent biolog spore environment sampl
55.45% agent biolog biolog.warfar spore simul
57.27% agent biolog biolog.warfar spore environment
46.10% warfar warfar.agent agent biolog biolog.warfar.agent simul chemic
48.05% warfar warfar.agent agent biolog biolog.warfar.agent biolog.warfar simul
47.27% decontamin agent biolog materi chemic
42.05% decontamin warfar warfar.agent agent biolog biolog.warfar.agent cleanup chemic
43.43% decontamin warfar warfar.agent agent biolog biolog.warfar.agent biolog.warfar cleanup environment

Sample Cluster Record Titles

Decontamination issues for chemical and biological warfare agents: how clean is clean enough?

Rapid recovery and identification of anthrax bacteria from the environment

Deleterious effects of electron beam radiation on allergen extracts

Destruction of bacterial spores by phenomenally high efficiency non-contact ultrasonic transducers

Novel sample preparation method for safe and rapid detection of Bacillus anthracis spores in environmental powders and nasal swabs

How clean is clean enough? Recent developments in response to threats posed by chemical and biological warfare agents

Cluster Metrics

Authors

raber, e 2; kirvel, rd 2; zook, c 1; zapata, am 1; woodall, jp 1; winkel, rj 1; wilkening, da 1; walters, ra 1; walt, dr 1; wallace, wh 1

Sources

international journal of environmental health research 2; ieee sensors journal 2; environmental science & technology 2; tropical veterinary diseases 1; radiation physics and chemistry 1; public opinion quarterly 1; physics of plasmas 1; optics express 1; materials research innovations 1; journal of infection 1

Keywords

spores 6; anthrax 5; environmental sciences 5; management 4; physics, applied 3; bacillus-anthracis 3; public, environmental & occupational health 2; optics 2; occupational health 2; materials science, multidisciplinary 2

Country

usa 19; switzerland 1; ny 1; ga 1; england 1; canada 1

Institution

usaf 2; univ s florida 2; tufts univ 2; walter reed army med ctr 1; veridian inc 1; usn 1; usa 1; us mil acad 1; univ zurich hosp 1; univ zurich 1

- # CLUSTER 42
  Sampling for anthrax spores in potentially contaminated sites, including nasal swabs in humans (27 Records)

Cluster Syntax Features

Descriptive Terms
spore 11.9%, sampl 7.0%, swab 5.9%, contamin 4.8%, anthraci.spore 4.7%, anthrax.spore 2.5%, anthraci 1.4%, machin 1.4%, mail 1.4%, exposur 1.3%, letter 1.3%, facil 1.1%, bacillu.anthraci.spore 1.1%, envelop 1.1%, carcass 1.0%

Discriminating Terms
swab 4.5%, sampl 3.3%, spore 3.2%, contamin 2.8%, anthraci.spore 2.7%, anthrax.spore 1.4%, strain 1.3%, cell 1.3%, protein 1.2%, vaccin 1.2%, toxin 1.1%, machin 1.1%, gene 0.9%, letter 0.8%, nasal.swab 0.8%

Single Word Terms
spore 27, anthrax 22, bacillu 22, anthraci 21, contamin 20, sampl 16, swab 10, mail 10, collect 10, exposur 10, aerosol 10, potenti 9, inhal 9, concentr 9, conduct 8

Double Word Terms
bacillu.anthraci 21, anthraci.spore 17, anthrax.spore 10, sampl.collect 5, spore.contamin 5, swab.sampl 5, environment.sampl 4, postal.facil 4, nasal.swab 4, inhal.anthrax 4, exposur.anthrax 3, detect.anthraci 3, unit.state 3, facil.washington 3, anthraci.contamin 3

Triple Word Terms
bacillu.anthraci.spore 11, envelop.bacillu.anthraci 3, number.anthrax.spore 3, postal.facil.washington 3, contamin.bacillu.anthraci 2, contamin.anthrax.spore 2, anthrax.spore.contamin 2, growth.bacillu.anthraci 2, anthrax.spore.detect 2, exposur.anthraci.spore 2, attack.bacillu.anthraci 2, detect.anthraci.spore 2, contamin.anthraci.spore 2, exposur.anthrax.spore 2, form.gram.posit 1

Term Cliques
35.45% spore machin mail exposur letter facil envelop
45.27% spore anthraci.spore anthraci machin mail exposur facil bacillu.anthraci.spore envelop
40.74% spore contamin machin mail letter facil envelop
48.68% spore contamin anthraci machin mail facil envelop
55.56% spore contamin anthrax.spore carcass
58.33% spore contamin anthrax.spore letter
35.45% spore swab machin exposur letter facil envelop
45.27% spore swab anthraci.spore anthraci machin exposur facil bacillu.anthraci.spore envelop
41.27% spore sampl machin mail exposur letter facil
49.79% spore sampl anthraci.spore anthraci machin mail exposur facil bacillu.anthraci.spore
61.11% spore sampl contamin carcass
46.56% spore sampl contamin machin mail letter facil
54.50% spore sampl contamin anthraci machin mail facil
41.27% spore sampl swab machin exposur letter facil
49.79% spore sampl swab anthraci.spore anthraci machin exposur facil bacillu.anthraci.spore

Sample Cluster Record Titles

Airborne movement of anthrax spores from carcass sites in the Etosha National Park, Namibia

Comparison of noninvasive sampling sites for early detection of Bacillus anthracis spores from rhesus monkeys after aerosol exposure

Detection of anthrax spores in endemic regions of northern Canada

Mailborne transmission of anthrax: Modeling and implications

Ozone and anthrax - Knowns and unknowns

Large-scale screening of nasal swabs for Bacillus anthracis: Descriptive summary and discussion of the National Institutes of Health's experience

Opening a Bacillus anthracis-containing envelope, Capitol Hill, Washington, DC: The public health response

Bacillus anthracis aerosolization associated with a contaminated mail sorting machine

Cluster Metrics

Authors

whitney, eas 2; sanderson, wt 2; popovic, t 2; dragon, dc 2; canter, da 2; arduino, mj 2; woollen, n 1; wong, a 1; witebsky, fg 1; wilson, ke 1

Sources

emerging infectious diseases 6; journal of applied microbiology 3; ozone-science & engineering 2; journal of occupational and environmental hygiene 2; jama-journal of the american medical association 2; applied and environmental microbiology 2; soil science 1; proceedings of the national academy of sciences of the united states of america 1; military medicine 1; journal of toxicology and environmental health-part a-current issues 1

Keywords

immunology 6; microbiology 6; infectious diseases 6; public, environmental & occupational health 5; occupational health 5; biotechnology & applied microbiology 5; public, environmental & 5; environmental sciences 5; medicine, general & internal 3; anthrax 3

Country

usa 23; canada 3; namibia 1; finland 1; england 1; australia 1

Institution

ctr dis control & prevent 6; usa 3; us epa 3; natl naval med res inst 2; wood buffalo natl pk 1; vet adm med ctr 1; vanderbilt univ 1; us phs 1; us dept justice 1; us dept def 1

- # CLUSTER 11
  Germination of bacillus anthracis spores and endospores (19 Records)

Cluster Syntax Features

Descriptive Terms
germin 43.1%, spore 9.6%, endospor 5.0%, alanin 2.2%, inosin 1.8%, kill 1.7%, germin.respons 1.3%, gerh 1.2%, esteras 0.8%, lyas 0.7%, ab 0.7%, membran.potenti 0.6%, cell.germin 0.6%, spore.germin 0.6%, macrophag 0.6%

Discriminating Terms
germin 27.8%, endospor 3.1%, spore 1.9%, alanin 1.3%, inosin 1.2%, vaccin 1.1%, toxin 0.9%, germin.respons 0.9%, anthrax 0.8%, gerh 0.8%, kill 0.8%, protein 0.7%, cell 0.6%, gene 0.6%, esteras 0.5%

Single Word Terms
bacillu 19, germin 18, spore 15, anthraci 14, strain 10, endospor 9, alanin 8, role 8, cell 7, essenti 6, activ 6, respons 6, inosin 6, acid 6, mutant 5

Double Word Terms
bacillu.anthraci 13, spore.germin 7, germin.spore 5, anthraci.spore 5, germin.receptor 5, endospor.germin 5, alanin.inosin 5, veget.cell 4, germin.alanin 4, bacillu.cereu 4, alanin.germin 4, germin.respons 4, spore.form 3, wild.type 3, operon.bacillu 3

Triple Word Terms
bacillu.anthraci.spore 5, germin.bacillu.anthraci 3, anti.spore.anti 2, anthraci.spore.germin 2, operon.bacillu.anthraci 2, transmiss.electron.microscopi 1, periton.macrophag.macrophag 1, express.bacillu.anthraci 1, rapid.identif.anthraci 1, atom.forc.microscopi 1, forc.microscopi.afm 1, wild.type.mutant 1, bacillu.anthraci.caus 1, anthraci.caus.agent 1, caus.agent.anthrax 1

Term Cliques
31.58% endospor alanin lyas
42.11% spore alanin lyas
40.79% germin kill cell.germin macrophag
43.42% germin kill cell.germin spore.germin
39.47% germin kill ab macrophag
40.79% germin kill gerh macrophag
43.16% germin alanin inosin ab spore.germin
50.88% germin endospor membran.potenti
42.11% germin endospor inosin germin.respons gerh
47.37% germin endospor alanin inosin germin.respons
61.40% germin spore membran.potenti
49.47% germin spore kill ab spore.germin
52.63% germin spore alanin ab spore.germin
51.58% germin spore alanin esteras spore.germin

Sample Cluster Record Titles

Amino acid- and purine ribonucleoside-induced germination of Bacillus anthracis Delta Sterne endospores: gerS mediates responses to aromatic ring structures

Germination of Bacillus cereus spores in response to L-alanine and to inosine: the roles of gerL and gerQ operons

A bacteriolytic agent that detects and kills Bacillus anthracis

Macrophage-enhanced germination of Bacillus anthracis endospores requires gerS

In-vitro characterisation of the phagocytosis and fate of anthrax spores in macrophages and the effects of anti-PA antibody

Identification and characterization of the gerH operon of Bacillus anthracis endospores: a differential role for purine nucleosides in germination

Macrophage-mediated germination of Bacillus anthracis endospores requires the gerH operon

A microtiter fluorometric assay to detect the germination of Bacillus anthracis spores and the germination inhibitory effects of antibodies

Cluster Metrics

Authors

hanna, pc 4; weiner, ma 2; laflamme, c 2; ireland, jaw 2; hornstra, lm 2; ho, j 2; hibbs, s 2; duchaine, c 2; de vries, yp 2; de vos, wm 2

Sources

infection and immunity 3; journal of bacteriology 2; journal of applied microbiology 2; fems microbiology letters 2; proteomics 1; nature 1; microscopy research and technique 1; microbiology-sgm 1; journal of microbiological methods 1; journal of medical microbiology 1

Keywords

microbiology 8; germination 7; subtilis 6; anthracis 5; trigger 4; thuringiensis 4; spores 4; resistance 4; proteins 4; microbiology 4

Country

usa 13; netherlands 2; canada 2; india 1; england 1

Institution

univ michigan 4; usa 2; univ maryland 2; univ laval 2; duke univ 2; wageningen ur 1; wageningen univ 1; wageningen ctr food sci 1; vaxin inc 1; usn 1

- # CLUSTER 3
  Bacillus anthracis exosporium, especially the major BclA glycoprotein layer coating the spore surface (17 Records)

Cluster Syntax Features

Descriptive Terms
exosporium 15.5%, bcla 11.1%, spore 8.5%, coat 8.5%, layer 4.0%, glycoprotein 2.2%, protein 2.1%, coat.protein 2.0%, collagen 1.9%, spore.coat 1.5%, surfac 1.3%, structur 1.2%, spore.surfac 1.1%, outer 1.1%, nap 1.0%

Discriminating Terms
exosporium 10.4%, bcla 7.5%, coat 5.3%, layer 2.0%, glycoprotein 1.5%, spore 1.5%, coat.protein 1.3%, vaccin 1.2%, collagen 1.2%, toxin 1.0%, spore.coat 1.0%, anthrax 0.8%, cell 0.8%, spore.surfac 0.7%, nap 0.7%

Single Word Terms
spore 17, bacillu 17, anthraci 15, exosporium 15, protein 14, layer 13, structur 13, glycoprotein 11, surfac 10, microscopi 9, gene 9, bcla 9, collagen 9, electron 8, outer 8

Double Word Terms
bacillu.anthraci 14, spore.bacillu 8, bacillu.cereu 8, anthraci.spore 8, electron.microscopi 7, spore.surfac 6, coat.protein 6, spore.coat 6, bacillu.subtili 6, agent.anthrax 5, glycoprotein.bcla 5, wild.type 5, outer.spore 4, structur.compon 4, bacillu.thuringiensi 4

Triple Word Terms
bacillu.anthraci.spore 5, spore.bacillu.anthraci 5, spore.coat.protein 4, outer.spore.coat 4, promin.loos.fit 3, collagen.glycoprotein.bcla 3, basal.layer.extern 3, atom.forc.microscopi 3, exosporium.basal.layer 3, anthrax.enclos.promin 3, bacillu.anthraci.caus 3, enclos.promin.loos 3, anthraci.caus.agent 3, caus.agent.anthrax 3, bcla.structur.compon 3

Term Cliques
69.75% exosporium spore protein surfac structur spore.surfac outer
65.55% exosporium spore coat protein coat.protein surfac outer
62.18% exosporium spore coat protein coat.protein spore.coat outer
72.06% exosporium spore coat layer protein surfac structur outer
68.07% exosporium spore coat layer protein spore.coat outer
68.38% exosporium bcla spore protein collagen surfac structur spore.surfac
66.18% exosporium bcla spore glycoprotein collagen surfac structur spore.surfac
73.53% exosporium bcla spore layer protein collagen surfac structur
66.91% exosporium bcla spore layer glycoprotein collagen structur nap
71.32% exosporium bcla spore layer glycoprotein collagen surfac structur

Sample Cluster Record Titles

A collagen-like surface glycoprotein is a structural component of the Bacillus anthracis exosporium

Proteomic analysis of the spore coats of Bacillus subtilis and Bacillus anthracis

Polymorphism in the collagen-like region of the Bacillus anthracis BclA protein leads to variation in

exosporium filament length

Identification of the immunodominant protein and other proteins of the Bacillus anthracis exosporium

Genes of Bacillus cereus and Bacillus anthracis encoding proteins of the exosporium

Morphogenesis of Bacillus spore surfaces

Identification of proteins in the exosporium of Bacillus anthracis

Characterization of a major Bacillus anthracis spore coat protein and its role in spore inactivation

Cluster Metrics

Authors

turnbough, cl 4; sylvestre, p 3; steichen, ct 3; moir, a 3; mock, m 3; driks, a 3; couture-tosi, e 3; chen, p 3; wang, r 2; waller, ln 2

Sources

journal of bacteriology 12; molecular microbiology 1; microbiology-sgm 1; langmuir 1; journal of microbiological methods 1; journal of biological chemistry 1

Keywords

microbiology 13; subtilis 7; cereus 6; identification 5; glycoprotein 5; germination 4; cloning 4; thuringiensis 3; spores 3; resistance 3

Country

usa 12; france 3; england 3

Institution

univ sheffield 3; univ alabama 3; loyola univ 3; inst pasteur 3; univ s carolina 2; iit 2; usn 1; univ missouri 1; univ michigan 1; uab 1

- # CLUSTER 62
  Inactivation of bacillus anthracis spores (45 Records)

Cluster Syntax Features

Descriptive Terms
spore 35.9%, inactiv 1.6%, subtili 1.5%, veget 1.3%, anthraci.spore 1.3%, spore.bacillu 1.2%, speci 1.2%, radiat 1.2%, min 0.9%, log 0.9%, disinfect 0.9%, anthraci 0.8%, spore.surfac 0.8%, bacillu 0.8%, surfac 0.7%

Discriminating Terms
spore 19.6%, vaccin 1.4%, toxin 1.3%, inactiv 1.1%, radiat 0.9%, spore.bacillu 0.9%, anthrax 0.8%, veget 0.8%, protein 0.8%, diseas 0.8%, disinfect 0.7%, gene 0.7%, log 0.7%, spore.surfac 0.6%, protect 0.6%

Single Word Terms
bacillu 42, spore 42, anthraci 32, speci 19, surfac 17, cereu 17, subtili 16, strain 16, cell 15, inactiv 13, bacteri 12, stern 12, high 12, veget 12, anthrax 11

Double Word Terms
bacillu.anthraci 27, spore.bacillu 18, anthraci.spore 16, bacillu.cereu 12, veget.cell 10, bacillu.speci 10, bacillu.subtili 9, cell.spore 7, anthrax.spore 7, bacteri.spore 6, anthraci.stern 6, bacillu.spore 6, spore.anthraci 6, spore.surfac 6, spore.form 5

Triple Word Terms
bacillu.anthraci.spore 8, spore.bacillu.anthraci 8, veget.cell.spore 6, spore.bacillu.speci 5, spore.bacillu.cereu 4, bacillu.cereu.spore 4, anthraci.stern.spore 3, surrog.bacillu.anthraci 3, reduct.log.cfu 3, bind.spore.speci 3, phage.displai.peptid 3, cell.spore.bacillu 3, potenti.surrog.bacillu 3, kill.veget.cell 3, strain.bacillu.anthraci 3

Term Cliques
38.67% inactiv min disinfect bacillu surfac
21.33% inactiv radiat disinfect spore.surfac surfac
23.89% inactiv spore.bacillu radiat disinfect
38.52% inactiv anthraci.spore spore.bacillu min disinfect bacillu
57.14% spore anthraci.spore spore.bacillu speci min anthraci bacillu
38.52% spore veget speci log spore.surfac surfac
47.94% spore veget speci min log bacillu surfac
52.70% spore veget speci min log anthraci bacillu
55.87% spore veget spore.bacillu speci min anthraci bacillu
54.81% spore subtili veget speci bacillu surfac
41.48% spore subtili veget speci spore.surfac surfac
55.19% spore subtili veget spore.bacillu speci bacillu
49.26% spore inactiv min log bacillu surfac
54.81% spore inactiv min log anthraci bacillu
34.81% spore inactiv radiat log spore.surfac surfac
55.24% spore inactiv anthraci.spore spore.bacillu min anthraci bacillu
57.78% spore inactiv subtili bacillu surfac
37.78% spore inactiv subtili radiat spore.surfac surfac
58.22% spore inactiv subtili spore.bacillu bacillu
43.11% spore inactiv subtili spore.bacillu radiat

Sample Cluster Record Titles

Molecular recognition specificity of Bacillus anthracis spore antibodies

A novel surfactant nanoemulsion with broad-spectrum sporicidal activity against Bacillus species

Pulsed microwave induced bioeffects

On the fate of ingested Bacillus spores

Molecular recognition specificity of Bacillus globigii spore antibodies

Evaluation of spore extraction and purification methods for selective recovery of viable Bacillus anthracis spores

Molecular investigation of the Aum Shinrikyo anthrax release in Kameido, Japan

Cluster Metrics

Authors

turnbough, cl 3; nicholson, wl 3; lee, sh 3; williams, dd 2; tremblay, me 2; sigmund, w 2; seaman, rl 2; scouten, aj 2; roselle, bj 2; rose, lj 2

Sources

applied and environmental microbiology 8; letters in applied microbiology 3; journal of food protection 3; journal of infectious diseases 2; journal of clinical microbiology 2; journal of applied microbiology 2; ieee transactions on plasma science 2; research in microbiology 1; radiation research 1; process safety and environmental protection 1

Keywords

biotechnology & applied microbiology 17; microbiology 17; spores 7; water 6; anthracis 6; cereus 5; microbiology 4; subtilis spores 4; exosporium 4; biophysics 4

Country

usa 34; japan 4; france 2; south korea 1; peoples r china 1; italy 1; israel 1; canada 1; belgium 1

Institution

usa 3; univ arizona 3; univ alabama 3; veridian inc 2; usaf 2; us epa 2; univ michigan 2; univ georgia 2; univ florida 2; univ calif berkeley 2

- # CLUSTER 7
  Detection and identification of bacillus anthracis spores using mass spectrometry, especially MALDI TOF, with some emphasis on small, acid-soluble protein bio-markers (16 Records)

Cluster Syntax Features

Descriptive Terms
sasp 8.9%, mass 8.9%, maldi 4.5%, biomark 3.6%, spectrometri 3.2%, databas 3.0%, proteom 2.9%, mass.spectrometri 2.9%, identif 2.8%, speci 2.6%, protein 2.1%, spore 2.1%, tryptic 1.8%, extract 1.3%, plasma 1.1%

Discriminating Terms
sasp 6.1%, mass 5.0%, maldi 3.0%, biomark 2.4%, spectrometri 2.0%, proteom 1.8%, mass.spectrometri 1.8%, databas 1.8%, vaccin 1.3%, tryptic 1.2%, identif 1.2%, toxin 1.0%, anthrax 0.9%, gene 0.7%, plasma 0.6%

Single Word Terms
mass 14, protein 13, identif 12, rapid 11, spectrometri 11, bacillu 11, speci 11, spore 10, ioniz 9, acid 9, anthraci 8, detect 8, databas 8, sequenc 8, small 7

Double Word Terms
mass.spectrometri 11, laser.desorpt 7, matrix.laser 7, bacillu.speci 7, desorpt.ioniz 6, small.acid 6, acid.solubl 6, time.flight 5, tryptic.peptid 5, protein.sasp 5, solubl.protein 5, rapid.identif 5, bacillu.anthraci 4, tryptic.digest 4, flight.mass 4

Triple Word Terms
matrix.laser.desorpt 7, laser.desorpt.ioniz 6, small.acid.solubl 6, acid.solubl.protein 5, time.flight.mass 4, solubl.protein.sasp 4, flight.mass.spectrometri 4, desorpt.ioniz.time 3, ioniz.time.flight 3, rapid.identif.bacillu 2, high.liquid.chromatographi 2, tandem.mass.spectrometri 2, detect.pathogen.bacteria 2, ioniz.mass.spectrometri 2, bacillu.speci.anthraci 2

Term Cliques
57.50% spectrometri mass.spectrometri speci spore plasma
61.46% mass databas proteom identif protein tryptic
61.72% mass maldi biomark spectrometri mass.spectrometri identif spore extract
64.84% mass maldi biomark spectrometri mass.spectrometri identif speci spore
61.46% sasp mass identif protein tryptic extract
62.50% sasp mass databas identif protein tryptic
60.71% sasp mass databas identif speci spore tryptic
66.07% sasp mass spectrometri mass.spectrometri identif protein extract
56.25% sasp mass maldi identif spore tryptic extract
59.82% sasp mass maldi identif speci spore tryptic
60.94% sasp mass maldi spectrometri mass.spectrometri identif spore extract
64.06% sasp mass maldi spectrometri mass.spectrometri identif speci spore

Sample Cluster Record Titles

Decontamination of chemical and biological warfare, (CBW) agents using an atmospheric pressure plasma jet (APPJ)

Rapid characterization of spores of Bacillus cereus group bacteria by matrix-assisted laser desorption-ionization time-of-flight mass spectrometry

Detection of specific Bacillus anthracis spore biomarkers by matrix-assisted laser desorption/ionization time-of-flight mass spectrometry

Small, acid-soluble proteins as biomarkers in mass spectrometry analysis of Bacillus spores

Characterization of Bacillus spore species and their mixtures using postsource decay with a curved-field reflectron

Bacillus spore identification via proteolytic peptide mapping with a miniaturized MALDI TOF mass spectrometer

Cluster Metrics

Authors
fenselau, c 7; warscheid, b 4; hathout, y 3; ross, pl 2; krishnamurthy, t 2; whiteaker, jr 1; verberkmoes, nc 1; van berkel, gj 1; song, j 1; shah, m 1

Sources
rapid communications in mass spectrometry 3; applied and environmental microbiology 3; analytical chemistry 3; journal of mass spectrometry 2; proteomics 1; physics of plasmas 1; johns hopkins apl technical digest 1; ieee transactions on plasma science 1; biochimica et biophysica acta-proteins and proteomics 1

Keywords
chemistry, analytical 6; spectroscopy 5; mixtures 4; anthracis 4; biotechnology & applied microbiology 3; whole cells 3; subtilis 3; rapid identification 3; proteins 3; microorganism identification 3

Country
usa 12; israel 1; germany 1

Institution
univ maryland 7; johns hopkins univ 2; univ tennessee 1; univ giessen 1; univ connecticut 1; univ calif los alamos natl lab 1; oak ridge natl lab 1; microenergy technol inc 1; max planck inst mol genet 1; max planck inst marine mikrobiol 1

- # CLUSTER 5
  Detection of pathogenic bacteria by mass spectrometric profiling of fatty acids, with emphasis on pyrolysis mass spectrometry (13 Records)

Cluster Syntax Features

Descriptive Terms
fatti.acid 7.4%, fatti 7.4%, ion 5.6%, spectra 4.5%, fame 4.2%, acid 3.2%, pyrolysi 3.2%, mass 2.5%, ioniz 2.3%, profil 2.3%, methyl 1.8%, spectrometri 1.5%, bacteri 1.4%, whole 1.3%, thermal.hydrolysi.methyl 1.1%

Discriminating Terms
fatti.acid 4.5%, fatti 4.5%, ion 3.0%, fame 2.7%, spectra 2.6%, pyrolysi 2.0%, ioniz 1.3%, profil 1.1%, vaccin 1.1%, methyl 1.0%, acid 1.0%, mass 1.0%, toxin 0.9%, anthrax 0.9%, strain 0.9%

Single Word Terms
acid 13, bacillu 12, anthraci 11, fatti 10, mass 10, bacteri 9, bacteria 9, spectrometri 8, ion 8, detect 8, whole 7, profil 6, ioniz 6, speci 6, neg 6

Double Word Terms
fatti.acid 10, bacillu.anthraci 10, mass.spectrometri 7, dipicolin.acid 5, thermal.hydrolysi 4, whole.cell 4, ion.trap 4, electron.ioniz 4, hydrolysi.methyl 4, methyl.ester 4, gram.posit 3, bacillu.cereu 3, situ.thermal 3, whole.bacteria 3, yersinia.pesti 3

Triple Word Terms
thermal.hydrolysi.methyl 4, profil.fatti.acid 3, methyl.ester.fame 3, acid.methyl.ester 3, situ.thermal.hydrolysi 3, dipicolin.acid.dpa 3, fatti.acid.profil 3, quadrupol.ion.trap 3, ion.trap.mass 3, fatti.acid.methyl 3, gram.neg.bacteria 2, gram.posit.gram 2, posit.gram.neg 2, anthraci.bacillu.cereu 2, bacillu.anthraci.bacillu 2

Term Cliques
58.46% acid pyrolysi mass methyl hydrolysi.methyl
61.54% ion acid pyrolysi mass hydrolysi.methyl
67.69% ion acid pyrolysi mass spectrometri
67.52% fatti.acid fatti acid mass ioniz profil spectrometri bacteri whole
60.77% fatti.acid fatti fame acid mass profil methyl bacteri whole hydrolysi.methyl
68.27% fatti.acid fatti ion acid mass bacteri whole hydrolysi.methyl
66.92% fatti.acid fatti ion spectra acid mass ioniz spectrometri bacteri whole

Sample Cluster Record Titles

Pathogenic bacteria: their detection and differentiation by rapid lipid profiling with pyrolysis mass spectrometry

The effects of electron and chemical ionization modes on the MS profiling of whole bacteria

Rapid chemotaxonomy of pathogenic bacteria using in situ thermal hydrolysis and methylation as a sample preparation step coupled with a field-portable membrane-inlet quadrupole ion trap mass spectrometer

Direct mass spectrometric analysis of Bacillus spores

Labelled trinucleotides as quantitative probes to identify Bacillus spp. using fluorescent probes to identify in situ hybridization

Repeatability and pattern recognition of bacterial fatty acid profiles generated by direct mass spectrometric analysis of in situ thermal hydrolysis/methylation of whole cells

Identification of foodborne bacteria by infrared spectroscopy using cellular fatty acid methyl esters

Evaluation of a micro-fabricated pyrolyzer for the detection of Bacillus anthracis spores

Cluster Metrics

Authors

voorhees, kj 7; hadfield, tl 5; basile, f 5; beverly, mb 4; yurawecz, mp 2; whittaker, p 2; mossoba, mm 2; fry, fs 2; dunkel, vc 2; xu, m 1

Sources

rapid communications in mass spectrometry 2; journal of microbiological methods 2; trac-trends in analytical chemistry 1; talanta 1; molecular and cellular probes 1; journal of the american society for mass spectrometry 1; journal of analytical and applied pyrolysis 1; journal of agricultural and food chemistry 1; international journal of mass spectrometry 1; asian journal of chemistry 1

Keywords

chemistry, analytical 7; spectroscopy 5; biochemical research methods 3; strains 3; pyrolysis 3; microorganisms 3; identification 3; gas-chromatography 3; differentiation 3; bacteria 3

Country

usa 12; spain 1; south korea 1; india 1

Institution

colorado sch mines 7; armed forces inst pathol 6; geocenters inc 2; univ girona 1; sandia natl labs 1; osas 1; opdfb 1; onplds 1; kwangju inst sci & technol 1; fds 1

- # CLUSTER 10
  Detection of anthrax spores with Raman spectroscopy, emphasizing signal detection from dipicolinic acid in spores (19 Records)

Cluster Syntax Features

Descriptive Terms
dpa 9.5%, raman 7.3%, ser 7.2%, coher 4.0%, spectroscopi 3.6%, porphyrin 2.6%, spore 2.5%, car 2.3%, raman.spectroscopi 2.0%, spectra 2.0%, detect 1.9%, dipicolin 1.9%, bacteri.spore 1.6%, dipicolin.acid 1.5%, vibrat 1.3%

Discriminating Terms
dpa 5.8%, raman 4.5%, ser 4.3%, coher 2.5%, spectroscopi 2.0%, porphyrin 1.6%, car 1.4%, raman.spectroscopi 1.2%, dipicolin 1.1%, vaccin 1.1%, spectra 1.0%, strain 0.9%, cell 0.9%, toxin 0.9%, dipicolin.acid 0.9%

Single Word Terms
detect 14, raman 14, spectroscopi 14, spore 14, bacteri 13, dipicolin 12, acid 12, bacillu 11, anthrax 10, anthraci 9, spectra 8, dpa 8, molecul 7, signal 7, coher 7

Double Word Terms
dipicolin.acid 10, raman.spectroscopi 10, bacteri.spore 10, acid.dpa 8, bacillu.anthraci 6, surfac.raman 6, anti.stoke 6, coher.anti 6, stoke.raman 6, spore.anthrax 5, limit.detect 5, dpa.marker 5, marker.molecul 5, anthrax.spore 4, raman.scatter 4

Triple Word Terms
dipicolin.acid.dpa 8, anti.stoke.raman 6, coher.anti.stoke 6, acid.dpa.marker 5, stoke.raman.spectroscopi 5, bacteri.spore.anthrax 4, molecul.bacteri.spore 4, dpa.marker.molecul 4, raman.spectroscopi.car 4, marker.molecul.bacteri 4, raman.scatter.ser 3, surfac.raman.scatter 3, raman.spectroscopi.ser 3, surfac.raman.spectroscopi 3, simul.bacillu.anthraci 2

Term Cliques
42.11% porphyrin spectra detect
46.05% ser spectra detect vibrat
60.15% raman coher spectroscopi spore raman.spectroscopi detect vibrat
61.40% raman coher spectroscopi spore raman.spectroscopi detect dipicolin bacteri.spore dipicolin.acid
56.14% raman coher spectroscopi spore car raman.spectroscopi dipicolin bacteri.spore dipicolin.acid
57.02% raman ser spectroscopi raman.spectroscopi detect vibrat
46.32% dpa porphyrin detect bacteri.spore dipicolin.acid
57.89% dpa raman coher spore raman.spectroscopi detect dipicolin bacteri.spore dipicolin.acid
52.63% dpa raman coher spore car raman.spectroscopi dipicolin bacteri.spore dipicolin.acid

Sample Cluster Record Titles

Detection of anthrax simulants with microcalorimetric spectroscopy: Bacillus subtilis and Bacillus cereus spores

Detection and differentiation of biological species using microcalorimetric spectroscopy

Towards a FAST-CARS anthrax detector: CARS generation in a DPA surrogate molecule

Detecting Bacillus cereus spores on a mail sorting system using Raman spectroscopy

Interaction of dipicolinic acid with water-soluble and immobilized porphyrins

Mid-ultraviolet light-emitting diode detects dipicolinic acid

Towards a FAST-CARS anthrax detector: analysis of cars generation from DPA

Towards an anthrax detector using the femtosecond adaptive spectroscopic technique for coherent anti-Stokes Raman spectroscopy: coherent anti-Stokes Raman spectroscopy signal from dipicolinic acid in bacterial spores

Characterization of the Surface Enhanced Raman Scattering (SERS) of bacteria

Cluster Metrics

Authors

scully, mo 7; beadie, g 4; zhang, xy 3; van duyne, rp 3; reintjes, j 3; yonzon, cr 2; white, bj 2; sokolov, av 2; sariyanni, ze 2; rostovtsev, yv 2

Sources

journal of modern optics 3; journal of raman spectroscopy 2; journal of physical chemistry b 2; ultramicroscopy 1; talanta 1; sensors and actuators b-chemical 1; proceedings of the national academy of sciences of the united states of america 1; physical review a 1; optics express 1; optics communications 1

Keywords

optics 6; spectroscopy 6; identification 5; dipicolinic acid 5; anthrax 4; spectroscopy 3; dipicolinic acid 3; chemistry, analytical 3; spectra 3; photoluminescence 3

Country

usa 18; germany 2; north ireland 1

Institution

texas a&m univ 7; princeton univ 6; usn 5; northwestern univ 3; univ tennessee 2; oklahoma state univ 2; oak ridge natl lab 2; max planck inst quantum opt 2; w rock associates 1; univ wurzburg 1

- # CLUSTER 51
  Biosensor detection of bacillus anthracis spores (33 Records)

Cluster Syntax Features

Descriptive Terms
biosensor 8.2%, detect 7.1%, spore 2.7%, assai 2.1%, captur 2.0%, bioaerosol 1.6%, ecl 1.6%, electr 1.5%, optic 1.5%, dna 1.4%, charg 1.4%, probe 1.3%, target 1.2%, analyt 1.2%, label 1.0%

Discriminating Terms
biosensor 6.5%, detect 2.7%, captur 1.5%, vaccin 1.4%, bioaerosol 1.2%, ecl 1.2%, electr 1.1%, strain 1.1%, optic 1.0%, toxin 1.0%, charg 0.9%, anthrax 0.9%, analyt 0.8%, gene 0.8%, electr.charg 0.7%

Single Word Terms
detect 25, bacillu 23, anthraci 23, spore 17, assai 16, sensit 15, target 14, captur 13, biolog 13, two 13, cell 13, anthrax 13, singl 12, sampl 12, biosensor 12

Double Word Terms
bacillu.anthraci 17, bacillu.globigii 6, bacillu.subtili 6, biosensor.detect 6, anthraci.spore 6, nucleic.acid 6, assai.time 5, subtili.var 5, target.sequenc 5, var.niger 5, hybrid.target 5, bacteri.cell 4, sensit.detect 4, detect.pathogen 4, electr.field 4

Triple Word Terms
subtili.var.niger 5, nucleic.acid.sequenc 4, bacillu.subtili.var 4, acid.sequenc.amplif 3, sequenc.amplif.nasba 3, hybrid.target.sequenc 3, target.sequenc.hybrid 3, quantifi.hand.reflectomet 3, bacillu.anthraci.spore 3, captur.detect.zone 3, enzym.link.immunosorb 2, link.immunosorb.assai 2, bovin.serum.albumin 2, coloni.form.unit 2, singl.strand.dna 2

Term Cliques
21.21% ecl analyt label
28.79% ecl dna target label
27.27% ecl dna probe target
12.12% ecl electr
22.73% spore bioaerosol electr charg
43.43% biosensor detect assai dna probe target
43.72% biosensor detect assai captur dna target label
40.26% biosensor detect assai captur optic analyt label
43.43% biosensor detect spore captur optic label

Sample Cluster Record Titles

Comparative studies of magnetic particle-based solid phase fluorogenic and electrochemiluminescent immunoassay

Ultrasensitive, direct detection of a specific DNA sequence of Bacillus anthracis in solution

Effect of electrical charges and fields on injury and viability of airborne bacteria

Detection of DNA hybridization via fluorescent polymer superquenching

Design and collection efficiency of a new electrostatic precipitator for bioaerosol collection

Collection of airborne microorganisms by a new electrostatic precipitator

Nine-analyte detection using an array-based biosensor

Cluster Metrics

Authors

vo-dinh, t 4; reponen, t 4; grinshpun, sa 4; baeumner, aj 4; willeke, k 3; mainelis, g 3; anderson, gp 3; adhikari, a 3; yu, h 2; whitten, d 2

Sources

analytical chemistry 6; biosensors & bioelectronics 4; analytical and bioanalytical chemistry 3; langmuir 2; applied and environmental microbiology 2; aerosol science and technology 2; sensors and actuators b-chemical 1; new scientist 1; nano letters 1; molecular biology 1

Keywords

chemistry, analytical 12; dna 6; biosensor 5; system 5; spores 5; bacillus-anthracis 5; chemistry, physical 4; biophysics 4; biotechnology & applied microbiology 4; biosensor 4

Country

usa 30; russia 1; israel 1; france 1; england 1

Institution

univ cincinnati 5; oak ridge natl lab 4; cornell univ 4; usn 3; usa 3; univ texas 3; rutgers state univ 2; george mason univ 2; yale univ 1; veridian corp 1

- # CLUSTER 37
  Polymerase Chain Reaction for detection of bacillus anthracis spores (39 Records)

Cluster Syntax Features

Descriptive Terms
pcr 10.1%, spore 9.5%, detect 7.8%, dna 3.4%, real.time 2.9%, real 2.7%, sampl 2.2%, time 2.2%, assai 2.1%, soil 1.9%, rapid 1.7%, real.time.pcr 1.7%, time.pcr 1.7%, sensit 1.3%, bead 1.1%

Discriminating Terms
pcr 5.7%, detect 3.4%, spore 2.4%, real.time 2.1%, real 1.9%, vaccin 1.4%, time.pcr 1.3%, real.time.pcr 1.3%, toxin 1.2%, dna 1.2%, soil 1.1%, protein 1.1%, strain 1.0%, bead 0.9%, anthrax 0.8%

Single Word Terms
detect 35, bacillu 34, spore 30, pcr 29, anthraci 29, dna 27, time 24, rapid 23, sampl 20, sensit 20, assai 18, real 17, reaction 16, min 13, anthrax 13

Double Word Terms
bacillu.anthraci 27, real.time 17, anthraci.spore 13, time.pcr 11, polymeras.chain 11, chain.reaction 11, detect.spore 11, detect.bacillu 8, reaction.pcr 7, anthrax.spore 7, rapid.detect 6, pcr.assai 6, veget.cell 6, detect.anthrax 6, detect.anthraci 5

Triple Word Terms
real.time.pcr 11, polymeras.chain.reaction 11, bacillu.anthraci.spore 9, detect.bacillu.anthraci 7, chain.reaction.pcr 7, time.polymeras.chain 5, real.time.polymeras 5, detect.anthrax.spore 3, protect.antigen.gene 3, pathogen.identif.devic 2, bacillu.anthraci.caus 2, rugged.advanc.pathogen 2, anthraci.caus.agent 2, caus.agent.anthrax 2, detect.anthraci.spore 2

Term Cliques
51.28% detect assai sensit bead
61.54% detect assai rapid sensit
57.44% spore detect sampl sensit bead
57.69% spore detect sampl soil rapid sensit
51.92% pcr spore real.time real time rapid real.time.pcr time.pcr
53.21% pcr spore dna real.time real time real.time.pcr time.pcr
53.48% pcr spore detect soil rapid real.time.pcr time.pcr
59.71% pcr spore detect time rapid real.time.pcr time.pcr
61.54% pcr spore detect sampl soil rapid
68.80% pcr spore detect sampl time rapid
54.95% pcr spore detect dna soil real.time.pcr time.pcr
61.17% pcr spore detect dna time real.time.pcr time.pcr
63.25% pcr spore detect dna sampl soil
63.00% pcr spore detect dna sampl time bead

Sample Cluster Record Titles

Small-scale DNA sample preparation method for field PCR detection of microbial cells and spores in soil

Rapid pathogen detection using a microchip PCR array Instrument

In vitro selection of DNA aptamers to anthrax spores with electrochemiluminescence detection

Fluorescent detection techniques for real-time multiplex strand specific detection of Bacillus anthracis using rapid PCR

Polymerase chain reaction-ELISA to detect Bacillus anthracis from soil samples - limitations of present published primers

Cluster Metrics

Authors

belgrader, p 4; nasarabadi, s 3; watarai, m 2; uchida, i 2; pourahmadi, f 2; perdue, ml 2; okuzumi, m 2; northrup, ma 2; milanovich, f 2; mariella, r 2

Sources

applied and environmental microbiology 5; letters in applied microbiology 4; analytical chemistry 4; journal of applied microbiology 3; biosensors & bioelectronics 3; journal of food protection 2; ultrasound in medicine and biology 1; nucleic acids research 1; nature methods 1; molecular and cellular probes 1

Keywords

biotechnology & applied microbiology 15; microbiology 14; dna 7; polymerase-chain-reaction 6; chemistry, analytical 6; pcr 6; identification 6; polymerase chain-reaction 5; bacillus anthracis 5; microbiology 4

Country

usa 25; england 3; japan 2; germany 2; france 2; wales 1; south korea 1; mongol peo rep 1; india 1; finland 1

Institution

usa 4; usda 3; lawrence livermore natl lab 3; usn 2; usda ars 2; univ texas 2; univ calif lawrence livermore natl lab 2; obihiro univ agr & vet med 2; natl inst anim hlth 2; cepheid 2

CATEGORY 6 - 125A2

Bacillus cereus/ anthracis strain identification (458 REC)

THRUST 1

(Identification and differention of strains in bacillus cereus group)

- Characterization of bacillus anthrascis strains using Polymerase Chain Reaction, especially PCR analysis of sequences on plasmids pXO1 and pXO2 and chromosomal DNA, using primers to amplify DNA fragments (35 Records)
- Amplified fragment length polymorphism and single nucleotide polymorphism of microbial genomes to analyze isolates from anthracis bacillus strains and related bacillus species, followed by further confirmatory sequence analyses. (30 Records)
- Variable number tandem repeat sequences as markers for genotyping anthracis bacillus isolates (32 Records)
- Identification of bacillus anthracis species, using female genetalia to aid in species discrimination (11 Records)
- Sequencing of 16S rRNA gene, for identification of bacillus anthracis strains (30 Records)
- Differentiating among strains in the bacillus cereus group (51 Records)
- Identification of bacillus thuringiensis serovars and strains (21 Records)

THRUST 1

(Identification and differention of strains in bacillus cereus group)

(Descriptive Terms

cereu 9.3%, strain 8.4%, isol 4.4%, sequenc 3.5%, thuringiensi 3.4%, pcr 3.3%, speci 2.9%, group 2.3%, anthraci 1.5%, dna 1.5%, gene 1.4%, cereu.group 1.4%, 16 1.3%, genom 1.0%, (46.59%)

Single Word Terms

bacillu 173, strain 161, anthraci 137, sequenc 122, cereu 121, isol 115, gene 102, two 97, speci 97, dna 92, group 91, pcr 89, thuringiensi 84, on 65, genet 64

Double Word Terms

bacillu.anthraci 112, bacillu.cereu 88, cereu.group 60, bacillu.thuringiensi 50, cereu.thuringiensi 42, anthraci.strain 41, strain.cereu 34, strain.bacillu 32, cereu.strain 30, anthraci.isol 29, cereu.bacillu 29, 16.rrna 26, tandem.repeat 25, anthraci.cereu 21, dna.sequenc 21

Triple Word Terms

bacillu.cereu.group 29, bacillu.cereu.bacillu 26, number.tandem.repeat 20, variabl.number.tandem 20, fragment.length.polymorph 18, 16.rrna.gene 17, polymeras.chain.reaction 16, bacillu.anthraci.isol 14,

amplifi.fragment.length 14, cereu.bacillu.thuringiensi 13, tandem.repeat.vntr 12, bacillu.anthraci.bacillu 12, strain.cereu.group 12, bacillu.anthraci.strain 12, cereu.group.strain 11)

- # CLUSTER 44
  Characterization of bacillus anthrascis strains using Polymerase Chain Reaction, especially PCR analysis of sequences on plasmids pXO1 and pXO2 and chromosomal DNA, using primers to amplify DNA fragments (35 Records)

Cluster Syntax Features

Descriptive Terms
pcr 11.2%, primer 4.0%, strain 4.0%, pxo1 3.0%, dna 2.8%, probe 2.5%, anthraci 2.4%, amplif 2.2%, assai 1.9%, plasmid 1.7%, detect 1.6%, amplifi 1.5%, anthraci.strain 1.4%, pxo2 1.4%, pxo1.pxo2 1.4%

Discriminating Terms
pcr 6.5%, primer 2.7%, spore 2.0%, pxo1 1.9%, amplif 1.5%, probe 1.5%, protein 1.2%, toxin 1.1%, cell 1.1%, amplifi 1.0%, pxo1.pxo2 1.0%, ba813 0.9%, vaccin 0.9%, anthrax 0.9%, pxo2 0.9%

Single Word Terms
pcr 30, anthraci 28, bacillu 28, strain 27, dna 25, primer 22, detect 21, sequenc 20, gene 18, plasmid 17, isol 17, assai 17, rapid 16, chromosom 16, cereu 15

Double Word Terms
bacillu.anthraci 26, anthraci.strain 14, pxo1.pxo2 9, bacillu.cereu 9, pcr.primer 9, chromosom.marker 9, real.time 8, dna.fragment 8, pcr.assai 8, chain.reaction 8, strain.anthraci 7, cereu.group 7, polymeras.chain 7, anthraci.chromosom 6, time.pcr 6

Triple Word Terms
polymeras.chain.reaction 7, chain.reaction.pcr 6, real.time.pcr 6, bacillu.anthraci.strain 6, pxo1.pxo2.plasmid 5, bacillu.cereu.group 4, identif.bacillu.anthraci 4, time.pcr.assai 3, virul.factor.gene 3, anthraci.chromosom.marker 3, isol.bacillu.cereu 3, plasmid.pxo1.pxo2 3, cereu.group.bacteria 3, differenti.bacillu.anthraci 3, pcr.random.amplif 2

Term Cliques
60.82% pcr primer strain dna amplif assai anthraci.strain
60.71% pcr primer strain dna amplif assai detect amplifi
66.53% pcr primer strain dna anthraci assai anthraci.strain
65.71% pcr primer strain dna anthraci assai detect amplifi
55.71% pcr primer strain pxo1 amplif assai detect amplifi
60.71% pcr primer strain pxo1 anthraci assai detect amplifi
52.57% pcr primer strain pxo1 anthraci assai plasmid anthraci.strain pxo2 pxo1.pxo2
54.57% pcr primer strain pxo1 anthraci assai plasmid detect pxo2 pxo1.pxo2
52.38% pcr primer strain pxo1 probe amplif assai plasmid anthraci.strain
54.60% pcr primer strain pxo1 probe amplif assai plasmid detect
56.83% pcr primer strain pxo1 probe anthraci assai plasmid anthraci.strain
59.05% pcr primer strain pxo1 probe anthraci assai plasmid detect

Sample Cluster Record Titles

PCR analysis of tissue samples from the 1979 Sverdlovsk anthrax victims: The presence of multiple Bacillus anthracis strains in different victims

Development of internal controls for PCR detection of Bacillus anthracis

Co-existence of clpB and clpC in the Bacillaceae

The Ba813 chromosomal DNA sequence effectively traces the whole Bacillus anthracis community

Restriction site insertion-PCR (RSI-PCR) for rapid discrimination and typing of closely related microbial strains

Characterization of Bacillus anthracis strains used for vaccination

PCR amplification on a microarray of gel-immobilized oligonucleotides: Detection of bacterial toxin- and drug-resistant genes and their mutations

Molecular characterization of Bacillus anthracis using multiplex PCR, ERIC-PCR and RAPD

Use of long-range repetitive element polymorphism-PCR to differentiate Bacillus anthracis strains

Cluster Metrics

Authors

patra, g 6; mock, m 4; ramisse, v 3; yoshikawa, m 2; williams, le 2; rose, s 2; redkar, rj 2; norwood, d 2; maruyama, t 2; makino, si 2

Sources

journal of clinical microbiology 7; fems microbiology letters 4; molecular and cellular probes 3; journal of applied microbiology 3; fems immunology and medical microbiology 2; applied and environmental microbiology 2; vaccine 1; rapid communications in mass spectrometry 1; proceedings of the national academy of sciences of the united states of america 1; letters in applied microbiology 1

Keywords

identification 13; microbiology 12; biotechnology & applied microbiology 11; microbiology 11; dna 9; plasmid 8; cereus 8; thuringiensis 7; polymerase chain-reaction 6; bacillus anthracis 6

Country

usa 17; france 5; japan 4; italy 3; england 3; russia 2; wales 1; taiwan 1; south korea 1; peoples r china 1

Institution

usa 5; inst pasteur 5; univ scranton 4; ctr etud bouchet 3; natl inst anim hlth 2; louisiana state univ 2; lawrence livermore natl lab 2; ist super sanita 2; gifu univ 2; ctr dis control & prevent 2

- # CLUSTER 57
  Amplified fragment length polymorphism and single nucleotide polymorphism of microbial genomes to analyze isolates from anthracis bacillus strains and related bacillus species, followed by further confirmatory sequence analyses. (30 Records)

Cluster Syntax Features

Descriptive Terms
genom 9.0%, isol 6.5%, sequenc 5.3%, aflp 4.9%, snp 3.1%, phage 2.5%, dna 2.1%, nucleotid 1.9%, polymorph 1.9%, anthraci 1.4%, genet 1.3%, strain 1.3%, marker 1.2%, agar 1.1%, speci 1.0%

Discriminating Terms
genom 5.8%, aflp 4.0%, isol 2.8%, snp 2.5%, spore 2.0%, sequenc 1.9%, phage 1.6%, vaccin 1.4%, cell 1.3%, nucleotid 1.2%, polymorph 1.2%, toxin 1.2%, anthrax 0.9%, protein 0.8%, agar 0.8%

Single Word Terms
anthraci 24, bacillu 23, isol 21, sequenc 19, strain 18, dna 16, genom 16, polymorph 14, two 14, genet 13, detect 13, bacteri 12, singl 12, speci 11, sampl 11

Double Word Terms
bacillu.anthraci 21, singl.nucleotid 7, nucleotid.polymorph 7, length.polymorph 6, fragment.length 6, anthraci.isol 5, genom.sequenc 5, bacteri.speci 5, amplifi.fragment 5, polymorph.snp 5, anthraci.strain 5, bacillu.speci 5, dna.sequenc 4, isol.anthraci 4, polymorph.aflp 4

Triple Word Terms
singl.nucleotid.polymorph 6, fragment.length.polymorph 6, amplifi.fragment.length 5, nucleotid.polymorph.snp 5, length.polymorph.aflp 4, bacillu.anthraci.isol 3, polymeras.chain.reaction 2, doubl.strand.dna 2, read.frame.orf 2, strain.bacillu.anthraci 2, bacillu.anthraci.strain 2, open.read.frame 2, bacillu.cereu.bacillu 2, plasmid.pxo1.pxo2 1, bacillu.anthraci.plasmid 1

Term Cliques
41.67% snp polymorph anthraci marker
41.67% aflp polymorph anthraci marker
48.00% aflp polymorph anthraci strain speci
39.52% sequenc snp dna nucleotid polymorph genet marker
41.11% sequenc aflp dna polymorph genet marker
44.17% isol phage anthraci agar
55.83% isol phage anthraci strain
52.67% isol aflp anthraci strain speci
50.00% genom sequenc dna nucleotid polymorph genet strain
46.67% genom sequenc aflp dna polymorph genet strain speci
50.00% genom isol phage dna strain
50.48% genom isol sequenc aflp dna strain speci

Sample Cluster Record Titles

Internal and flanking sequence from AFLP fragments using ligation-mediated suppression PCR

Genetic comparison of Bacillus anthracis and its close relatives using amplified fragment length polymorphism and polymerase chain reaction analysis

Rapid identification of pathogenic bacteria by single-enzyme amplified fragment length polymorphism analysis

Cluster Metrics

Authors

keim, p 7; fraser, cm 4; ticknor, lo 3; read, td 3; kuske, cr 3; williams, e 2; van ert, mn 2; schupp, jm 2; ravel, j 2; pannucci, j 2

Sources

biotechniques 4; proceedings of the national academy of sciences of the united states of america 3; journal of clinical microbiology 2; journal of bacteriology 2; emerging infectious diseases 2; current microbiology 2; science 1; onderstepoort journal of veterinary research 1; journal of molecular biology 1; journal of medical microbiology 1

Keywords

microbiology 8; cereus 5; multidisciplinary sciences 4; identification 4; gene 4; biotechnology & applied microbiology 4; biochemical research methods 4; microbiology 4; identification 4; gene 4

Country

usa 21; sweden 1; south africa 1; nc 1; japan 1; italy 1; india 1; greece 1; finland 1; england 1

Institution

no arizona univ 7; los alamos natl lab 4; inst genom res 4; usa 2; univ calif los alamos natl lab 2; univ calif berkeley 2; johns hopkins univ 2; wistar inst anat & biol 1; ut southwestern med ctr 1; usn 1

- # CLUSTER 16
  Variable number tandem repeat sequences as markers for genotyping anthracis bacillus isolates (32 Records)

Cluster Syntax Features

Descriptive Terms
vntr 11.4%, genotyp 9.4%, isol 5.0%, tandem.repeat 3.9%, mlva 3.8%, repeat 3.5%, tandem 3.3%, strain 3.1%, variabl 3.0%, loci 1.9%, variabl.number 1.7%, variabl.number.tandem 1.6%, number.tandem.repeat 1.6%, number.tandem 1.6%, genet 1.4%

Discriminating Terms
vntr 7.8%, genotyp 6.1%, tandem.repeat 2.6%, mlva 2.6%, tandem 2.1%, repeat 2.0%, variabl 1.8%, spore 1.6%, isol 1.6%, loci 1.2%, variabl.number 1.2%, vaccin 1.1%, variabl.number.tandem 1.1%, cell 1.1%, number.tandem 1.1%

Single Word Terms
isol 28, strain 24, repeat 24, number 24, tandem 23, variabl 21, genet 20, bacillu 20, type 20, anthraci 19, genotyp 19, locu 18, two 18, sequenc 17, polymorph 16

Double Word Terms
tandem.repeat 23, number.tandem 20, variabl.number 20, bacillu.anthraci 18, anthraci.isol 12, repeat.vntr 12, multipl.locu 9, vntr.loci 8, dna.sequenc 6, length.polymorph 6, repeat.mlva 6, fragment.length 5, locu.variabl 5, locu.vntr 5, amplifi.fragment 5

Triple Word Terms
number.tandem.repeat 20, variabl.number.tandem 20, tandem.repeat.vntr 12, bacillu.anthraci.isol 6, tandem.repeat.mlva 6, amplifi.fragment.length 5, repeat.vntr.loci 5, locu.variabl.number 5, multipl.locu.variabl 5, fragment.length.polymorph 5, locu.vntr.mlva 4, multipl.locu.vntr 4, multilocu.variabl.number 3, length.polymorph.aflp 3, singl.nucleotid.polymorph 3

Term Cliques
63.94% isol tandem.repeat mlva repeat tandem strain variabl loci variabl.number variabl.number.tandem number.tandem.repeat number.tandem genet
59.38% genotyp isol mlva strain loci genet
60.42% vntr tandem.repeat mlva repeat tandem strain variabl loci variabl.number variabl.number.tandem number.tandem.repeat number.tandem

Sample Cluster Record Titles

Molecular characterization of Bacillus strains involved in outbreaks of anthrax in France in 1997

Meso-scale ecology of anthrax in southern Africa: a pilot study of diversity and clustering

Molecular diversity in Bacillus anthracis

Multiple-locus variable-number tandem repeat analysis reveals genetic relationships within Bacillus anthracis

vrrB, a hypervariable open reading frame in Bacillus anthracis

Bacillus anthracis diversity in Kruger National Park

AFLP fingerprinting and genotypic characterization of some serovars of Bacillus thuringiensis

Extensive allelic variation among Francisella tularensis strains in a short-sequence tandem repeat region

Identification and characterization of variable-number tandem repeats in the Yersinia pestis genome

Cluster Metrics

Authors

keim, p 12; schupp, jm 6; price, lb 6; smith, kl 5; klevytska, am 4; hugh-jones, me 4; van ert, mn 3; jackson, pj 3; zinser, g 2; vergnaud, g 2

Sources

journal of clinical microbiology 16; applied and environmental microbiology 3; journal of bacteriology 2; journal of applied microbiology 2; fems microbiology letters 2; world journal of microbiology & biotechnology 1; genetics 1; emerging infectious diseases 1; bmc microbiology 1; bmc bioinformatics 1

Keywords

microbiology 22; diversity 13; bacillus-anthracis 13; pcr 7; biotechnology & applied microbiology 6; cereus 6; strains 5; microbiology 5; identification 5; sequence 4

Country

usa 19; france 5; south korea 2; norway 2; italy 2; sweden 1; south africa 1; singapore 1; poland 1; peoples r china 1

Institution

no arizona univ 12; louisiana state univ 6; univ paris 11 2; univ calif los alamos natl lab 2; inst pasteur 2; ctr etud bouchet 2; ctr dis control & prevent 2; usda ars 1; usa 1; univ wisconsin 1

- # CLUSTER 9
  Identification of bacillus anthracis species, (11 Records)

Cluster Syntax Features

Descriptive Terms
speci 24.1%, synonym 3.6%, genera 3.5%, gelatin 3.4%, new.speci 2.6%, genu 2.5%, macquart 2.4%, specimen 2.0%, new 2.0%, wiedemann 1.7%, taxonom 1.6%, charact 1.5%, group 1.2%, speci.genu 1.2%

Discriminating Terms
speci 11.2%, synonym 2.2%, gelatin 2.0%, genera 2.0%, new.speci 1.6%, macquart 1.5%, spore 1.5%, genu 1.4%, vaccin 1.1%, wiedemann 1.0%, specimen 1.0%, cell 1.0%, taxonom 0.9%, toxin 0.9%

Single Word Terms
speci 11, genu 6, anthrax 6, group 5, bacillu 5, two 5, new 5, genera 4, cereu 4, type 4, kei 4, bacteria 4, taxonom 4, identif 4, pattern 4

Double Word Terms
new.speci 4, speci.genu 3, genu.bacillu 3, anthrax.speci 2, three.speci 2, bacillu.licheniformi 2, cereu.group 2, endospor.form 2, isol.bacillu 2, isol.belong 2, conform.polymorph 1, speci.phylogenet 1, strain.pattern 1, pcr.fingerprint 1

Triple Word Terms
posit.gram.neg 1, strain.bacillu.cereu 1, rrna.gene.sequenc 1, 16.rrna.gene 1, isol.bacillu.anthraci 1, genet.divers.group 1, tularensi.yersinia.pesti 1, francisella.tularensi.yersinia 1, bacillu.cereu.bacillu 1, strand.conform.polymorph 1, singl.strand.conform 1, gram.neg.bacteria 1, gram.posit.gram 1, bacillu.subtili.bacillu 1, member.cereu.group 1

Term Cliques
50.91% speci new.speci genu taxonom speci.genu
54.55% speci new.speci genu taxonom group
54.55% speci new.speci genu new taxonom
50.91% speci new.speci genu macquart speci.genu
54.55% speci new.speci genu macquart new
50.91% speci genera new.speci genu speci.genu
54.55% speci genera new.speci genu group
54.55% speci genera new.speci genu new
50.91% speci genera gelatin genu group
42.42% speci synonym new.speci macquart specimen speci.genu

Sample Cluster Record Titles

Single strand conformation polymorphism analysis of PCR-tDNA fingerprinting to address the identification of Bacillus species

Study of the bacterial load in a gelatine production process focussed on Bacillus and related endosporeforming genera

Identifying and subtyping species of dangerous pathogens by automated ribotyping

Isolation, characterization, and identification of bacterial contaminants in semifinal gelatin extracts

Taxonomy of the genus Bacillus and related genera: The aerobic endospore-forming bacteria

Cluster Metrics

Authors
greathead, dj 3; de vos, p 2; de clerck, e 2; yeates, dk 1; yasunaga, t 1; vanhoutte, t 1; sorlini, c 1; schwartz, md 1; nagatomi, a 1; much, p 1

Sources
zoological science 1; systematic and applied microbiology 1; phytopathology 1; invertebrate taxonomy 1; insect systematics & evolution 1; fems microbiology letters 1; entomologica scandinavica 1; diagnostic microbiology and infectious disease 1; deutsche entomologische zeitschrift 1; applied and environmental microbiology 1

Keywords
entomology 3; microbiology 3; identification 3; dna 3; anthracis 3; zoology 2; biotechnology & applied microbiology 2; bacillus 2; 16s ribosomal-rna 2; sscp 1

Country
belgium 3; england 2; usa 1; japan 1; italy 1; germany 1; canada 1; austria 1; australia 1

Institution
univ london imperial coll sci technol & med 2; state univ ghent 2; univ queensland 1; univ milan 1; okayama univ 1; inst hyg & social med 1; free univ brussels 1; dsmz deutsche sammlung mikroorgan & zellkulturen 1; bernice p bishop museum 1; austrian agcy hlth & food safety 1

- # CLUSTER 20
  Sequencing of 16S rRNA gene, for identification of bacillus anthracis strains (30 Records)

Cluster Syntax Features

Descriptive Terms
16 13.7%, rrna 6.2%, strain 5.9%, sequenc 4.6%, rrna.gene 4.2%, 16.rrna 3.8%, 16.rrna.gene 3.3%, cereu 2.8%, speci 2.4%, gene 2.2%, rdna 1.6%, 23 1.5%, group 1.2%, trna 1.1%, thuringiensi 1.1%

Discriminating Terms
16 9.4%, rrna 4.1%, rrna.gene 3.0%, 16.rrna 2.6%, 16.rrna.gene 2.3%, spore 1.4%, vaccin 1.3%, sequenc 1.3%, strain 1.2%, cell 1.1%, rdna 1.1%, protein 1.0%, 23 1.0%, toxin 1.0%, anthrax 0.9%

Single Word Terms
16 29, bacillu 27, strain 25, gene 24, sequenc 24, cereu 21, rrna 20, speci 20, anthraci 17, two 16, dna 15, group 14, isol 12, thuringiensi 12, type 12

Double Word Terms
16.rrna 18, rrna.gene 16, bacillu.cereu 14, bacillu.anthraci 11, gene.sequenc 10, 16.23 10, strain.bacillu 9, sequenc.16 8, 16.rdna 7, bacillu.thuringiensi 7, type.strain 7, cereu.group 6, transcrib.spacer 6, bacillu.subtili 6, strain.cereu 6

Triple Word Terms
16.rrna.gene 14, rrna.gene.sequenc 9, bacillu.cereu.bacillu 5, intern.transcrib.spacer 4, strain.bacillu.cereu 4, fragment.length.polymorph 4, sequenc.16.rrna 4, bacillu.mycoid.bacillu 3, food.born.pathogen 3, cereu.bacillu.mycoid 3, bacillu.anthraci.bacillu 3, anthraci.bacillu.cereu 3, dna.dna.hybrid 3, 23.rrna.gene 3, nucleotid.sequenc.16 3

Term Cliques
59.17% 16 strain cereu speci rdna 23 group thuringiensi
64.17% 16 strain sequenc cereu speci rdna 23 group
65.24% 16 rrna 16.rrna speci gene group thuringiensi
66.30% 16 rrna sequenc rrna.gene 16.rrna 16.rrna.gene speci gene group
60.33% 16 rrna strain cereu speci gene 23 group trna thuringiensi
64.33% 16 rrna strain sequenc cereu speci gene 23 group trna
68.89% 16 rrna strain sequenc rrna.gene 16.rrna.gene speci gene group

Sample Cluster Record Titles

The Arthromitus stage of Bacillus cereus: Intestinal symbionts of animals

PCR fingerprinting of whole genomes: the spacers between the 16S and 23S rRNA genes and of intergenic tRNA gene regions reveal a different intraspecific genomic variability of Bacillus cereus and Bacillus licheniformis

Taxonomic studies of the beta hemolysis-causing pathogen Bacillus cereus isolated from sea water

16S-23S rRNA internal transcribed spacers as molecular markers for the species of the 16S rRNA group I of the genus Bacillus

Utility of 16S-23S rRNA spacer region methodology: how similar are interspace regions within a genome and between strains for closely related organisms?

Number of triplets in 16S rRNA gene related with pathogenicity of Bacillus spp. and Clostridium spp.

Cluster Metrics

Authors

daffonchio, d 3; borin, s 3; stackebrandt, e 2; sorlini, c 2; rainey, fa 2; manachini, pl 2; cote, jc 2; collins, md 2; ash, c 2; andersen, gl 2

Sources

applied and environmental microbiology 5; journal of clinical microbiology 3; fems microbiology letters 3; journal of microbiological methods 2; international journal of systematic bacteriology 2; international journal of systematic and evolutionary microbiology 2; proceedings of the national academy of sciences of the united states of america 1; microbiology-sgm 1; journal of veterinary medical science 1; journal of theoretical biology 1

Keywords

microbiology 14; microbiology 11; identification 10; anthracis 9; biotechnology & applied microbiology 8; cereus 8; 16s ribosomal-rna 7; thuringiensis 6; pcr 6; ribosomal-rna 5

Country

usa 10; germany 6; italy 4; canada 3; south korea 2; japan 2; france 2; brazil 2; tunisia 1; spain 1

Institution

univ milan 3; usa 2; agr & agri food canada 2; yhtyneet lab oy 1; vet affairs med ctr 1; univ tsukuba 1; univ s carolina 1; univ queensland 1; univ ouagadougou 1; univ oldenburg 1

- # CLUSTER 29
  Differentiating among strains in the bacillus cereus group (51 Records)

Cluster Syntax Features

Descriptive Terms
cereu 29.9%, strain 6.0%, cereu.group 5.2%, thuringiensi 5.2%, group 5.0%, cereu.thuringiensi 2.4%, mycoid 1.6%, speci 1.4%, pcr 1.3%, bacillu.cereu 1.3%, sequenc 1.2%, isol 0.9%, cereu.strain 0.9%, anthraci 0.9%, bacillu 0.8%

Discriminating Terms
cereu 18.4%, cereu.group 3.6%, thuringiensi 2.8%, group 2.3%, spore 1.6%, cereu.thuringiensi 1.6%, vaccin 1.4%, strain 1.4%, anthrax 1.1%, mycoid 1.1%, toxin 1.0%, protein 0.9%, protect 0.7%, cereu.strain 0.6%, diseas 0.6%

Single Word Terms
cereu 51, bacillu 49, strain 46, group 40, anthraci 38, thuringiensi 38, sequenc 30, speci 28, gene 26, isol 22, mycoid 20, two 19, on 19, pcr 18, dna 17

Double Word Terms
bacillu.cereu 42, cereu.group 36, cereu.thuringiensi 26, bacillu.anthraci 26, cereu.strain 21, bacillu.thuringiensi 18, strain.cereu 17, cereu.bacillu 13, bacillu.mycoid 10, anthraci.strain 10, anthraci.cereu 10, thuringiensi.bacillu 9, speci.bacillu 9, thuringiensi.strain 8, speci.cereu 8

Triple Word Terms
bacillu.cereu.group 19, bacillu.cereu.bacillu 10, bacillu.thuringiensi.bacillu 8, anthraci.cereu.thuringiensi 7, strain.cereu.group 7, speci.bacillu.cereu 7, bacillu.mycoid.bacillu 7, cereu.group.strain 7, bacillu.anthraci.bacillu 7, member.bacillu.cereu 6, speci.cereu.group 6, cereu.bacillu.thuringiensi 6, cereu.thuringiensi.mycoid 6, cereu.thuringiensi.strain 5, member.cereu.group 5

Term Cliques
67.25% cereu strain thuringiensi mycoid speci sequenc isol cereu.strain anthraci bacillu
71.18% cereu strain thuringiensi mycoid speci bacillu.cereu sequenc cereu.strain anthraci bacillu
63.33% cereu strain thuringiensi mycoid speci pcr sequenc isol cereu.strain bacillu
67.25% cereu strain thuringiensi mycoid speci pcr bacillu.cereu sequenc cereu.strain bacillu
74.51% cereu strain cereu.group thuringiensi group mycoid speci bacillu.cereu sequenc anthraci bacillu
70.94% cereu strain cereu.group thuringiensi group mycoid speci pcr bacillu.cereu sequenc bacillu
71.66% cereu strain cereu.group thuringiensi group cereu.thuringiensi mycoid speci sequenc anthraci bacillu

Sample Cluster Record Titles

Integrated physical and genetic mapping of Bacillus cereus and other gram-positive bacteria based on IS231A transposition vectors

Bacillus weihenstephanensis sp. nov. is a new psychrotolerant species of the Bacillus cereus group

Bacillus cereus in a whey process

A randomly amplified polymorphic DNA marker specific for the Bacillus cereus group is diagnostic for Bacillus anthracis

Genome organization is not conserved between Bacillus cereus and Bacillus subtilis

Improved cytotoxicity assay for Bacillus cereus diarrhoeal enterotoxin

Cluster Metrics

Authors

kolsto, ab 7; turnbull, pcb 5; daffonchio, d 5; borin, s 5; okstad, oa 4; mock, m 4; fouet, a 4; cherif, a 4; tourasse, nj 3; scherer, s 3

Sources

journal of applied microbiology 8; applied and environmental microbiology 8; journal of clinical microbiology 5; fems microbiology letters 4; journal of bacteriology 3; international journal of systematic bacteriology 3; international journal of food microbiology 3; microbiology-sgm 2; letters in applied microbiology 2; journal of food protection 2

Keywords

thuringiensis 25; biotechnology & applied microbiology 23; strains 22; microbiology 22; microbiology 21; anthracis 20; identification 11; bacteria 10; thuringiensis 9; pcr 8

Country

usa 11; norway 8; france 8; italy 7; taiwan 6; england 6; tunisia 4; germany 4; denmark 3; south korea 2

Institution

univ oslo 7; univ milan 7; inst pasteur 5; inra 5; univ tunis 3; univ udine 2; univ munich 2; univ helsinki 2; tech univ munich 2; seoul natl univ hosp 2

- # CLUSTER 22
  Identification of bacillus thuringiensis serovars and strains (21 Records)

Cluster Syntax Features

Descriptive Terms
thuringiensi 16.1%, serovar 13.1%, cereu 6.1%, strain 5.2%, isol 3.4%, bacillu.thuringiensi 2.4%, phage 2.2%, thuringiensi.serovar 2.0%, st 1.5%, is231 1.4%, bam35 1.3%, bacillu.cereu 1.1%, element 1.0%, gene 0.8%, strain.serovar 0.8%

Discriminating Terms
thuringiensi 9.4%, serovar 9.1%, cereu 1.7%, spore 1.7%, thuringiensi.serovar 1.5%, bacillu.thuringiensi 1.4%, vaccin 1.3%, phage 1.2%, st 1.1%, cell 1.0%, is231 1.0%, toxin 1.0%, anthrax 1.0%, bam35 0.9%, strain 0.8%

Single Word Terms
bacillu 21, thuringiensi 20, strain 19, cereu 19, gene 13, isol 12, three 11, serovar 11, sequenc 10, dna 10, two 10, anthraci 10, group 8, bacteria 8, refer 8

Double Word Terms
bacillu.thuringiensi 20, bacillu.cereu 16, bacillu.anthraci 9, thuringiensi.serovar 9, strain.bacillu 7, thuringiensi.strain 7, cereu.group 6, cereu.bacillu 6, strain.cereu 6, strain.serovar 5, strain.thuringiensi 5, refer.strain 5, cereu.thuringiensi 5, cereu.strain 4, gram.posit 4

Triple Word Terms
bacillu.cereu.bacillu 6, strain.thuringiensi.serovar 4, bacillu.thuringiensi.serovar 4, bacillu.cereu.group 3, cereu.thuringiensi.strain 3, strain.bacillu.thuringiensi 3, cereu.bacillu.anthraci 3, gram.posit.bacteria 3, bacillu.anthraci.isol 3, cereu.bacillu.thuringiensi 3, bacillu.thuringiensi.bacillu 2, thuringiensi.subsp.kurstaki 2, anthraci.bacillu.thuringiensi 2, bacillu.anthraci.bacillu 2, strain.cereu.strain 2

Term Cliques
55.95% thuringiensi bacillu.thuringiensi phage is231
67.46% thuringiensi isol bacillu.thuringiensi bacillu.cereu element gene
57.14% thuringiensi isol bacillu.thuringiensi is231 element gene
64.29% thuringiensi cereu bacillu.thuringiensi phage bam35 bacillu.cereu
76.19% thuringiensi cereu strain bacillu.thuringiensi gene strain.serovar
80.95% thuringiensi cereu strain isol bacillu.thuringiensi bacillu.cereu gene
62.59% thuringiensi serovar isol bacillu.thuringiensi thuringiensi.serovar bacillu.cereu element
70.07% thuringiensi serovar cereu strain bacillu.thuringiensi thuringiensi.serovar strain.serovar
69.05% thuringiensi serovar cereu strain bacillu.thuringiensi thuringiensi.serovar bam35 bacillu.cereu
67.72% thuringiensi serovar cereu strain isol bacillu.thuringiensi thuringiensi.serovar st bacillu.cereu

Sample Cluster Record Titles

Cloning and nucleotide sequence analysis of gyrB of Bacillus cereus, B-thuringinesis, B-mycoides, and B-anthracis and their application to the detection of B-cereus in rice

Identification of Bacillus anthracis strains in China

Phenotypic and genotypic comparisons of 23 strains from the Bacillus cereus complex for a selection of known and putative B-thuringiensis virulence factors

Common occurrence of enterotoxin genes and enterotoxicity in Bacillus thuringiensis

Bacillus thuringiensis in fecal samples from greenhouse workers after exposure to B-thuringiensis-based pesticides

The identification of a tetracycline resistance gene tet(M), on a Tn916-like transposon, in the Bacillus cereus group

The Bacillus thuringiensis linear double-stranded DNA phage Bam35, which is highly similar to the Bacillus cereus linear plasmid pBClin15, has a prophage state

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Cluster Metrics

Authors
priest, fg 4; mahillon, j 3; barker, m 2; andrup, l 2; zhang, j 1; yu, d 1; yamada, s 1; wong, acl 1; walter, tm 1; verheust, c 1

Sources
applied and environmental microbiology 6; fems microbiology letters 5; journal of bacteriology 4; microbiology-uk 2; systematic and applied microbiology 1; journal of applied microbiology 1; international journal of systematic bacteriology 1; bmc genomics 1

Keywords
microbiology 12; anthracis 11; biotechnology & applied microbiology 9; microbiology 8; cereus 7; strains 5; bacillus thuringiensis 4; bacteria 4; bacillus cereus 3; anthracis 3

Country
usa 4; scotland 3; peoples r china 3; denmark 3; belgium 3; norway 2; england 2; mexico 1; japan 1; france 1

Institution
univ catholique louvain 3; heriot watt univ 3; natl inst occupat hlth 2; wistar inst anat & biol 1; usn 1; univ wisconsin 1; univ washington 1; univ oxford 1; univ oslo 1; univ helsinki 1

THRUST 2
(Plasmid virulence genes in anthrax strains, emphasizing atxa-regulated genes encoding proteins)

- Transcription analysis of the control of bacillus anthracis capsule synthesis by atxA gene expression (30 Records)
- PlcR regulation of virulence factor gene expression in bacillus group strains (17 Records)

- Identification of sigma-dependent genes in bacillus group, emphasizing transcription analysis and focusing on sporulating bacteria (22 Records)
- Replicon isolation of bacillus cereus group virulence plasmids, and DNA binding with PcrA interacting with plasmid (30 Records)
- Role of iron compounds in inhibiting or supporting growth of infections, particularly epidermidis and related staphylococci (17 Records)
- Bacteria genomics, emphasizing gene expression in Escherichia Coli (25 Records)
- Resistance of bacillus anthracis isolate strains to antibiotics, and antimicrobial susceptibilities of bacillus anthracis isolates (32 Records)
- Gamma polyglutamic acid production and degradation, and biochemical analysis of poly-gamma-glutamate (11 Records)
- Calmodulin-activated bacillus anthracis enzyme adenylate cyclase, especially its ATP binding sequences (31 Records)
- Surface layer homology domains for binding proteins to cell walls of bacillus anthracis (20 Records)
- Surface layers in bacillus anthracis, emphasizing surface layer proteins and surface array proteins (13 Records)

(Descriptive Terms

gene 6.8%, plasmid 2.6%, protein 2.4%, strain 2.1%, atxa 1.6%, resist 1.6%, express 1.5%, activ 1.4%, encod 1.2%, transcript 1.2%, anthraci 1.1%, sequenc 1.1%, cam 1.1%, mutant 0.9%, (27.45%)

Single Word Terms

bacillu 208, anthraci 182, gene 145, protein 118, activ 103, strain 102, two 97, express 92, cell 92, sequenc 91, encod 78, similar 73, plasmid 71, anthrax 67, on 66

Double Word Terms

bacillu.anthraci 171, escherichia.coli 47, gram.posit 41, amino.acid 40, bacillu.cereu 39, bacillu.subtili 39, gene.encod 29, gene.express 28, cell.wall 28, plasmid.pxo1 23, staphylococcu.aureu 22, anthraci.strain 21, posit.bacteria 20, read.frame 20, open.read 20

Triple Word Terms

open.read.frame 20, gram.posit.bacteria 20, amino.acid.sequenc 13, express.escherichia.coli 10, virul.plasmid.pxo1 9, adenylyl.cyclas.activ 9, anthrax.toxin.gene 8, poli.gamma.glutam 8, strain.bacillu.anthraci 7, factor.bacillu.anthraci 7, sodium.dodecyl.sulfat 7, read.frame.orf 7, calmodulin.cam.activ 6, express.bacillu.anthraci 6, bacillu.anthraci.strain 6)

- # CLUSTER 12
  Transcription analysis of the control of bacillus anthracis capsule synthesis by atxA gene expression (30 Records)

Cluster Syntax Features

Descriptive Terms
atxa 21.3%, capsul 6.4%, gene 5.6%, pxo1 4.0%, transcript 3.7%, co2 3.5%, pag 3.2%, cap 2.3%, regul 2.1%, plasmid 2.0%, acpa 2.0%, express 1.6%, toxin.gene 1.6%, pxo2 1.2%, mutant 1.2%

Discriminating Terms
atxa 15.0%, capsul 4.0%, co2 2.4%, pxo1 2.2%, pag 2.2%, transcript 2.1%, spore 1.6%, cap 1.5%, gene 1.4%, acpa 1.4%, vaccin 1.3%, toxin.gene 1.0%, regul 1.0%, cell 0.7%, acpb 0.6%

Single Word Terms
gene 30, bacillu 28, anthraci 28, plasmid 25, toxin 23, strain 22, express 22, pxo1 21, atxa 19, virul 19, regul 19, anthrax 18, transcript 18, capsul 18, mutant 16

Double Word Terms
bacillu.anthraci 27, toxin.gene 16, plasmid.pxo1 15, anthrax.toxin 11, protect.antigen 9, gene.express 9, atxa.gene 9, gene.locat 8, parent.strain 8, null.mutant 8, capsul.synthesi 8, transcript.fusion 7, regulatori.gene 6, virul.plasmid 6, pxo1.pxo2 6

Triple Word Terms
anthrax.toxin.gene 7, plasmid.pxo1.pxo2 5, express.bacillu.anthraci 4, toxin.gene.express 4, lacz.transcript.fusion 4, transcript.start.site 4, regulatori.gene.atxa 3, regul.capsul.synthesi 3, virul.plasmid.pxo1 3, pxo1.plasmid.capsul 3, plasmid.capsul.format 3, activ.toxin.gene 3, atxa.null.mutant 3, gene.capsul.product 3, plasmid.pxo1.carri 3

Term Cliques
59.52% capsul gene cap regul plasmid acpa mutant
58.10% capsul gene cap regul plasmid acpa pxo2
67.62% capsul gene pxo1 regul plasmid toxin.gene pxo2
61.48% atxa gene transcript co2 regul plasmid acpa express mutant
63.75% atxa gene transcript co2 pag plasmid express mutant
66.67% atxa gene pxo1 transcript co2 regul plasmid express toxin.gene
64.44% atxa gene pxo1 transcript co2 pag plasmid express toxin.gene
63.81% atxa capsul gene regul plasmid acpa mutant
70.48% atxa capsul gene pxo1 regul plasmid toxin.gene

Sample Cluster Record Titles

Carbon dioxide as a regulator of gene expression in microorganisms

The expression of the protective antigen of Bacillus anthracis in Bacillus subtilis

Identification and characterization of a germination operon on the virulence plasmid pXOI of Bacillus anthracis

Control of virulence gene expression in Bacillus anthracis

Characterization of a plasmid region involved in Bacillus anthracis toxin production and pathogenesis

Early Bacillus anthracis macrophage interactions: intracellular survival and escape

Effect of the lower molecular capsule released from the cell surface of Bacillus anthracis on the pathogenesis of anthrax

A plasmid-encoded regulator couples the synthesis of toxins and surface structures in Bacillus anthracis

Global effects of virulence gene regulators in a Bacillus anthracis strain with both virulence plasmids

Cluster Metrics

Authors

koehler, tm 10; mock, m 9; fouet, a 7; sirard, jc 4; drysdale, m 4; uchida, i 3; hoffmaster, ar 3; dai, zh 3; bourgogne, a 3; peterson, sn 2

Sources

molecular microbiology 5; journal of bacteriology 4; infection and immunity 4; journal of applied microbiology 2; international journal of medical microbiology 2; fems microbiology letters 2; research in microbiology 1; proceedings of the national academy of sciences of the united states of america 1; plasmid 1; journal of infectious diseases 1

Keywords

microbiology 11; escherichia-coli 10; transcription 9; microbiology 9; identification 9; cloning 9; transactivator 8; protective antigen gene 7; subtilis 7; product 7

Country

usa 13; france 7; japan 3; england 3; scotland 1; belgium 1; australia 1

Institution

univ texas 9; inst pasteur 7; obihiro univ agr & vet med 2; baylor coll med 2; usn 1; usa 1; univ sheffield 1; univ oxford 1; univ new mexico 1; univ minnesota 1

- # CLUSTER 28
  PlcR regulation of virulence factor gene expression in bacillus group strains (17 Records)

Cluster Syntax Features

Descriptive Terms
plcr 14.2%, virul 4.9%, strain 4.0%, hemolyt 3.9%, gene 3.8%, pxo1 2.5%, cereu 2.1%, plasmid 1.7%, anthraci 1.7%, encod 1.4%, express 1.4%, secret 1.3%, regul 1.2%, protein 1.1%, proteom 1.0%

Discriminating Terms
plcr 10.7%, hemolyt 3.0%, virul 2.6%, spore 1.8%, pxo1 1.3%, anthrax 0.9%, cell 0.9%, hemolyt.activ 0.8%, anthraci.pathogen 0.7%, gene 0.7%, pla 0.7%, plc 0.7%, diseas 0.6%, proteom 0.6%, bacillu.anthraci.pathogen 0.6%

Single Word Terms
bacillu 16, anthraci 16, gene 15, strain 13, encod 12, virul 12, plasmid 12, express 10, cereu 10, protein 10, activ 9, secret 8, pxo1 8, similar 7, hemolyt 7

Double Word Terms
bacillu.anthraci 15, bacillu.cereu 10, anthraci.strain 6, pxo1.pxo2 5, encod.protein 5, activ.plcr 5, bacillu.thuringiensi 5, gene.encod 5, virul.factor 3, anthraci.pathogen 3, anthraci.express 3, gene.bacillu 3, virul.plasmid 3, parent.strain 3, hemolyt.activ 3

Triple Word Terms
cereu.bacillu.thuringiensi 3, bacillu.anthraci.pathogen 2, express.bacillu.anthraci 2, gene.bacillu.anthraci 2, virul.factor.pathogen 2, bacillu.thuringiensi.bacillu 2, copi.number.plasmid 2, bacillu.cereu.group 2, member.bacillu.cereu 2, virul.plasmid.pxo1 2, bacillu.cereu.bacillu 2, gene.encod.protein 2, cell.surfac.protein 2, two.virul.plasmid 1, bacillu.anthraci.caus 1

Term Cliques
61.76% virul strain pxo1 plasmid anthraci proteom
80.00% virul strain gene plasmid anthraci
50.42% plcr anthraci encod secret regul protein proteom
49.02% plcr pxo1 anthraci secret protein proteom
56.86% plcr pxo1 cereu anthraci secret protein
58.82% plcr hemolyt gene cereu anthraci encod express secret regul protein
55.15% plcr strain plasmid anthraci encod secret regul proteom
54.62% plcr strain pxo1 plasmid anthraci secret proteom
61.34% plcr strain pxo1 cereu plasmid anthraci secret
63.53% plcr strain gene cereu plasmid anthraci encod express secret regul
60.59% plcr strain hemolyt gene cereu anthraci encod express secret regul

Sample Cluster Record Titles

PlcR is a pleiotropic regulator of extracellular virulence factor gene expression in Bacillus thuringiensis

The incompatibility between the PlcR- and AtxA-controlled regulons may have selected a nonsense mutation in Bacillus anthracis

Sequence analysis of the genes encoding for the major virulence factors of Bacillus anthracis vaccine strain 'Carbosap'

Anaerobic induction of Bacillus anthracis hemolytic activity

The genome sequence of Bacillus anthracis Ames and comparison to closely related bacteria

Characterization of anthrolysin O, the Bacillus anthracis cholesterol-dependent cytolysin

Cluster Metrics

Authors

pomerantsev, ap 3; lereclus, d 3; friedlander, am 3; okstad, oa 2; leppla, sh 2; kolsto, ab 2; koehler, tm 2; wu, m 1; wu, ag 1; wolf, am 1

Sources

infection and immunity 4; molecular microbiology 2; microbial pathogenesis 2; vaccine 1; trends in biochemical sciences 1; proteomics 1; nature 1; letters in applied microbiology 1; journal of bacteriology 1; journal of applied microbiology 1

Keywords

identification 8; virulence 7; microbiology 7; immunology 6; thuringiensis 5; biochemistry & molecular biology 4; transcription 4; infectious diseases 4; expression 4; biotechnology & applied microbiology 3

Country

usa 12; france 3; norway 2; italy 1; england 1

Institution

usa 4; univ texas 2; univ oslo 2; univ maryland 2; niaid 2; inst pasteur 2; usn 1; univ scranton 1; univ michigan 1; purdue univ 1

- # CLUSTER 43
  Identification of sigma-dependent genes in bacillus group, emphasizing transcription analysis and focusing on sporulating bacteria (22 Records)

Cluster Syntax Features

Descriptive Terms
gene 6.6%, sigma 5.1%, sporul 4.8%, transcript 4.6%, subtili 3.9%, abrb 3.2%, regul 2.8%, express 2.8%, spo0a 2.7%, growth 1.8%, promot 1.7%, homologu 1.3%, phase 1.2%, sigb 1.1%, rho 1.1%

Discriminating Terms
sigma 3.9%, sporul 3.6%, transcript 2.8%, abrb 2.6%, spo0a 2.2%, subtili 2.0%, gene 2.0%, spore 1.6%, regul 1.5%, vaccin 1.2%, anthrax 1.0%, promot 1.0%, homologu 0.9%, sigb 0.9%, growth 0.9%

Single Word Terms
gene 20, bacillu 20, express 19, transcript 16, protein 14, regul 14, anthraci 13, subtili 13, encod 11, factor 10, strain 10, phase 9, respons 9, cell 9, sequenc 9

Double Word Terms
bacillu.anthraci 13, bacillu.subtili 12, gene.express 8, stationari.phase 7, bacillu.cereu 6, escherichia.coli 4, adapt.respons 4, subtili.anthraci 4, rna.polymeras 4, amino.acid 4, depend.gene 4, gene.encod 4, transcript.factor 4, atcc.14579 3, subtili.cell 3

Triple Word Terms
gene.encod.transcript 2, polymeras.chain.reaction 2, amino.acid.sequenc 2, open.read.frame 2, sigma.factor.sigma 2, subtili.bacillu.anthraci 2, cereu.atcc.14579 2, two.dimension.gel 2, dimension.gel.electrophoresi 2, bacillu.cereu.strain 2, protect.antigen.lethal 1, anthrax.toxin.protein 1, antigen.lethal.factor 1, agent.bacillu.anthraci 1, bacillu.anthraci.anthrax 1

Term Cliques
58.18% gene regul express growth sigb
52.73% gene abrb express growth phase
56.36% gene abrb regul express promot
57.27% gene abrb regul express growth
57.27% gene subtili abrb express phase
54.55% gene subtili abrb regul express spo0a
59.85% gene transcript regul express promot sigb
55.45% gene transcript subtili homologu phase
62.73% gene transcript subtili express rho
70.00% gene transcript subtili express phase
55.30% gene sporul transcript subtili regul homologu
59.74% gene sporul transcript subtili regul express sigb
60.39% gene sporul transcript subtili regul express spo0a
61.82% gene sigma transcript express phase
52.27% gene sigma transcript express promot sigb

Sample Cluster Record Titles

Isolation of an asporogenic (spoOA) protective antigen-producing strain of Bacillus anthracis

Characterization of the operon encoding the alternative sigma(B) factor from Bacillus anthracis and its role in virulence

Control of anthrax toxin gene expression by the transition state regulator abrB

Bicarbonate ion stimulates the expression of locus of enterocyte effacement-encoded genes in enterohemorrhagic Escherichia coli O157 : H7

DNA complexed structure of the key transcription factor initiating development in sporulating bacteria

Detection of a luxS-signaling molecule in Bacillus anthracis

Computational identification of the Spo0A-phosphate regulon that is essential for the cellular differentiation and development in Gram-positive spore-forming bacteria

Cluster Metrics

Authors

shaw, gc 2; severinov, k 2; semenova, e 2; lee, tr 2; jones, mb 2; hoch, ja 2; de vos, wm 2; blaser, mj 2; abee, t 2; zwietering, mh 1

Sources

journal of bacteriology 7; molecular microbiology 2; microbiology-sgm 2; infection and immunity 2; applied and environmental microbiology 2; structure 1; nucleic acids research 1; journal of molecular biology 1; journal of infectious diseases 1; canadian journal of microbiology 1

Keywords

microbiology 10; escherichia-coli 8; biochemistry & molecular biology 7; subtilis 6; protein 6; expression 6; complete genome sequence 5; transcription 5; microbiology 5; subtilis 4

Country

usa 11; japan 3; taiwan 2; netherlands 2; france 2; wales 1; russia 1; rep of georgia 1; italy 1; ireland 1

Institution

scripps res inst 2; rutgers state univ 2; nyu 2; natl yang ming univ 2; inst pasteur 2; dept vet affairs med ctr 2; washington univ 1; wageningen ur 1; wageningen ctr food sci 1; usa 1

- # CLUSTER 45
  Replicon isolation of bacillus cereus group virulence plasmids, and DNA binding with PcrA interacting with plasmid (30 Records)

Cluster Syntax Features

Descriptive Terms
plasmid 19.8%, dna 4.0%, replic 3.4%, pcra 3.4%, orf 3.0%, gene 2.9%, sequenc 2.4%, intron 2.0%, helicas 1.8%, splice 1.7%, replicon 1.7%, region 1.6%, clone 1.0%, strain 0.9%, coli 0.9%

Discriminating Terms
plasmid 12.8%, pcra 2.7%, replic 2.5%, orf 2.1%, spore 1.8%, intron 1.5%, helicas 1.4%, dna 1.4%, splice 1.4%, replicon 1.3%, vaccin 1.2%, anthrax 1.0%, toxin 0.8%, cell 0.7%, diseas 0.7%

Single Word Terms
bacillu 25, gene 23, dna 23, plasmid 22, anthraci 19, sequenc 19, similar 15, region 15, protein 14, replic 14, posit 13, on 13, gram 12, encod 12, two 11

Double Word Terms
bacillu.anthraci 19, gram.posit 11, escherichia.coli 8, open.read 7, posit.bacteria 7, read.frame 7, staphylococcu.aureu 6, gene.encod 5, bacillu.cereu 5, roll.circl 5, frame.orf 5, anthraci.strain 4, plasmid.dna 4, virul.plasmid 4, plasmid.pxo1 4

Triple Word Terms
open.read.frame 7, gram.posit.bacteria 7, read.frame.orf 5, singl.strand.dna 3, high.molecular.weight 3, amino.acid.sequenc 3, virul.plasmid.pxo1 3, deduc.amino.acid 2, clone.escherichia.coli 2, plasmid.gram.posit 2, amino.termin.end 2, bacillu.anthraci.virul 2, anthraci.virul.plasmid 2, polymeras.chain.reaction 2, anthraci.bacillu.cereu 2

Term Cliques
25.56% splice strain coli
46.67% gene sequenc splice strain
37.33% orf gene sequenc intron splice
50.56% dna orf gene sequenc intron region
38.33% dna pcra helicas region
37.50% dna replic pcra helicas
56.19% plasmid dna gene sequenc replicon region strain
51.67% plasmid dna orf gene sequenc replicon region clone
52.67% plasmid dna replic strain coli
52.00% plasmid dna replic clone coli
54.44% plasmid dna replic gene replicon strain
53.89% plasmid dna replic gene replicon clone

Sample Cluster Record Titles

Genetic diversity in the protective antigen gene of Bacillus anthracis

Sequence, assembly and analysis of pX01 and pX02

Sequence and organization of pXO1, the large Bacillus anthracis plasmid harboring the anthrax toxin genes

Correlation between plasmid content and infectivity in Borrelia burgdorferi

Pathogen evolution: How good bacteria go bad

Group I self-splicing intron in the recA gene of Bacillus anthracis

Search for potential vaccine candidate open reading frames in the Bacillus anthracis virulence plasmid pXO1: In silico and in vitro screening

Cluster Metrics

Authors

khan, sa 5; vary, ps 3; naqvi, a 3; keim, p 3; anand, sp 3; tinsley, e 2; svensson, r 2; ricke, d 2; martinez, y 2; manter, d 2

Sources

journal of bacteriology 8; plasmid 3; applied and environmental microbiology 3; rna-a publication of the rna society 2; nucleic acids research 2; gene 2; systematic and applied microbiology 1; proceedings of the national academy of sciences of the united states of america 1; molecular microbiology 1; journal of applied microbiology 1

Keywords

microbiology 10; escherichia-coli 8; identification 7; genetics & heredity 6; biochemistry & molecular biology 6; subtilis 6; microbiology 6; dna 6; biotechnology & applied microbiology 5; thuringiensis 5

Country

usa 21; south korea 1; norway 1; japan 1; israel 1; england 1; canada 1; belgium 1

Institution

univ pittsburgh 5; univ texas 4; univ calif los alamos natl lab 3; no illinois univ 3; no arizona univ 3; vical inc 1; usa 1; univ washington 1; univ oslo 1; univ minnesota 1

- # CLUSTER 30
  Role of iron compounds in inhibiting or supporting growth of infections, particularly epidermidis and related staphylococci (17 Records)

Cluster Syntax Features

Descriptive Terms
iron 15.0%, compound 7.1%, epidermidi 3.6%, siderophor 3.0%, extract 2.3%, activ 2.2%, antimicrobi 2.2%, staphylococcu 2.2%, antimicrobi.activ 1.7%, bactericid 1.7%, antibacteri 1.6%, coordin.compound 1.2%, cobalt 1.2%, copper 1.1%, transferrin 1.1%

Discriminating Terms
iron 9.8%, compound 4.1%, epidermidi 2.4%, siderophor 2.0%, spore 1.6%, staphylococcu 1.3%, vaccin 1.2%, antimicrobi 1.1%, antimicrobi.activ 1.1%, extract 1.1%, cell 1.0%, bactericid 1.0%, antibacteri 1.0%, toxin 0.9%, coordin.compound 0.8%

Single Word Terms
bacillu 15, anthraci 12, strain 10, activ 9, coli 7, antimicrobi 7, pathogen 7, infect 7, bacteria 7, staphylococcu 7, compound 6, iron 6, escherichia 6, growth 6, system 5

Double Word Terms
bacillu.anthraci 12, escherichia.coli 6, staphylococcu.aureu 4, gram.posit 4, coordin.compound 3, activ.gram 3, antifung.activ 3, activ.bacillu 3, antimicrobi.activ 3, natur.central 3, posit.bacteria 3, strain.staphylococcu 3, antibacteri.activ 3, iron.sourc 3, glutam.acid 2

Triple Word Terms
activ.bacillu.anthraci 3, gram.posit.bacteria 3, activ.gram.posit 3, bacteria.bacillu.anthraci 1, operon.bacillu.anthraci 1, bacillu.cereu.human 1, open.read.frame 1, cereu.human.pathogen 1, glutam.acid.pga 1, sulfat.polyacrylamid.gel 1, molecular.mass.kda 1, dodecyl.sulfat.polyacrylamid 1, sodium.dodecyl.sulfat 1, bacillu.anthraci.stern 1, system.anthrax.infect 1

Term Cliques
32.94% extract activ antimicrobi bactericid antibacteri
30.59% extract activ antimicrobi antimicrobi.activ bactericid
26.47% epidermidi staphylococcu
26.47% epidermidi antimicrobi
25.21% compound activ antimicrobi.activ bactericid cobalt coordin.compound copper
28.68% compound activ staphylococcu bactericid antibacteri cobalt coordin.compound copper
29.41% compound extract activ antimicrobi.activ bactericid
33.33% compound extract activ staphylococcu bactericid antibacteri
21.57% iron siderophor transferrin
22.69% iron compound antimicrobi.activ bactericid cobalt coordin.compound copper

Sample Cluster Record Titles

A ferric dicitrate uptake system is required for the full virulence of Bacillus cereus

Production of catechol-siderophore and utilization of transferrin-bound iron in Bacillus cereus

Bacteriocin with a broad antimicrobial spectrum, produced by Bacillus sp isolated from kimchi

Munumbicins, wide-spectrum antibiotics produced by Streptomyces NRRL 30562, endophytic on Kennedia nigriscans

Antibacterial and antifungal activity of extracts and quercetagetin derivate isolated from Centaurea rupestris L. (Asteraceae)

Kakadumycins, novel antibiotics from Streptomyces sp NRRL 30566, an endophyte of Grevillea pteridifolia

Bacillus anthracis requires siderophore biosynthesis for growth in macrophages and mouse virulence

Cluster Metrics

Authors

samus, nm 3; burdenko, ta 3; yaver, d 2; tsapkov, vi 2; toleva, ad 2; strobel, ga 2; robison, r 2; porter, h 2; jensen, jb 2; hess, wm 2

Sources

khimiko-farmatsevticheskii zhurnal 3; current microbiology 2; molecular microbiology 1; microbiology-sgm 1; journal of microbiology and biotechnology 1; journal of ethnopharmacology 1; journal of clinical investigation 1; journal of bacteriology 1; journal of applied microbiology 1; fems microbiology letters 1

Keywords

microbiology 5; chemistry, multidisciplinary 4; identification 4; staphylococcus-aureus 3; pharmacology & pharmacy 3; microbiology 3; pharmacology & pharmacy 2; biotechnology & applied microbiology 2; biochemistry & molecular biology 2; antimicrobial activity 2

Country

usa 6; england 4; south korea 2; tanzania 1; india 1; croatia 1

Institution

novozymes biotech inc 2; montana state univ 2; harvard univ 2; brigham young univ 2; brigham & womens hosp 2; virginia commonwealth univ hlth syst 1; vet affairs med ctr 1; univ zagreb 1; univ york 1; univ washington 1

- # CLUSTER 55
  Bacteria genomics, emphasizing gene expression in Escherichia Coli (25 Records)

Cluster Syntax Features

Descriptive Terms
genom 8.4%, gene 5.6%, enzym 3.9%, peptidoglycan 2.7%, sequenc 2.2%, coli 1.9%, amino 1.9%, cereu 1.8%, acetyl 1.5%, prokaryot 1.4%, amino.acid 1.3%, famili 1.2%, branch 1.2%, bac 1.2%, express 1.1%

Discriminating Terms
genom 5.0%, enzym 2.1%, peptidoglycan 2.0%, spore 1.9%, gene 1.5%, vaccin 1.5%, toxin 1.2%, acetyl 1.1%, prokaryot 1.0%, anthrax 1.0%, coli 0.9%, strain 0.9%, bac 0.9%, branch 0.8%, amino 0.8%

Single Word Terms
bacillu 21, gene 20, genom 17, sequenc 17, anthraci 17, express 14, cereu 12, amino 11, coli 11, protein 11, enzym 10, escherichia 10, dna 9, acid 9, activ 9

Double Word Terms
bacillu.anthraci 13, bacillu.cereu 10, escherichia.coli 10, amino.acid 9, bacillu.subtili 8, express.escherichia 5, clone.express 5, cell.wall 4, genom.sequenc 4, genom.bacillu 4, gram.posit 4, sequenc.genom 3, rel.bacillu 3, encod.protein 3, read.frame 3

Triple Word Terms
express.escherichia.coli 5, rel.bacillu.anthraci 3, open.read.frame 3, amino.acid.sequenc 3, gram.posit.bacterium 2, posit.bacterium.bacillu 2, gene.express.escherichia 2, genom.bacillu.cereu 2, sequenc.bacillu.cereu 2, termin.amino.acid 2, yersinia.pesti.bacillu 1, escherichia.coli.express 1, deduc.amino.acid 1, motif.amino.terminu 1, anthraci.cell.wall 1

Term Cliques
27.20% peptidoglycan amino cereu famili bac
32.80% enzym acetyl amino.acid famili express
31.20% enzym cereu acetyl amino.acid famili
34.67% enzym amino cereu amino.acid famili branch
35.20% enzym sequenc acetyl amino.acid famili
27.20% enzym peptidoglycan cereu acetyl famili
33.60% enzym peptidoglycan amino cereu famili
31.20% enzym peptidoglycan sequenc acetyl famili
38.00% gene coli famili bac
37.00% gene coli prokaryot bac
33.60% gene peptidoglycan amino famili bac
42.29% gene enzym amino amino.acid famili branch express
48.00% gene enzym coli famili express
48.00% gene enzym sequenc amino amino.acid famili
50.40% gene enzym sequenc coli famili
44.67% gene enzym peptidoglycan sequenc amino famili
36.80% genom cereu acetyl amino.acid famili
43.20% genom amino cereu amino.acid famili
40.80% genom sequenc acetyl amino.acid famili
54.67% genom gene prokaryot
52.67% genom gene sequenc amino amino.acid famili

Sample Cluster Record Titles

Toward functional genomics in bacteria: Analysis of gene expression in Escherichia coli from a bacterial artificial chromosome library of Bacillus cereus

Geobacillus stearothermophilus V ubiE gene product is involved in the evolution of dimethyl telluride in Escherichia coli K-12 cultures amended with potassium tellurate but not with potassium tellurite

A general strategy for identification of S-layer genes in the Bacillus cereus group: molecular characterization of such a gene in Bacillus thuringiensis subsp galleriae NRRL 4045

Identification and properties of type I-signal peptidases of Bacillus amyloliquefaciens

Basis for the extraordinary genetic stability of anthrax

Methionine regeneration and aminotransferases in Bacillus subtilis, Bacillus cereus, and Bacillus anthracis

Cluster Metrics

Authors

knodel, mh 2; berger, bj 2; zigha, a 1; zhang, r 1; zhang, jh 1; zhang, ct 1; yang, f 1; xu, wl 1; winstanley, d 1; weadge, jt 1

Sources

journal of biological chemistry 2; journal of bacteriology 2; bmc microbiology 2; world journal of microbiology & biotechnology 1; proceedings of the national academy of sciences of the united states of america 1; physiological genomics 1; nucleic acids research 1; molecular biology and evolution 1; microbiology-uk 1; microbiology-sgm 1

Keywords

biochemistry & molecular biology 8; microbiology 7; gene 6; biotechnology & applied microbiology 5; subtilis 5; escherichia-coli 5; anthracis 5; bacillus-anthracis 4; sequence 4; genome sequence 4

Country

usa 11; canada 4; germany 3; france 3; england 3; south korea 2; peoples r china 2; norway 2; ireland 1; greece 1

Institution

johns hopkins univ 2; inst pasteur 2; wyeth 1; warwick hri wellesbourne 1; veridian inc 1; usaf 1; univ wisconsin 1; univ stuttgart 1; univ sheffield 1; univ santiago chile 1

- # CLUSTER 2
  Gamma polyglutamic acid production and degradation, and biochemical analysis of poly-gamma-glutamate (11 Records)

Cluster Syntax Features

Descriptive Terms
pga 25.3%, glutam 12.7%, gamma 6.6%, polyglutam 5.6%, poli 5.2%, gene 2.3%, capd 2.2%, phb 1.9%, subtili 1.6%, gamma.glutam 1.3%, enzym 1.2%, poli.gamma.glutam 1.1%, poli.gamma 1.1%, synthesi 1.1%, polym 1.0%

Discriminating Terms
pga 15.2%, glutam 7.5%, gamma 3.5%, polyglutam 3.4%, poli 3.0%, spore 1.4%, capd 1.3%, vaccin 1.1%, phb 1.1%, toxin 0.9%, anthrax 0.8%, gamma.glutam 0.8%, poli.gamma 0.7%, poli.gamma.glutam 0.7%, anthraci 0.6%

Single Word Terms
bacillu 10, gene 10, poli 8, subtili 8, glutam 8, gamma 8, enzym 7, cell 7, clone 6, pga 6, acid 6, anthraci 5, operon 5, coli 4, product 4

Double Word Terms
bacillu.subtili 8, poli.gamma 6, gamma.glutam 6, bacillu.anthraci 4, escherichia.coli 4, coli.clone 3, pga.biosynthesi 3, three.gene 3, gamma.glutamyl 3, histidin.tag 3, locat.downstream 2, gene.locat 2, affin.chromatographi 2, acid.pga 2, two.subunit 2

Triple Word Terms
poli.gamma.glutam 6, open.read.frame 2, clone.bacillu.subtili 2, gamma.glutam.pga 2, gene.locat.downstream 2, pathogen.bacillu.anthraci 1, amino.acid.peptid 1, wild.type.strain 1, plai.central.role 1, capsul.biosynthet.operon 1, glutam.acid.pga 1, spore.form.bacillu 1, chelat.affin.chromatographi 1, metal.chelat.affin 1, express.escherichia.coli 1

Term Cliques
50.00% gene capd gamma.glutam poli.gamma.glutam poli.gamma synthesi
40.91% poli phb
43.18% polyglutam gene capd synthesi
56.57% glutam gamma gene subtili gamma.glutam poli.gamma.glutam poli.gamma synthesi polym
56.57% glutam gamma poli gene gamma.glutam poli.gamma.glutam poli.gamma synthesi polym
62.12% glutam gamma polyglutam gene subtili synthesi
65.66% pga glutam gamma gene subtili gamma.glutam enzym poli.gamma.glutam poli.gamma
65.66% pga glutam gamma poli gene gamma.glutam enzym poli.gamma.glutam poli.gamma
66.67% pga glutam gamma polyglutam gene subtili

Sample Cluster Record Titles

A poly-gamma-glutamate synthetic system of Bacillus subtilis IFO 3336: Gene cloning and biochemical analysis of poly-gamma-glutamate produced by Escherichia coli clone cells

Physiological and biochemical characteristics of poly gamma-glutamate synthetase complex of Bacillus subtilis

Characterization of the Bacillus subtilis ywsC gene, involved in gamma-polyglutamic acid production

Characterization of the Bacillus subtilis ywtD gene, whose product is involved in gamma-polyglutamic acid degradation

Characterization of poly-gamma-glutamate hydrolase encoded by a bacteriophage genome: Possible role in phage infection of Bacillus subtilis encapsulated with poly-gamma-glutamate

Poly-gamma-glutamate depolymerase of Bacillus subtilis: production, simple purification and substrate selectivity

Cluster Metrics

Authors

soda, k 3; misono, h 3; ashiuchi, m 3; yagi, t 2; tahara, y 2; sung, mh 2; kimura, k 2; kamei, t 2; itoh, y 2; fouet, a 2

Sources

journal of bacteriology 3; proceedings of the national academy of sciences of the united states of america 1; molecular microbiology 1; microbiology-sgm 1; journal of molecular catalysis b-enzymatic 1; journal of analytical and applied pyrolysis 1; european journal of biochemistry 1; biochemical and biophysical research communications 1; applied and environmental microbiology 1

Keywords

anthracis 6; poly(gamma-glutamic acid) 4; microbiology 4; gene 4; escherichia-coli 3; biochemistry & molecular biology 3; purification 3; poly(gamma-d-glutamyl) capsule 3; licheniformis 3; identification 3

Country

japan 7; usa 2; south korea 2; france 2

Institution

kochi univ 3; kansai univ 3; natl food res inst 2; inst pasteur 2; univ shizuoka 1; univ s carolina 1; stanford univ 1; shizuoka univ 1; natl inst anim hlth 1; korea res inst biosci & biotechnol 1

- # CLUSTER 35
  Resistance of bacillus anthracis isolate strains to antibiotics, and antimicrobial susceptibilities of bacillus anthracis isolates (32 Records)

Cluster Syntax Features

Descriptive Terms
resist 14.7%, mic 11.9%, penicillin 4.3%, antibiot 3.7%, isol 3.5%, strain 3.0%, suscept 2.4%, fluoroquinolon 2.3%, antimicrobi 2.0%, bla1 1.8%, stern 1.5%, bla2 1.3%, ciprofloxacin 1.2%, tetracyclin 1.0%, antimicrobi.agent 1.0%

Discriminating Terms
resist 8.4%, mic 8.3%, penicillin 2.7%, spore 1.7%, antibiot 1.7%, fluoroquinolon 1.5%, suscept 1.3%, bla1 1.2%, antimicrobi 1.1%, cell 1.1%, toxin 1.0%, vaccin 1.0%, protein 0.9%, isol 0.9%, bla2 0.9%

Single Word Terms
bacillu 32, anthraci 32, resist 27, isol 19, strain 19, mic 18, antibiot 16, penicillin 14, suscept 14, anthrax 14, two 13, antimicrobi 13, agent 13, stern 12, gene 11

Double Word Terms
bacillu.anthraci 30, antimicrobi.agent 9, anthraci.stern 7, escherichia.coli 7, resist.isol 6, strain.bacillu 6, penicillin.amoxicillin 5, isol.bacillu 5, isol.suscept 5, stern.strain 5, isol.resist 5, beta.lactam 5, strain.anthraci 5, anthraci.strain 4, staphylococcu.aureu 4

Triple Word Terms
strain.bacillu.anthraci 6, isol.bacillu.anthraci 5, anthraci.stern.strain 4, russian.anthrax.vaccin 3, ciprofloxacin.ofloxacin.levofloxacin 3, open.read.frame 2, horizont.gene.transfer 2, bacillu.anthraci.isol 2, bacillu.anthraci.high 2, anthraci.isol.suscept 2, bacillu.anthraci.strain 2, bacillu.anthraci.stern 2, express.escherichia.coli 2, anthrax.vaccin.strain 2, amino.acid.sequenc 2

Term Cliques
38.12% antibiot strain fluoroquinolon stern tetracyclin
22.92% penicillin bla1 bla2
37.50% penicillin antibiot tetracyclin
38.75% mic antimicrobi stern ciprofloxacin antimicrobi.agent
33.75% mic fluoroquinolon stern ciprofloxacin tetracyclin
39.38% mic strain fluoroquinolon stern tetracyclin
38.75% mic penicillin suscept ciprofloxacin tetracyclin
43.30% mic penicillin isol suscept antimicrobi ciprofloxacin antimicrobi.agent
41.25% resist strain bla1 stern bla2
50.00% resist antibiot strain stern tetracyclin
47.50% resist mic stern ciprofloxacin antimicrobi.agent
45.63% resist mic stern ciprofloxacin tetracyclin
51.25% resist mic strain stern tetracyclin
51.88% resist mic isol ciprofloxacin antimicrobi.agent

Sample Cluster Record Titles

In vitro resistance of Bacillus anthracis Sterne to doxycycline, macrolides and quinolones

Molecular analysis of rifampin resistance in Bacillus anthracis and Bacillus cereus

Antimicrobial susceptibility testing of Bacillus anthracis: Comparison of results obtained by using National Committee for Clinical Laboratory Standards broth microdilution reference and etest agar gradient diffusion methods

Antibiotic susceptibilities of 96 isolates of Bacillus anthracis isolated in France between 1994 and 2000

Antimicrobial susceptibility of Bacillus anthracis in an endemic area

Antimicrobial susceptibilities of diverse Bacillus anthracis isolates

Cluster Metrics

Authors

rubinstein, e 5; athamna, a 5; bast, dj 4; athamna, m 4; tenover, fc 3; medlej, b 3; koehler, tm 3; stanhope, mj 2; smith, kl 2; palzkill, t 2

Sources

antimicrobial agents and chemotherapy 11; journal of antimicrobial chemotherapy 6; scandinavian journal of infectious diseases 2; journal of clinical microbiology 2; onderstepoort journal of veterinary research 1; molecular and cellular biochemistry 1; journal of bacteriology 1; international journal of antimicrobial agents 1; infection and immunity 1; embo reports 1

Keywords

pharmacology & pharmacy 19; microbiology 15; infectious diseases 10; microbiology 9; resistance 6; resistance 5; anthrax 5; macrolides 5; sterne 4; doxycycline 4

Country

usa 17; israel 5; canada 5; france 3; england 3; turkey 2; south africa 2; switzerland 1; spain 1; italy 1

Institution

triangle res & dev ctr 5; tel aviv univ 5; mt sinai hosp 5; univ texas 3; glaxosmithkline 3; ctr dis control & prevent 3; no arizona univ 2; baylor coll med 2; armed forces radiobiol res inst 2; vital probes inc 1

- # CLUSTER 17
  Calmodulin-activated bacillus anthracis enzyme adenylate cyclase, especially its ATP binding sequences (31 Records)

Cluster Syntax Features

Descriptive Terms
cam 15.3%, cyclas 10.3%, adenylyl 7.0%, adenylyl.cyclas 6.6%, calmodulin 5.6%, cyaa 4.2%, atp 2.5%, bind 1.8%, activ 1.7%, camp 1.6%, ca2 1.5%, complex 1.3%, adenyl 1.2%, adenyl.cyclas 1.2%, catalyt 1.1%

Discriminating Terms
cam 10.1%, cyclas 6.5%, adenylyl 4.6%, adenylyl.cyclas 4.4%, calmodulin 3.6%, cyaa 2.8%, atp 1.6%, spore 1.6%, vaccin 1.2%, strain 1.0%, ca2 1.0%, camp 0.9%, gene 0.7%, adenyl.cyclas 0.7%, adenyl 0.7%

Single Word Terms
cyclas 27, activ 25, bind 22, calmodulin 22, catalyt 19, adenylyl 18, factor 17, structur 17, protein 16, site 16, domain 16, two 15, anthraci 14, atp 14, edema 14

Double Word Terms
adenylyl.cyclas 18, bacillu.anthraci 14, edema.factor 14, bordetella.pertussi 12, calmodulin.cam 11, cyclas.activ 10, adenyl.cyclas 9, cam.activ 7, cam.bind 7, termin.domain 6, amino.acid 6, bind.site 6, catalyt.domain 6, pseudomona.aeruginosa 5, wild.type 5

Triple Word Terms
adenylyl.cyclas.activ 9, calmodulin.cam.activ 6, activ.adenylyl.cyclas 5, pertussi.adenyl.cyclas 4, anthrax.edema.factor 4, adenylyl.cyclas.toxin 4, adenylyl.cyclas.domain 4, depend.adenylyl.cyclas 4, mammalian.adenylyl.cyclas 4, termin.domain.cam 4, cam.activ.adenylyl 4, bordetella.pertussi.adenyl 3, edema.factor.kei 3, domain.bordetella.pertussi 3, cyclas.bordetella.pertussi 3

Term Cliques
46.24% calmodulin atp bind complex adenyl adenyl.cyclas
43.01% cyclas cyaa bind ca2 adenyl adenyl.cyclas
56.22% cyclas calmodulin atp bind adenyl adenyl.cyclas catalyt
52.53% cyclas calmodulin cyaa bind adenyl adenyl.cyclas catalyt
51.15% cam calmodulin atp bind activ camp complex
55.91% cam cyclas adenylyl adenylyl.cyclas bind ca2
59.03% cam cyclas adenylyl adenylyl.cyclas calmodulin atp bind activ camp catalyt

Sample Cluster Record Titles

ExoY, an adenylate cyclase secreted by the Pseudomonas aeruginosa type III system

Direct delivery of the Bordetella pertussis adenylate cyclase toxin to the MHC class I antigen presentation pathway

Crystallization and preliminary X-ray study of the edema factor exotoxin adenylyl cyclase domain from Bacillus anthracis in the presence of its activator, calmodulin

Structural basis for the activation of anthrax adenylyl cyclase exotoxin by calmodulin

Physiological calcium concentrations regulate calmodulin binding and catalysis of adenylyl cyclase exotoxins

An extended conformation of calmodulin induces interactions between the structural domains of adenylyl cyclase from Bacillus anthracis to promote catalysis

Cluster Metrics

Authors

tang, wj 13; shen, yq 8; barzu, o 6; zhukovskaya, nl 5; munier, h 5; soelaiman, s 4; mrksich, m 4; lee, ys 4; guo, q 4; gilles, am 4

Sources

journal of biological chemistry 8; embo journal 4; proceedings of the national academy of sciences of the united states of america 2; biochemistry 2; biochemical and biophysical research communications 2; archives of biochemistry and biophysics 2; vaccine 1; nature 1; molecular biology of the cell 1; journal of the serbian chemical society 1

Keywords

biochemistry & molecular biology 21; bacillus-anthracis 19; bordetella-pertussis 6; x-ray 5; identification 5; escherichia-coli 5; edema factor 5; domain 5; crystal-structure 5; calmodulin 5

Country

usa 20; france 9; romania 2; yugoslavia 1; spain 1; kuwait 1; canada 1

Institution

univ chicago 13; inst pasteur 9; boston biomed res inst 4; tufts univ 3; rice univ 2; med coll wisconsin 2; loyola univ 2; gilead sci inc 2; univ virginia 1; univ texas 1

- # CLUSTER 18
  Surface layer homology domains for binding proteins to cell walls of bacillus anthracis (20 Records)

Cluster Syntax Features

Descriptive Terms
cell.wall 10.6%, wall 9.7%, slh 5.7%, protein 4.9%, sortas 3.8%, anchor 3.3%, surfac 2.9%, cell 2.8%, domain 2.5%, slh.domain 1.8%, motif 1.8%, surfac.protein 1.6%, secret 1.6%, sort.signal 1.3%, sort 1.2%

Discriminating Terms
cell.wall 7.0%, wall 6.3%, slh 4.0%, sortas 2.6%, anchor 2.2%, spore 1.7%, slh.domain 1.3%, vaccin 1.2%, surfac.protein 1.0%, surfac 1.0%, motif 1.0%, strain 1.0%, anthrax 0.9%, toxin 0.9%, sort.signal 0.9%

Single Word Terms
protein 19, cell 18, wall 17, bacillu 15, anthraci 15, bind 14, surfac 12, bacteria 11, anchor 10, domain 9, encod 9, aureu 8, gram 8, posit 8, signal 8

Double Word Terms
cell.wall 17, bacillu.anthraci 13, gram.posit 8, staphylococcu.aureu 6, posit.bacteria 6, surfac.protein 6, sort.signal 5, layer.homolog 5, layer.protein 5, cell.surfac 5, electron.microscopi 4, wall.anchor 4, slh.domain 4, wall.envelop 4, bacillu.subtili 4

Triple Word Terms
gram.posit.bacteria 6, cell.wall.envelop 4, cell.wall.anchor 4, cell.wall.bind 3, layer.homolog.slh 3, surfac.protein.gram 3, protein.gram.posit 3, wall.sort.signal 3, bacillu.subtili.cell 3, cell.wall.sort 3, chimer.gene.encod 2, sequenc.bacillu.anthraci 2, protein.cell.wall 2, agent.anthrax.synthes 2, listeria.monocytogen.bacillu 2

Term Cliques
53.57% slh protein anchor surfac cell slh.domain motif
55.71% slh protein anchor surfac cell domain slh.domain
61.25% cell.wall wall protein anchor cell motif surfac.protein secret
60.00% cell.wall wall protein anchor cell slh.domain motif secret
64.38% cell.wall wall protein anchor surfac cell slh.domain motif
66.25% cell.wall wall protein anchor surfac cell domain slh.domain
53.64% cell.wall wall protein sortas anchor surfac cell motif surfac.protein sort.signal sort

Sample Cluster Record Titles

Production and cell surface anchoring of functional fusions between the SLH motifs of the Bacillus anthracis S-layer proteins and the Bacillus subtilis levansucrase

Distinct affinity of binding sites for S-layer homologous domains in Clostridium thermocellum and Bacillus anthracis cell envelopes

The S-layer homology domain as a means for anchoring heterologous proteins on the cell surface of Bacillus anthracis

Bacterial SLH domain proteins are non-covalently anchored to the cell surface via a conserved mechanism

involving wall polysaccharide pyruvylation

Plasmid-encoded autolysin in Bacillus anthracis: Modular structure and catalytic properties

Optimization of the cell wall microenvironment allows increased production of recombinant Bacillus anthracis protective antigen from B-subtilis

Cluster Metrics

Authors

fouet, a 5; schneewind, o 4; mesnage, s 4; tosi-couture, e 2; mock, m 2; mignot, t 2; harwood, cr 2; gaspar, ah 2; zhang, rg 1; yang, c 1

Sources

journal of bacteriology 5; journal of biological chemistry 3; journal of applied microbiology 2; structure 1; proteomics 1; molecular microbiology 1; microbiology-sgm 1; langmuir 1; journal of biotechnology 1; infection and immunity 1

Keywords

biochemistry & molecular biology 7; microbiology 6; gram-positive bacteria 5; biotechnology & applied microbiology 4; surface-proteins 4; microbiology 4; escherichia-coli 4; bacillus-anthracis 4; cell-wall 3; staphylococcus-aureus 3

Country

usa 9; france 7; england 2; switzerland 1; israel 1; germany 1; finland 1

Institution

inst pasteur 7; univ chicago 4; univ newcastle upon tyne 2; argonne natl lab 2; weizmann inst sci 1; univ texas 1; univ penn 1; univ paris 11 1; univ illinois 1; univ greifswald 1

- # CLUSTER 4
  Surface layers in bacillus anthracis, emphasizing surface layer proteins and surface array proteins (13 Records)

Cluster Syntax Features

Descriptive Terms
layer 20.1%, ea1 18.8%, sap 9.0%, layer.protein 3.9%, protein 3.2%, surfac 1.6%, capsul 1.0%, eag 0.9%, abund 0.9%, surfac.layer 0.9%, polysaccharid 0.8%, ea1.sap 0.8%, molecular.mass 0.7%, mass.kda 0.7%, cell 0.7%

Discriminating Terms
ea1 12.4%, layer 12.0%, sap 5.7%, layer.protein 2.5%, vaccin 1.2%, toxin 1.0%, strain 0.8%, anthrax 0.8%, cereu 0.7%, diseas 0.6%, eag 0.6%, surfac.layer 0.5%, protect 0.5%, polysaccharid 0.5%, abund 0.5%

Single Word Terms
bacillu 12, cell 12, protein 11, layer 11, anthraci 11, surfac 9, two 9, form 8, bacterium 7, abund 7, structur 6, compon 6, anthrax 6, spore 6, sequenc 6

Double Word Terms
bacillu.anthraci 11, layer.protein 7, surfac.layer 6, cell.wall 5, gram.posit 5, surfac.protein 5, layer.layer 4, spore.form 4, two.dimension 4, form.bacterium 4, posit.spore 4, two.abund 4, abund.surfac 4, molecular.mass 4, singl.doubl 3

Triple Word Terms
abund.surfac.protein 4, gram.posit.spore 4, two.abund.surfac 4, spore.form.bacterium 4, posit.spore.form 4, surfac.layer.layer 4, layer.homolog.motif 3, sodium.dodecyl.sulfat 3, three.layer.homolog 3, agent.anthrax.gram 2, dodecyl.sulfat.polyacrylamid 2, molecular.mass.kda 2, sulfat.polyacrylamid.gel 2, anthraci.gram.posit 2, bacillu.anthraci.gram 2

Term Cliques
26.92% molecular.mass mass.kda
19.23% polysaccharid molecular.mass
64.62% layer.protein protein surfac mass.kda cell
61.54% layer polysaccharid cell
57.26% layer ea1 protein surfac capsul abund surfac.layer ea1.sap cell
60.68% layer ea1 layer.protein protein surfac capsul abund surfac.layer cell
56.41% layer ea1 sap protein surfac eag abund ea1.sap cell
56.41% layer ea1 sap protein surfac capsul abund ea1.sap cell
59.83% layer ea1 sap layer.protein protein surfac eag abund cell
59.83% layer ea1 sap layer.protein protein surfac capsul abund cell

Sample Cluster Record Titles

The capsule and S-layer: Two independent and yet compatible macromolecular structures in Bacillus anthracis

Bacillus anthracis surface: capsule and S-layer

Developmental switch of S-layer protein synthesis in Bacillus anthracis

Structural analysis and evidence for dynamic emergence of Bacillus anthracis S-layer networks

Surface layer protein EA1 is not a component of Bacillus anthracis spores but is a persistent contaminant in spore preparations

Cluster Metrics

Authors

fouet, a 7; mock, m 6; mesnage, s 6; gounon, p 4; tosicouture, e 2; tosi-couture, e 2; mignot, t 2; couture-tosi, e 2; chami, m 2; zhu, hc 1

Sources

journal of bacteriology 5; molecular microbiology 2; proteomics 1; journal of applied microbiology 1; international journal of modern physics c 1; fems microbiology reviews 1; fems microbiology letters 1; canadian journal of microbiology 1

Keywords

microbiology 7; microbiology 4; escherichia-coli 4; biochemistry & molecular biology 3; subtilis 3; plasmid 3; wall protein gene 2; gram-positive bacteria 2; anthracis 2; surface-layers 2

Country

france 7; usa 5; spain 1; russia 1; poland 1; peoples r china 1; netherlands 1; germany 1; finland 1; austria 1

Institution

inst pasteur 7; cnrs 2; vanderbilt univ 1; usa 1; univ vienna 1; univ rostock 1; univ paris 11 1; univ paris 06 1; univ minnesota 1; univ louisville 1

CATEGORY 7 – 125b1

Binding of anthrax lethal toxin to host cell receptors (228 REC)

- Prepore (heptameric) to pore conversion of anthrax protective antigen, and subsequent membrane translocation to cytosol (21 Records)
- Translocation of anthrax toxin components lethal factor and edema factor through protective antigen-formed channels in planar phospholipid bilayer membranes to cytosol (31 Records)
- Binding of anthrax toxin lethal factor residues to receptor domains (48 Records)
- Crystal structures with beta barrels or beta sheets and binding domains (22 Records)
- Binding domains of host cell receptors, especially TEM8 and CMG2, for binding protective antigen and mediating toxicity (27 Records)
- Clostridium botulinum C2 toxin, emphasizing its enzyme component C2I, and the separated binding/translocation component C2II. (9 Records)
- Modified anthrax toxin lethal factor (LFn) fusion protein for translating antigens, especially cytotoxic epitopes, across cell membranes for inducing antiviral immunity (32 Records)
- Furin's toxin activation by proteolytic cleavage, and replacement of furin protease cleavage sites in anthrax toxin protective antigen proteins by sequences selectively cleaved by matrix metalloproteinases for designing tumor cell-selective cytotoxins. (18 Records)
- Polyarginine-containing peptides for inhibiting furin, and reducing activation of pathogenic toxins. (20 Records)

- CLUSTER 8

  Prepore (heptameric) to pore conversion of anthrax protective antigen, and subsequent membrane translocation to cytosol (21 Records)

Cluster Syntax Features

Descriptive Terms

pore 30.0%, prepor 4.7%, beta 2.8%, form 2.8%, heptamer 2.1%, membran 1.9%, pore.form 1.7%, pore.format 1.5%, toxin 1.5%, barrel 1.5%, complex 1.4%, transloc 1.1%, transmembran 1.0%, residu 0.9%, structur 0.9%

Discriminating Terms

pore 19.9%, prepor 3.1%, spore 1.6%, heptamer 1.3%, vaccin 1.3%, beta 1.2%, pore.form 1.2%, strain 1.1%, pore.format 1.0%, barrel 1.0%, form 0.9%, anthraci 0.9%, gene 0.8%, cereu 0.7%, transmembran 0.6%

Single Word Terms
form 21, pore 21, toxin 20, protect 18, antigen 18, anthrax 17, heptamer 15, protein 13, cell 13, membran 13, prepor 11, bind 11, format 11, structur 11, cytosol 11

Double Word Terms
protect.antigen 18, anthrax.toxin 15, pore.form 9, prepor.pore 8, pore.format 8, lethal.factor 8, beta.barrel 7, edema.factor 7, form.pore 7, transmembran.beta 6, toxin.form 5, mammalian.cell 5, conform.rearrang 5, factor.edema 5, heptamer.pore 5

Triple Word Terms
factor.edema.factor 5, transmembran.beta.barrel 5, lethal.factor.edema 5, compon.anthrax.toxin 4, cytosol.mammalian.cell 4, moieti.anthrax.toxin 4, pore.format.transloc 4, protect.antigen.compon 3, pore.form.protein 3, anthrax.toxin.form 3, protect.antigen.moieti 3, prepor.pore.convers 3, antigen.compon.anthrax 3, cystein.substitut.residu 3, pore.endosom.membran 3

Term Cliques
70.63% pore form pore.format toxin complex transloc
65.48% pore form membran pore.format toxin barrel transloc transmembran
69.64% pore form heptamer membran pore.format toxin barrel transloc
70.24% pore form heptamer membran pore.form pore.format toxin structur
71.43% pore beta form heptamer membran toxin residu structur
70.63% pore prepor form pore.format toxin complex
65.48% pore prepor form membran pore.format toxin barrel transmembran
69.64% pore prepor form heptamer membran pore.format toxin barrel
70.24% pore prepor form heptamer membran pore.form pore.format toxin
64.02% pore prepor beta form membran toxin barrel transmembran residu
67.72% pore prepor beta form heptamer membran toxin barrel residu

Sample Cluster Record Titles

Identification of residues lining the anthrax protective antigen channel

Anthrax protective antigen: Prepore-to-pore conversion

Point mutations in anthrax protective antigen that block translocation

Detoxification of a bacterial toxin by the toxin itself

PA(63) channel of anthrax toxin: An extended beta-barrel

Monomer-monomer interactions drive the prepore to pore conversion of a beta-barrel-forming cholesterol-dependent cytolysin

Cluster Metrics

Authors
collier, rj 13; tweten, rk 4; lacy, db 4; melnyk, ra 3; krantz, ba 3; finkelstein, a 3; zhang, s 2; young, jat 2;

wigelsworth, dj 2; rainey, gja 2

Sources
proceedings of the national academy of sciences of the united states of america 5; journal of biological chemistry 5; biochemistry 3; trends in pharmacological sciences 1; science 1; nature structural biology 1; molecular and cellular biology 1; journal of structural biology 1; journal of molecular biology 1; journal of biomolecular structure & dynamics 1

Keywords
biochemistry & molecular biology 14; edema factor 8; lethal factor 7; multidisciplinary sciences 6; mammalian-cells 6; crystal-structure 6; channel 6; adenylate-cyclase 6; translocation 5; receptor 5

Country
usa 19; italy 1; canada 1; australia 1

Institution
harvard univ 13; univ oklahoma 4; yeshiva univ albert einstein coll med 2; salk inst biol studies 2; childrens hosp 2; albert einstein coll med 2; usamriid 1; univ wisconsin 1; univ washington 1; univ virginia 1

- # CLUSTER 26
  Translocation of anthrax toxin components lethal factor and edema factor through protective antigen-formed channels in planar phospholipid bilayer membranes to cytosol (31 Records)

Cluster Syntax Features

Descriptive Terms
channel 15.3%, membran 7.4%, transloc 5.3%, lipid 3.2%, pa63 2.4%, bind 2.4%, toxin 2.2%, block 1.8%, ion 1.7%, bilay 1.4%, form 1.4%, ligand 1.3%, moieti 1.2%, cell 1.1%, oligom 1.0%

Discriminating Terms
channel 10.9%, membran 4.0%, transloc 3.1%, lipid 2.2%, spore 1.8%, pa63 1.5%, vaccin 1.4%, strain 1.2%, block 1.1%, bilay 1.0%, ion 1.0%, gene 0.9%, anthraci 0.8%, cereu 0.8%, moieti 0.7%

Single Word Terms
toxin 27, membran 27, antigen 22, protein 22, protect 22, anthrax 21, cell 21, transloc 20, bind 20, form 20, factor 19, edema 18, two 17, lethal 17, channel 17

Double Word Terms
protect.antigen 22, anthrax.toxin 17, edema.factor 17, lethal.factor 16, lipid.bilay 10, plasma.membran 9, bacillu.anthraci 9, factor.lethal 8, cho.cell 6, mammalian.cell 6, factor.cytosol 6, form.ion 6, proteolyt.activ 5, membran.insert 5, bind.site 5

Triple Word Terms
edema.factor.lethal 8, factor.lethal.factor 8, protect.antigen.compon 5, compon.anthrax.toxin 5, protect.antigen.moieti 4, plasma.membran.cho 4, antigen.moieti.anthrax 4, moieti.anthrax.toxin 4, lethal.factor.cytosol 4, antigen.compon.anthrax 4, acid.intracellular.compart 4, protect.antigen.kda 3, lethal.factor.kda 3, membran.cho.cell 3, lipid.bilay.membran 3

Term Cliques
60.83% membran transloc toxin form ligand moieti cell
58.06% membran transloc bind toxin block form ligand cell oligom
61.29% membran transloc pa63 toxin form moieti cell
58.78% channel membran bind toxin block ion form cell oligom
60.93% channel membran bind toxin block ion bilay form cell
60.57% channel membran lipid bind toxin ion bilay form cell
58.06% channel membran transloc pa63 bind toxin block form cell oligom
60.00% channel membran transloc pa63 bind toxin block bilay form cell
59.68% channel membran transloc lipid pa63 bind toxin bilay form cell

Sample Cluster Record Titles

Use of a photoactivatable lipid to probe the topology of PA63 of Bacillus anthracis in lipid membranes

Characterization of membrane translocation by anthrax protective antigen

Permeation of large tetra-alkylammonium cations through mutant and wild-type voltage-gated sodium channels as revealed by relief of block at high voltage

Translocation of Bacillus anthracis lethal and oedema factors across endosome membranes

Dominant-negative mutants of a toxin subunit: An approach to therapy of anthrax

A dominant negative mutant of Bacillus anthracis protective antigen inhibits anthrax toxin action in vivo

Ionic blockade of the rat connexin40 gap junction channel by large tetraalkylammonium ions

Cluster Metrics

Authors

collier, rj 11; mock, m 5; cabiaux, v 5; zhang, s 3; wang, xm 3; ruysschaert, jm 3; popoff, mr 3; milne, jc 3; finkelstein, a 3; benz, r 3

Sources

journal of biological chemistry 6; biochemistry 6; biophysical journal 3; molecular microbiology 2; toxicology 1; structure 1; science 1; proceedings of the national academy of sciences of the united states of america 1; nano letters 1; molecular medicine 1

Keywords

biochemistry & molecular biology 19; adenylate-cyclase 12; mammalian-cells 9; diphtheria-toxin 8; toxin 7; lethal factor 7; protective antigen 6; diphtheria-toxin 6; macrophages 6; bacillus-anthracis 5

Country

usa 20; france 8; belgium 5; germany 3; italy 2; india 2; norway 1; new zealand 1

Institution

harvard univ 12; inst pasteur 8; usa 3; univ wurzburg 3; free univ brussels 3; yale univ 2; univ padua 2; univ mons hainaut 2; albert einstein coll med 2; yeshiva univ albert einstein coll med 1

- # CLUSTER 50
  Binding of anthrax toxin lethal factor residues to receptor domains (48 Records)

Cluster Syntax Features

Descriptive Terms
bind 7.1%, residu 4.2%, factor 3.0%, lethal 2.5%, cell 2.0%, lethal.factor 2.0%, kda 1.8%, toxin 1.7%, protect.antigen 1.6%, antigen 1.5%, receptor 1.5%, edema 1.5%, protein 1.4%, toxic 1.4%, protect 1.2%

Discriminating Terms
bind 3.4%, residu 2.8%, spore 2.2%, strain 1.5%, vaccin 1.2%, kda 1.0%, lethal.factor 1.0%, factor 0.9%, cereu 0.9%, anthraci 0.9%, oligomer 0.8%, diseas 0.8%, toxic 0.8%, asn 0.7%, leu 0.7%

Single Word Terms
antigen 44, protect 44, factor 43, bind 42, cell 41, lethal 40, anthrax 39, toxin 37, protein 36, residu 30, edema 28, activ 27, receptor 25, anthraci 22, surfac 22

Double Word Terms
protect.antigen 44, lethal.factor 39, edema.factor 27, anthrax.toxin 25, bacillu.anthraci 22, cell.surfac 19, amino.acid 13, factor.edema 12, lethal.toxin 12, proteolyt.activ 12, kda.fragment 11, surfac.receptor 11, mammalian.cell 10, factor.lethal 9, anthrax.lethal 9

Triple Word Terms
lethal.factor.edema 12, factor.edema.factor 12, cell.surfac.receptor 11, factor.lethal.factor 9, edema.factor.lethal 9, anthrax.lethal.toxin 8, protect.antigen.lethal 8, antigen.lethal.factor 8, protein.protect.antigen 7, protect.antigen.kda 6, site.direct.mutagenesi 6, amino.acid.residu 6, surfac.receptor.cleav 5, protect.antigen.compon 5, anthrax.toxin.three 5

Term Cliques
74.68% bind factor lethal cell kda toxin protect.antigen antigen receptor edema protein toxic protect
77.40% bind factor lethal cell lethal.factor toxin protect.antigen antigen receptor edema protein toxic protect
76.89% bind residu factor lethal cell kda protect.antigen antigen protein toxic protect
80.11% bind residu factor lethal cell lethal.factor protect.antigen antigen protein toxic protect

Sample Cluster Record Titles

Site directed mutagenesis of histidine residues in anthrax toxin lethal factor binding domain reduces toxicity

Oligomerization of anthrax toxin protective antigen and binding of lethal factor during endocytic uptake into mammalian cells

Disruption of anthrax toxin binding with the use of human antibodies and competitive inhibitors

Autogenous regulation of the Bacillus anthracis pag operon

A quantitative study of the interactions of Bacillus anthracis edema factor and lethal factor with activated protective antigen

Proteolytic activation of receptor-bound anthrax protective antigen on macrophages promotes its internalization

Cluster Metrics

Authors

leppla, sh 12; singh, y 8; collier, rj 8; klimpel, kr 7; bhatnagar, r 7; chauhan, v 5; arora, n 5; singh, a 4; mogridge, j 3; little, sf 3

Sources

journal of biological chemistry 8; biochemical and biophysical research communications 7; proceedings of the national academy of sciences of the united states of america 5; infection and immunity 5; fems microbiology letters 3; biochemistry 3; protein expression and purification 2; nature biotechnology 1; molecular microbiology 1; molecular and cellular biochemistry 1

Keywords

biochemistry & molecular biology 23; macrophages 13; bacillus-anthracis 12; mammalian-cells 11; protective antigen 10; lethal factor 10; expression 10; biophysics 10; toxin 9; adenylate-cyclase 9

Country

usa 29; india 14; italy 3; south korea 2; switzerland 1; new zealand 1; israel 1; germany 1; france 1; australia 1

Institution

nidr 8; harvard univ 8; jawaharlal nehru univ 7; ctr biochem technol 4; univ delhi 3; univ texas 2; univ padua 2; niaid 2; nci 2; walter reed army inst res 1

- # CLUSTER 46
  Crystal structures with beta barrels or beta sheets and binding domains (22 Records)

Cluster Syntax Features

Descriptive Terms
beta 12.6%, structur 5.7%, bind 5.2%, crystal 2.5%, domain 2.4%, lactamas 2.2%, interact 2.1%, rna 1.9%, crystal.structur 1.8%, beta.lactamas 1.8%, protein 1.7%, ligand 1.7%, motif 1.5%, hydrogen 1.5%, alpha 1.4%

Discriminating Terms
beta 7.9%, structur 2.7%, spore 1.8%, bind 1.6%, crystal 1.5%, lactamas 1.5%, beta.lactamas 1.2%, strain 1.2%, vaccin 1.2%, crystal.structur 1.2%, rna 1.1%, cell 1.1%, hydrogen 1.0%, interact 1.0%, toxin 0.9%

Single Word Terms
protein 16, structur 15, bind 14, sequenc 11, bacillu 10, beta 10, acid 9, three 9, motif 8, first 8, anthraci 8, interact 8, form 7, two 7, anthrax 7

Double Word Terms
bacillu.anthraci 8, crystal.structur 7, amino.acid 5, acid.residu 3, bind.affin 3, side.chain 3, bind.protein 3, beta.sheet 3, bind.pocket 3, bind.site 3, angstrom.resolut 3, beta.strand 3, escherichia.coli 3, von.willebrand 2, converg.evolut 2

Triple Word Terms
amino.acid.sequenc 2, anthrax.protect.antigen 2, amino.acid.residu 1, plai.central.role 1, protect.antigen.domain 1, express.escherichia.coli 1, protect.antigen.human 1, anthrax.lethal.factor 1, bacillu.anthraci.pathogen 1, gram.posit.bacteria 1, phage.displai.peptid 1, protein.escherichia.coli 1, anti.anthrax.vaccin 1, report.crystal.structur 1, compon.bacillu.anthraci 1

Term Cliques
25.76% interact ligand hydrogen
30.00% bind domain lactamas beta.lactamas motif
49.24% structur bind domain interact protein ligand
46.10% structur bind domain interact rna protein motif
46.10% structur bind crystal domain crystal.structur protein ligand
43.75% structur bind crystal domain rna crystal.structur protein motif
28.79% beta hydrogen alpha
33.33% beta domain alpha
26.36% beta domain lactamas beta.lactamas motif
41.67% beta crystal domain crystal.structur protein motif

Sample Cluster Record Titles

BETAWRAP: Successful prediction of parallel beta-helices from primary sequence reveals an association with many microbial pathogens

Structure of two iron-binding proteins from Bacillus anthracis

Structural studies of the nudix hydrolase DR1025 from Deinococcus radiodurans and its ligand complexes

Crystal structure of the a domain from complement factor B reveals an integrin-like open conformation

The PA14 domain, a conserved all-beta domain in bacterial toxins, enzymes, adhesins and signaling molecules

Covalent reaction intermediate revealed in crystal structure of the Geobacillus stearothermophilus carboxylesterase Est30

Cluster Metrics

Authors

zhang, z 2; saksena, r 2; rigden, dj 2; palzkill, t 2; nishikawa, s 2; kovac, p 2; galperin, my 2; adamo, r 2; zwieb, c 1; zanotti, g 1

Sources

structure 3; journal of molecular biology 3; journal of biological chemistry 2; carbohydrate research 2; trends in biochemical sciences 1; protein engineering 1; proceedings of the national academy of sciences of the united states of america 1; organic letters 1; nucleic acids research 1; molecular microbiology 1

Keywords

biochemistry & molecular biology 14; crystal-structure 6; escherichia-coli 5; biophysics 4; anthrax toxin 4; protein 3; expression 3; cell biology 3; biochemistry & molecular biology 3; ligands 2

Country

usa 14; england 4; japan 2; france 2; switzerland 1; italy 1; india 1; brazil 1

Institution

univ liverpool 2; niddk 2; natl inst adv ind sci & technol aist 2; baylor coll med 2; univ washington 1; univ tennessee 1; univ poitiers 1; univ paris 11 1; univ padua 1; univ oxford 1

- # CLUSTER 23
  Binding domains of host cell receptors, especially TEM8 and CMG2, for binding protective antigen and mediating toxicity (27 Records)

Cluster Syntax Features

Descriptive Terms
receptor 12.5%, domain 9.6%, cmg2 6.0%, tem8 3.8%, bind 3.2%, atr 2.9%, toxin 2.5%, anthrax.toxin 2.1%, vwa 1.6%, toxin.receptor 1.5%, protein 1.3%, mutat 1.2%, cell 1.2%, vwa.domain 1.1%, interact 1.1%

Discriminating Terms
receptor 7.9%, domain 5.5%, cmg2 4.6%, tem8 2.9%, atr 2.2%, spore 1.8%, vaccin 1.4%, strain 1.3%, vwa 1.3%, toxin.receptor 1.1%, anthrax.toxin 0.9%, anthraci 0.9%, vwa.domain 0.8%, anthrax.toxin.receptor 0.8%, bind 0.8%

Single Word Terms
receptor 26, toxin 26, anthrax 26, protein 23, bind 23, antigen 22, protect 22, domain 21, cell 20, factor 17, interact 14, membran 13, lethal 13, bacillu 13, two 12

Double Word Terms
anthrax.toxin 23, protect.antigen 22, toxin.receptor 14, bacillu.anthraci 12, lethal.factor 11, receptor.bind 9, cellular.receptor 9, cell.surfac 8, capillari.morphogenesi 7, endotheli.marker 6, compon.anthrax 6, von.willebrand 6, amino.acid 6, crystal.structur 6, tumor.endotheli 6

Triple Word Terms
anthrax.toxin.receptor 12, tumor.endotheli.marker 6, compon.anthrax.toxin 6, receptor.anthrax.toxin 5, von.willebrand.factor 5, toxin.receptor.atr 4, depend.adhes.site 4, metal.ion.depend 4, adhes.site.mida 4, ion.depend.adhes 4, anthrax.toxin.protect 4, toxin.protect.antigen 4, capillari.morphogenesi.protein 4, receptor.bind.compon 3, protect.antigen.compon 3

Term Cliques
72.43% receptor cmg2 bind toxin anthrax.toxin toxin.receptor protein cell interact
59.26% receptor cmg2 bind toxin anthrax.toxin vwa toxin.receptor protein mutat vwa.domain interact
69.55% receptor cmg2 bind atr toxin anthrax.toxin toxin.receptor protein cell
58.89% receptor cmg2 bind atr toxin anthrax.toxin vwa toxin.receptor protein vwa.domain
64.35% receptor cmg2 tem8 atr toxin anthrax.toxin protein cell
53.09% receptor cmg2 tem8 atr toxin anthrax.toxin vwa protein vwa.domain
75.31% receptor domain cmg2 bind toxin anthrax.toxin protein cell interact
61.62% receptor domain cmg2 bind toxin anthrax.toxin vwa protein mutat vwa.domain interact
68.72% receptor domain cmg2 tem8 toxin anthrax.toxin protein cell interact
58.15% receptor domain cmg2 tem8 toxin anthrax.toxin vwa protein vwa.domain interact

Sample Cluster Record Titles

Functional analysis of the carboxy-terminal domain of Bacillus anthracis protective antigen

Identification of a receptor-binding region within domain 4 of the protective antigen component of anthrax toxin

Anthrax toxin entry into polarized epithelial cells

Involvement of domain 3 in oligomerization by the protective antigen moiety of anthrax toxin

Identification of the cellular receptor for anthrax toxin

Human capillary morphogenesis protein 2 functions as an anthrax toxin receptor

Anthrax toxin triggers endocytosis of its receptor via a lipid raft-mediated clathrin-dependent process

Cluster Metrics

Authors

collier, rj 9; leppla, sh 7; young, jat 5; wigelsworth, dj 3; scobie, hm 3; mogridge, j 3; liu, sh 3; liddington, rc 3; lacy, db 3; bradley, ka 3

Sources

nature 4; journal of biological chemistry 4; infection and immunity 4; proceedings of the national academy of sciences of the united states of america 2; american journal of human genetics 2; protein expression and purification 1; progress in biochemistry and biophysics 1; journal of virology 1; journal of infectious diseases 1; journal of cell biology 1

Keywords

biochemistry & molecular biology 7; lethal factor 7; multidisciplinary sciences 6; protective antigen 6; binding 6; protective antigen 5; bacillus-anthracis 5; crystal-structure 5; immunology 4; mutations 4

Country

usa 24; switzerland 3; canada 3; turkey 2; peoples r china 2; england 2; netherlands 1; kuwait 1; italy 1; india 1

Institution

harvard univ 9; univ wisconsin 4; niaid 3; salk inst biol studies 2; nidr 2; natl inst dent & craniofacial res 2; chu vaudois 2; burnham inst 2; yantai normal univ 1; wellcome trust sanger inst 1

- # CLUSTER 0
  Clostridium botulinum C2 toxin, emphasizing its enzyme component C2I, and the separated binding/translocation component C2II. (9 Records)

Cluster Syntax Features

Descriptive Terms
c2i 27.0%, c2ii 16.2%, c2iia 9.1%, actin 2.4%, enzym.compon 2.1%, adp 1.3%, adp.ribosyl 1.3%, transloc 1.3%, ribosyl 1.3%, bind 1.3%, toxin 1.2%, compon.c2i 1.2%, compon 1.1%, cell 1.1%, enzym.compon.c2i 1.0%

Discriminating Terms
c2i 15.7%, c2ii 9.4%, c2iia 5.3%, spore 1.4%, actin 1.3%, enzym.compon 1.2%, vaccin 1.1%, strain 0.9%, anthraci 0.8%, anthrax 0.8%, compon.c2i 0.7%, adp.ribosyl 0.7%, adp 0.7%, gene 0.7%, ribosyl 0.7%

Single Word Terms
c2ii 9, toxin 9, adp 9, c2i 9, bind 9, botulinum 9, clostridium 9, compon 9, activ 8, cell 8, ribosyl 8, form 8, binari 8, enzym 8, transloc 8

Double Word Terms
clostridium.botulinum 9, botulinum.toxin 8, compon.c2i 8, compon.c2ii 8, enzym.compon 8, adp.ribosyl 8, activ.c2ii 6, actin.adp 6, cell.membran 5, proteolyt.activ 5, target.cell 5, c2i.cytosol 5, cytosol.target 4, c2i.c2iia 4, bind.transloc 4

Triple Word Terms
clostridium.botulinum.toxin 8, enzym.compon.c2i 8, actin.adp.ribosyl 6, cytosol.target.cell 4, transloc.compon.c2ii 4, bind.transloc.compon 4, binari.clostridium.botulinum 4, across.cell.membran 4, form.heptam.bind 4, adp.ribosyl.actin 4, proteolyt.activ.c2ii 4, ribosyl.actin.cytosol 3, botulinum.toxin.prototyp 3, c2i.adp.ribosyl 3, receptor.mediat.endocytosi 3

Term Cliques
91.11% c2i c2ii c2iia actin enzym.compon adp adp.ribosyl transloc ribosyl bind toxin compon.c2i compon cell enzym.compon.c2i

Sample Cluster Record Titles

Cellular uptake of Clostridium botulinum C2 toxin requires oligomerization and acidification

The C terminus of component C2II of Clostridium botulinum C2 toxin is essential for receptor binding

Clostridium botulinum C2 toxin: binding studies with fluorescence-activated cytometry

Channel formation by the binding component of Clostridium botulinum C2 toxin: Glutamate 307 of C2II affects channel properties in vitro and pH-dependent C2I translocation in vivo

The host cell chaperone Hsp90 is essential for translocation of the binary Clostridium botulinum C2 toxin into the cytosol

Clostridium botulinum C2 toxin - Low pH-induced pore formation is required for translocation of the

enzyme component C2I into the cytosol of host cells

Cluster Metrics

Authors

barth, h 9; aktories, k 8; blocker, d 5; benz, r 4; haug, g 3; meyer, dk 2; leemhuis, j 2; bachmeyer, c 2; wilde, c 1; tiemann, d 1

Sources

journal of biological chemistry 3; biochemistry 2; toxicon 1; international journal of medical microbiology 1; infection and immunity 1; anaerobe 1

Keywords

anthrax protective antigen 6; biochemistry & molecular biology 5; bilayer-membranes 4; diphtheria-toxin 4; actin 4; perfringens iota-toxin 3; mammalian-cells 3; lipid 3; binary toxin 3; adp-ribosylates actin 3

Country

germany 9; usa 2; netherlands 1

Institution

univ freiburg 9; univ wurzburg 4; usa 1; univ groningen 1; med coll wisconsin 1; max delbruck zentrum mol med 1

- # CLUSTER 33
  Modified anthrax toxin lethal factor (LFn) fusion protein for translating antigens, especially cytotoxic epitopes, across cell membranes for inducing antiviral immunity (32 Records)

Cluster Syntax Features

Descriptive Terms
fusion 5.7%, fusion.protein 5.4%, cell 4.4%, lfn 4.4%, toxin 4.2%, iota 3.7%, protein 3.4%, cytosol 3.1%, ctl 2.6%, transloc 1.9%, epitop 1.8%, domain 1.6%, fuse 1.2%, terminu 1.2%, deliv 1.2%

Discriminating Terms
fusion.protein 4.0%, fusion 3.9%, lfn 3.2%, iota 2.8%, spore 2.0%, ctl 1.9%, cytosol 1.8%, strain 1.3%, epitop 1.1%, anthraci 1.0%, transloc 0.9%, vaccin 0.9%, iota.toxin 0.8%, fuse 0.8%, cereu 0.8%

Single Word Terms
toxin 30, cell 29, protein 28, lethal 25, anthrax 24, antigen 24, factor 24, fusion 23, protect 23, bind 21, transloc 20, activ 19, domain 19, cytosol 18, compon 16

Double Word Terms
lethal.factor 24, protect.antigen 22, fusion.protein 21, anthrax.toxin 18, mammalian.cell 9, edema.factor 8, amino.acid 8, compon.anthrax 8, adp.ribosyl 8, amino.termin 7, transloc.cytosol 7, cytosol.mammalian 7, termin.domain 7, bind.cell 7, cytotox.lymphocyt 7

Triple Word Terms
compon.anthrax.toxin 7, factor.edema.factor 6, lethal.factor.edema 6, cytotox.lymphocyt.ctl 6, protect.antigen.compon 6, cytosol.mammalian.cell 6, bind.cell.surfac 5, toxin.fusion.protein 5, toxin.lethal.factor 5, toxin.protect.antigen 4, anthrax.lethal.factor 4, chines.hamster.ovari 4, lethal.factor.lfn 4, anthrax.toxin.lethal 4, antigen.lethal.factor 3

Term Cliques
63.84% cell toxin iota protein transloc domain terminu
64.06% cell toxin iota protein transloc epitop
66.87% fusion fusion.protein cell toxin protein cytosol transloc domain fuse terminu
60.23% fusion fusion.protein cell toxin protein cytosol ctl transloc epitop fuse deliv
54.06% fusion fusion.protein cell lfn toxin cytosol ctl epitop fuse deliv

Sample Cluster Record Titles

Anthrax toxin-mediated delivery in vivo and in vitro of a cytotoxic T-lymphocyte epitope from ovalbumin

Internalization of a Bacillus anthracis protective antigen c-Myc fusion protein mediated by cell surface anti-c-Myc antibodies

Anthrax toxin as a molecular tool for stimulation of cytotoxic T lymphocytes: Disulfide-linked epitopes, multiple injections, and role of CD4+ cells

Bacterial toxins with intracellular protease activity

Antigen delivery using bacterial toxins

Anthrax toxin-mediated delivery of cholera toxin-A subunit into the cytosol of mammalian cells

Cytosolic delivery and characterization of the TcdB glucosylating domain by using a heterologous protein fusion

Cluster Metrics

Authors

collier, rj 6; singh, y 5; popoff, mr 5; leppla, sh 5; ballard, jd 5; arora, n 5; stiles, bg 3; starnbach, mn 3; marvaud, jc 3; spyres, lm 2

Sources

infection and immunity 10; proceedings of the national academy of sciences of the united states of america 5; journal of biological chemistry 3; biotechnology and applied biochemistry 2; molecular microbiology 1; molecular medicine 1; molecular biotechnology 1; microbiology and immunology 1; m s-medecine sciences 1; journal of bacteriology 1

Keywords

immunology 11; protective antigen 10; lethal factor 10; infectious diseases 10; biochemistry & molecular biology 9; receptor 8; bacillus-anthracis 8; mammalian-cells 6; multidisciplinary sciences 5; protein 5

Country

usa 19; france 6; india 4; germany 3; japan 1; italy 1; england 1

Institution

inst pasteur 6; harvard univ 6; nidr 5; ctr biochem technol 4; usa 3; univ oklahoma 2; univ delhi 2; us fda 1; univ stuttgart 1; univ roorkee 1

- # CLUSTER 15

  Furin’s toxin activation by proteolytic cleavage, and replacement of furin protease cleavage sites in anthrax toxin protective antigen proteins by sequences selectively cleaved by matrix metalloproteinases for designing tumor cell-selective cytotoxins. (18 Records)

Cluster Syntax Features

Descriptive Terms

furin 10.2%, mmp 6.2%, cell 5.8%, toxin 4.3%, tumor 3.9%, cleavag 3.6%, proteas 3.3%, tumor.cell 2.4%, activ 2.2%, express 1.8%, plasminogen 1.7%, pseudomona.exotoxin 1.4%, protein 1.2%, cleavag.site 1.2%, anthrax.toxin 1.2%

Discriminating Terms

furin 6.9%, mmp 4.6%, tumor 2.4%, cleavag 2.2%, proteas 1.8%, spore 1.8%, tumor.cell 1.7%, vaccin 1.4%, plasminogen 1.2%, cell 1.1%, strain 1.1%, anthraci 1.0%, pseudomona.exotoxin 1.0%, plasminogen.activ 0.9%, cleavag.site 0.8%

Single Word Terms

cell 17, toxin 16, protein 15, activ 14, anthrax 13, cleavag 12, express 12, factor 12, pseudomona 11, protect 11, antigen 11, exotoxin 11, furin 10, type 10, two 9

Double Word Terms

anthrax.toxin 12, protect.antigen 11, pseudomona.exotoxin 11, toxin.protect 9, lethal.factor 8, cell.surfac 7, tumor.cell 7, diphtheria.toxin 7, cleavag.site 6, toxin.activ 5, cell.express 5, chines.hamster 5, line.express 4, matrix.metalloproteinas 4, cell.line 4

Triple Word Terms

toxin.protect.antigen 9, anthrax.toxin.protect 9, tumor.cell.surfac 5, toxin.lethal.factor 4, chines.hamster.ovari 4, anthrax.toxin.lethal 4, urokinas.plasminogen.activ 3, cell.line.express 3, protect.antigen.pseudomona 3, antigen.pseudomona.exotoxin 3, matrix.metalloproteinas.mmp 3, hamster.ovari.cell 3, lethal.factor.residu 2, domain.pseudomona.exotoxin 2, ribosyl.domain.pseudomona 2

Term Cliques

79.63% cell toxin cleavag activ express protein
68.52% cell toxin cleavag activ express plasminogen
68.75% cell toxin tumor tumor.cell activ express pseudomona.exotoxin protein
60.42% cell toxin tumor tumor.cell activ express plasminogen pseudomona.exotoxin
67.59% mmp toxin cleavag activ express protein
53.17% mmp toxin cleavag activ express plasminogen cleavag.site
59.52% mmp toxin tumor tumor.cell activ express protein
47.92% mmp toxin tumor tumor.cell activ express plasminogen cleavag.site
62.70% furin toxin cleavag proteas activ cleavag.site anthrax.toxin
72.22% furin cell toxin proteas activ pseudomona.exotoxin protein anthrax.toxin
66.67% furin cell toxin cleavag activ plasminogen anthrax.toxin
72.92% furin cell toxin cleavag proteas activ protein anthrax.toxin
67.28% furin cell toxin tumor tumor.cell activ pseudomona.exotoxin protein anthrax.toxin
59.88% furin cell toxin tumor tumor.cell activ plasminogen pseudomona.exotoxin anthrax.toxin
65.87% furin mmp toxin cleavag activ protein anthrax.toxin

53.47% furin mmp toxin cleavag activ plasminogen cleavag.site anthrax.toxin
59.03% furin mmp toxin tumor tumor.cell activ protein anthrax.toxin
48.77% furin mmp toxin tumor tumor.cell activ plasminogen cleavag.site anthrax.toxin

Sample Cluster Record Titles

Endoprotease PACE4 is Ca2+-dependent and temperature-sensitive and can partly rescue the phenotype of a furin-deficient cell strain

Toxins that are activated by HIV type-1 protease through removal of a signal for degradation by the N-end-rule pathway

Design of toxins that can be activated by cell-specific proteases and their potential use in targeted cell killing

Tumor cell-selective cytotoxicity of matrix metalloproteinase-activated anthrax toxin

Targeting of tumor cells by cell surface urokinase plasminogen activator-dependent anthrax toxin

Membrane type-1 matrix metalloproteinase (MT1-MMP) protects malignant cells from tumoricidal activity of re-engineered anthrax lethal toxin

Cluster Metrics

Authors
leppla, sh 10; liu, sh 6; bugge, th 4; peinado, jr 2; lindberg, i 2; gordon, vm 2; falnes, po 2; zdanovsky, a 1; winkles, ja 1; welker, r 1

Sources
infection and immunity 3; biochemical journal 2; biochemical and biophysical research communications 2; protein expression and purification 1; protein engineering design & selection 1; protein and peptide letters 1; proceedings of the national academy of sciences of the united states of america 1; nature biotechnology 1; molecular cell 1; journal of cell biology 1

Keywords
lethal factor 11; biochemistry & molecular biology 9; diphtheria-toxin 7; anthrax toxin 5; protective antigen 4; protease 4; pseudomonas exotoxin-a 3; immunology 3; furin 3; sequence 3

Country
usa 14; norway 2; wales 1; germany 1; england 1

Institution
niaid 4; natl inst dent & craniofacial res 4; norwegian radium hosp 2; louisiana state univ 2; wake forest univ 1; us fda 1; univ vermont 1; univ minnesota 1; univ michigan 1; univ london 1

- # CLUSTER 36
  Polyarginine-containing peptides for inhibiting furin, and reducing activation of pathogenic toxins. (20 Records)

Cluster Syntax Features

Descriptive Terms
peptid 27.9%, furin 5.8%, substrat 3.0%, arg 2.1%, site 1.9%, inhibitor 1.9%, proteas 1.6%, protein 1.3%, network 0.7%, structur 0.7%, precursor 0.7%, activ 0.7%, cleav 0.7%, cleavag 0.6%, resin 0.6%

Discriminating Terms
peptid 18.6%, furin 3.7%, spore 1.8%, substrat 1.6%, arg 1.4%, vaccin 1.3%, strain 0.9%, anthraci 0.8%, inhibitor 0.8%, cereu 0.8%, proteas 0.7%, anthrax 0.7%, toxin 0.7%, site 0.6%, health 0.5%

Single Word Terms
peptid 17, activ 12, protein 12, substrat 10, factor 9, cell 9, anthrax 9, proteas 8, site 8, inhibitor 8, cleav 7, lethal 7, sequenc 7, inhibit 7, first 6

Double Word Terms
lethal.factor 7, bacillu.anthraci 4, cleavag.site 4, proteas.activ 3, anthraci.lethal 3, peptid.librari 3, anthrax.lethal 3, signal.peptid 3, cell.membran 3, factor.proteas 3, posit.charg 3, crystal.structur 3, basic.residu 3, zinc.metalloproteas 2, activ.site 2

Triple Word Terms
lethal.factor.proteas 3, bacillu.anthraci.lethal 3, anthrax.lethal.factor 3, ly.arg.arg 2, anthraci.lethal.factor 2, ioniz.time.flight 1, high.affin.bind 1, cleav.protect.antigen 1, protein.protein.interact 1, site.direct.mutagenesi 1, alpha.hemolysin.alpha 1, bind.enzymat.moieti 1, transmembran.beta.barrel 1, matrix.laser.desorpt 1, basic.residu.posit 1

Term Cliques
39.29% substrat site inhibitor proteas activ cleav resin
29.29% furin site proteas network precursor cleav cleavag
30.71% furin site inhibitor proteas network precursor cleav
35.62% furin arg site protein precursor activ cleav cleavag
33.13% furin arg site proteas precursor activ cleav cleavag
34.38% furin arg site inhibitor proteas precursor activ cleav
32.86% furin substrat site proteas network cleav cleavag
34.29% furin substrat site inhibitor proteas network cleav
36.25% furin substrat arg site proteas activ cleav cleavag
37.50% furin substrat arg site inhibitor proteas activ cleav
46.67% peptid substrat site activ cleav resin
37.00% peptid furin arg structur cleav
43.13% peptid furin arg site protein activ cleav cleavag
41.87% peptid furin substrat arg site activ cleav cleavag

Sample Cluster Record Titles

Chemical screening by mass spectrometry to identify inhibitors of anthrax lethal factor

Inhibition of furin by polyarginine-containing peptides - Nanomolar inhibition by NONA-D-arginine

Lethal factor active-site mutations affect catalytic activity in vitro

Optimized production and purification of Bacillus anthracis lethal factor

Designing a polyvalent inhibitor of anthrax toxin

Drug design with a new transition state analog of the hydrated carbonyl: silicon-based inhibitors of the HIV protease

The structural basis for substrate and inhibitor selectivity of the anthrax lethal factor

A peptide-based fluorescence resonance energy transfer assay for Bacillus anthracis lethal factor protease

Cluster Metrics

Authors

leppla, sh 3; than, me 2; lindberg, i 2; henrich, s 2; collier, rj 2; bode, w 2; wong, ty 1; wisniewski, d 1; wiltsie, j 1; whitesides, gm 1

Sources

journal of biological chemistry 3; nature biotechnology 2; protein science 1; protein expression and purification 1; protein engineering design & selection 1; proceedings of the national academy of sciences of the united states of america 1; organic letters 1; nature structural biology 1; nature structural & molecular biology 1; molecular biotechnology 1

Keywords

biochemistry & molecular biology 10; crystal-structure 5; binding 4; biotechnology & applied microbiology 3; toxin 3; cells 3; anthrax toxin 3; furin 2; translocation 2; receptor 2

Country

usa 16; germany 3; hungary 1; england 1; denmark 1; canada 1

Institution

univ chicago 2; max planck inst biochem 2; louisiana state univ 2; harvard univ 2; us forest serv 1; univ stuttgart 1; univ sherbrooke 1; univ oxford 1; univ minnesota 1; univ marburg 1

CATEGORY 8 – 125b2:

Lethal toxin inactivation of macrophages and protein kinase (134 REC)

- Mitogen-activated protein kinase, emphasizing its proteolytic inactivation by lethal factor by cleavage within the N-terminal region (51 Records)
- Lethal toxin neutralization by monoclonal antibodies against anthrax protective antigen (17 Records)
- Activation suppression of macrophages and dendritic cells by anthrax lethal toxin, including necrosis in macrophages and apoptosis in activated macrophages. (41 Records)
- Stimulation of macrophages by low levels of anthrax lethal toxin to produce cytokines (interleukin-1 beta and tumor necrosis factor-alpha), which induce systemic shock and death. (25 Records)

- CLUSTER 25

  Mitogen-activated protein kinase, emphasizing its proteolytic inactivation by lethal factor by cleavage within the N-terminal region (51 Records)

Cluster Syntax Features

Descriptive Terms

kinas 16.9%, activ 3.6%, protein.kinas 3.5%, mapk 3.4%, mitogen 3.2%, activ.protein 3.2%, mitogen.activ 3.1%, activ.protein.kinas 3.0%, mitogen.activ.protein 3.0%, lethal 2.0%, macrophag 1.8%, kinas.kinas 1.7%, mapkk 1.5%, cell 1.4%, mek 1.4%

Discriminating Terms

kinas 11.6%, protein.kinas 2.5%, mapk 2.4%, mitogen 2.2%, mitogen.activ 2.2%, activ.protein 2.2%, activ.protein.kinas 2.2%, mitogen.activ.protein 2.1%, spore 1.5%, vaccin 1.4%, kinas.kinas 1.2%, strain 1.1%, mapkk 1.0%, mek 1.0%, mek1 0.9%

Single Word Terms

kinas 51, activ 50, protein 48, lethal 46, mitogen 42, factor 41, anthrax 39, toxin 37, cell 35, bacillu 32, anthraci 32, inhibit 28, induc 27, signal 26, cleav 22

Double Word Terms

activ.protein 42, mitogen.activ 42, protein.kinas 40, kinas.kinas 32, lethal.factor 32, bacillu.anthraci 32, lethal.toxin 31, anthrax.lethal 24, kinas.mapkk 14, protect.antigen 10, virul.factor 10, kinas.mapk 9, anthrax.toxin 9, innat.immun 8, map.kinas 8

Triple Word Terms

mitogen.activ.protein 41, activ.protein.kinas 40, protein.kinas.kinas 26, anthrax.lethal.toxin 17, kinas.kinas.mapkk 13, protein.kinas.mapk 9, anthrax.lethal.factor 8, bacterium.bacillu.anthraci 7,

lethal.toxin.letx 6, factor.bacillu.anthraci 6, cleav.mitogen.activ 6, map.kinas.kinas 5, antigen.lethal.factor 5, protect.antigen.lethal 5, macrophag.cell.line 5

Term Cliques

74.51% kinas activ lethal kinas.kinas mapkk cell
69.28% kinas activ mapk lethal mapkk cell
76.72% kinas activ protein.kinas activ.protein.kinas lethal macrophag kinas.kinas cell
77.45% kinas activ protein.kinas mitogen activ.protein mitogen.activ activ.protein.kinas mitogen.activ.protein lethal kinas.kinas cell mek
74.84% kinas activ protein.kinas mapk mitogen activ.protein mitogen.activ activ.protein.kinas mitogen.activ.protein lethal cell mek

Sample Cluster Record Titles

Proteolytic inactivation of MAP-kinase-kinase by anthrax lethal factor

Anthrax lethal factor cleaves the N-terminus of MAPKKs and induces tyrosine/threonine phosphorylation of MAPKs in cultured macrophages

Proteasome activity is required for anthrax lethal toxin to kill macrophages

Anthrax lethal factor causes proteolytic inactivation of mitogen-activated protein kinase kinase

Anthrax lethal factor cleaves MKK3 in macrophages and inhibits the LPS/IFN gamma-induced release of NO and TNF alpha

A specific activation of the mitogen-activated protein kinase kinase 1 (MEK1) is required for Golgi fragmentation during mitosis

Cluster Metrics

Authors

montecucco, c 9; duesbery, ns 7; vitale, g 5; mock, m 5; leppla, sh 5; tonello, f 4; vande woude, gf 3; pellizzari, r 3; park, jm 3; karin, m 3

Sources

infection and immunity 6; proceedings of the national academy of sciences of the united states of america 5; journal of biological chemistry 4; journal of immunology 3; biochemical and biophysical research communications 3; science 2; nature 2; journal of infectious diseases 2; developmental biology 2; cellular microbiology 2

Keywords

biochemistry & molecular biology 14; immunology 11; macrophages 11; factor cleaves 11; toxin 10; bacillus-anthracis 10; multidisciplinary sciences 9; bacillus-anthracis 8; kinase 7; anthrax 6

Country

usa 33; italy 9; france 6; germany 5; canada 3; taiwan 2; south korea 2; japan 2; scotland 1; hungary 1

Institution

univ padua 8; van andel res inst 6; univ calif san diego 5; inst pasteur 5; nci 4; usa 3; us fda 3; univ texas 3; cnr 3; univ toronto 2

CLUSTER 1

Lethal toxin neutralization by monoclonal antibodies against anthrax protective antigen (17 Records)

Cluster Syntax Features

Descriptive Terms

letx 56.0%, mab 2.5%, macrophag 2.5%, repress 2.3%, plc 1.8%, cell 1.5%, toxin.letx 1.4%, lethal.toxin.letx 1.4%, lethal 0.9%, receptor 0.9%, lethal.toxin 0.8%, mphi 0.7%, toxin 0.7%, letx.induc 0.7%, cytotox 0.5%

Discriminating Terms

letx 36.4%, repress 1.4%, mab 1.4%, vaccin 1.2%, spore 1.2%, plc 1.2%, toxin.letx 0.9%, lethal.toxin.letx 0.9%, strain 0.8%, macrophag 0.7%, cereu 0.7%, anthraci 0.6%, gene 0.6%, sequenc 0.5%, protein 0.5%

Single Word Terms

toxin 15, lethal 15, letx 15, cell 12, anthrax 11, macrophag 11, bacillu 10, activ 10, anthraci 10, factor 10, mediat 9, protein 9, protect 9, role 7, death 7

Double Word Terms

toxin.letx 15, lethal.toxin 15, bacillu.anthraci 10, anthrax.lethal 7, lethal.factor 6, protect.antigen 5, cell.line 4, virul.factor 4, anthrax.infect 3, shock.lethal 3, resist.macrophag 3, sensit.letx 3, antibodi.mab 3, dna.bind 3, letx.induc 3

Triple Word Terms

lethal.toxin.letx 15, anthrax.lethal.toxin 6, monoclon.antibodi.mab 3, inbr.mous.strain 2, macrophag.cell.line 2, plai.central.role 2, lethal.factor.compon 2, letx.treat.cell 2, mitogen.activ.protein 2, phosphatidylinositol.phospholipas.plc 2, bacillu.anthraci.lethal 2, bacillu.anthraci.infect 2, anthraci.lethal.toxin 2, antigen.lethal.factor 1, p38.mitogen.activ 1

Term Cliques

41.18% plc cell cytotox
71.32% letx repress toxin.letx lethal.toxin.letx lethal receptor lethal.toxin toxin
75.82% letx macrophag cell toxin.letx lethal.toxin.letx lethal lethal.toxin toxin letx.induc
71.18% letx macrophag cell toxin.letx lethal.toxin.letx lethal lethal.toxin mphi toxin cytotox
71.32% letx mab toxin.letx lethal.toxin.letx lethal receptor lethal.toxin toxin

Sample Cluster Record Titles

Involvement of phospholipase A(2) activation in anthrax lethal toxin-induced cytotoxicity

Lethal toxin actions and their consequences

Enhancement of anthrax lethal toxin cytotoxicity: a subset of monoclonal antibodies against protective antigen increases lethal toxin-mediated killing of murine macrophages

An anthrax lethal factor-neutralizing monoclonal antibody protects rats before and after challenge with anthrax toxin

Cluster Metrics

Authors
moayeri, m 4; webster, ji 3; sternberg, em 3; leppla, sh 3; zenewicz, la 2; wei, zy 2; shen, h 2; li, y 2; li, xm 2; haley, m 2

Sources
infection and immunity 3; toxicology in vitro 1; proceedings of the national academy of sciences of the united states of america 1; molecular and cellular endocrinology 1; microbes and infection 1; journal of infectious diseases 1; journal of immunology 1; journal of biological chemistry 1; journal of applied microbiology 1; glucocorticoid action: basic and clinical implications 1

Keywords
bacillus-anthracis 6; apoptosis 6; immunology 5; macrophages 5; bacillus-anthracis 5; protective antigen 4; activation 4; cell biology 3; biochemistry & molecular biology 3; susceptibility 3

Country
usa 15; south korea 2

Institution
niaid 4; nimh 3; univ penn 2; nih 2; whitehead inst biomed res 1; van andel res inst 1; usn 1; usa 1; univ oklahoma 1; univ calif berkeley 1

- # CLUSTER 54

Activation suppression of macrophages and dendritic cells by anthrax lethal toxin, including necrosis in macrophages and apoptosis in activated macrophages. (41 Records)

Cluster Syntax Features

Descriptive Terms

macrophag 14.8%, lethal 6.5%, toxin 6.4%, lethal.toxin 4.8%, cell 4.4%, anthrax.lethal 2.2%, apoptosi 2.0%, anthrax.lethal.toxin 1.8%, inhibitor 1.8%, factor 1.4%, lethal.factor 1.0%, activ 0.9%, induc 0.8%, resist 0.8%, infect 0.7%

Discriminating Terms

macrophag 10.5%, lethal.toxin 3.2%, lethal 3.1%, toxin 1.9%, vaccin 1.6%, apoptosi 1.6%, anthrax.lethal 1.5%, anthrax.lethal.toxin 1.3%, inhibitor 1.0%, cereu 0.9%, strain 0.9%, spore 0.8%, cell 0.8%, detect 0.7%, sequenc 0.6%

Single Word Terms

toxin 34, cell 34, macrophag 32, lethal 31, bacillu 31, anthrax 31, anthraci 30, factor 28, activ 24, protect 23, infect 18, role 15, antigen 15, line 14, induc 14

Double Word Terms

bacillu.anthraci 30, lethal.toxin 24, anthrax.lethal 19, lethal.factor 19, protect.antigen 15, cell.line 12, macrophag.cell 10, antigen.lethal 9, anthrax.toxin 8, anthraci.spore 7, plai.role 7, mous.macrophag 7, toxin.induc 7, cell.surfac 7, protect.anthrax 5

Triple Word Terms

anthrax.lethal.toxin 16, antigen.lethal.factor 9, protect.antigen.lethal 9, macrophag.cell.line 7, protein.protect.antigen 5, toxin.bacillu.anthraci 5, factor.edema.factor 4, raw.264.cell 4, lethal.factor.edema 4, infect.bacillu.anthraci 4, bacillu.anthraci.lethal 3, bacillu.anthraci.spore 3, factor.protect.antigen 3, lethal.toxin.induc 3, lethal.factor.toxin 3

Term Cliques

55.28% lethal toxin lethal.toxin inhibitor activ resist
51.22% lethal toxin lethal.toxin anthrax.lethal anthrax.lethal.toxin inhibitor resist
67.60% lethal toxin lethal.toxin cell factor lethal.factor activ
62.02% lethal toxin lethal.toxin cell inhibitor lethal.factor activ
59.35% lethal toxin lethal.toxin cell anthrax.lethal anthrax.lethal.toxin factor lethal.factor induc
57.62% lethal toxin lethal.toxin cell anthrax.lethal anthrax.lethal.toxin inhibitor lethal.factor
51.83% macrophag activ resist infect
51.71% macrophag cell apoptosi induc infect
56.59% macrophag cell apoptosi activ infect
64.11% macrophag toxin lethal.toxin cell apoptosi factor activ
57.93% macrophag toxin lethal.toxin cell apoptosi anthrax.lethal.toxin factor induc
64.11% macrophag lethal toxin lethal.toxin factor activ resist
59.45% macrophag lethal toxin lethal.toxin anthrax.lethal anthrax.lethal.toxin factor resist
72.13% macrophag lethal toxin lethal.toxin cell factor activ
62.87% macrophag lethal toxin lethal.toxin cell anthrax.lethal anthrax.lethal.toxin factor induc

Sample Cluster Record Titles

Anthrax lethal toxin-induced mitogenic response of human T-cells

Ltx1, a mouse locus that influences the susceptibility of macrophages to cytolysis caused by intoxication with Bacillus anthracis lethal factor, maps to chromosome 11

Activation of phospholipase C and protein kinase C is required for expression of anthrax lethal toxin cytotoxicity in J774A.1 cells

Lethal toxin of Bacillus anthracis causes apoptosis of macrophages

Intracellular calcium antagonist protects cultured peritoneal macrophages against anthrax lethal toxin-induced cytotoxicity

Cluster Metrics

Authors

mock, m 6; bhatnagar, r 5; alibek, k 5; hanna, pc 4; singh, y 3; guidi-rontani, c 3; collier, rj 3; watters, jw 2; shin, s 2; park, ym 2

Sources

infection and immunity 4; biochemical and biophysical research communications 4; proceedings of the national academy of sciences of the united states of america 3; molecular microbiology 3; cellular microbiology 2; american journal of pathology 2; trends in pharmacological sciences 1; toxicon 1; molecular medicine 1; molecular cancer therapeutics 1

Keywords

biochemistry & molecular biology 13; protective antigen 11; cells 11; lethal toxin 9; toxin 7; macrophages 7; immunology 6; sequence 6; receptor 6; microbiology 6

Country

usa 23; france 7; india 4; south korea 3; germany 3; italy 2; taiwan 1; ny 1; netherlands 1; ma 1

Institution

inst pasteur 7; harvard univ 5; george mason univ 4; univ michigan 3; usa 2; us fda 2; univ padua 2; univ calif san diego 2; sungkyunkwan univ 2; jawaharlal nehru univ 2

- # CLUSTER 32
  Stimulation of macrophages by low levels of anthrax lethal toxin to produce cytokines (interleukin-1 beta and tumor necrosis factor-alpha), which induce systemic shock and death. (25 Records)

Cluster Syntax Features

Descriptive Terms
alpha 8.4%, cytokin 6.6%, mice 6.0%, tnf 5.8%, tnf.alpha 4.7%, camp 2.7%, toxin 2.5%, suppress 1.8%, macrophag 1.8%, edema 1.7%, edema.toxin 1.6%, respons 1.6%, platelet 1.5%, induc 1.1%, lethal.toxin 1.0%

Discriminating Terms
alpha 5.4%, cytokin 4.7%, tnf 4.3%, tnf.alpha 3.5%, mice 3.0%, camp 1.7%, vaccin 1.3%, suppress 1.3%, platelet 1.1%, edema.toxin 1.1%, protein 0.8%, cereu 0.8%, gene 0.7%, cytokin.respons 0.7%, edema 0.6%

Single Word Terms
toxin 19, bacillu 18, respons 17, anthraci 17, anthrax 17, induc 16, factor 16, alpha 15, macrophag 14, mice 14, cell 14, cytokin 13, lethal 13, strain 11, role 11

Double Word Terms
bacillu.anthraci 17, lethal.toxin 13, tnf.alpha 11, edema.toxin 7, necrosi.factor 7, anthraci.lethal 6, balb.mice 6, tumor.necrosi 6, factor.alpha 6, anthrax.lethal 5, cytokin.respons 5, infect.anthraci 4, alpha.tnf 4, periton.macrophag 4, bone.marrow 4

Triple Word Terms
necrosi.factor.alpha 6, tumor.necrosi.factor 6, anthraci.lethal.toxin 6, anthrax.lethal.toxin 5, factor.alpha.tnf 4, alpha.tnf.alpha 4, bacillu.anthraci.lethal 4, cyclic.amp.camp 3, tnf.alpha.product 3, induc.tnf.alpha 3, macrophag.cell.line 3, mous.periton.macrophag 2, factor.lethal.toxin 2, virul.factor.lethal 2, murin.macrophag.cell 2

Term Cliques
36.00% camp toxin suppress edema.toxin platelet induc
40.67% camp toxin suppress edema edema.toxin induc
58.40% cytokin macrophag respons induc lethal.toxin
50.40% cytokin suppress respons induc lethal.toxin
60.00% cytokin toxin macrophag induc lethal.toxin
46.86% cytokin toxin suppress edema edema.toxin induc lethal.toxin
56.80% cytokin mice macrophag respons lethal.toxin
58.40% cytokin mice toxin macrophag lethal.toxin
48.00% alpha cytokin tnf tnf.alpha edema
54.29% alpha cytokin mice tnf tnf.alpha macrophag respons

Sample Cluster Record Titles

Suppression of platelet aggregation by Bordetella pertussis adenylate cyclase toxin

Dehydroepiandrosterone and melatonin prevent Bacillus anthracis lethal toxin-induced TNF production in macrophages

Bacillus anthracis lethal toxin induces TNF-alpha-independent hypoxia-mediated toxicity in mice

Macrophage-derived cell lines do not express proinflammatory cytokines after exposure to Bacillus anthracis lethal toxin

Macrophages release tumor necrosis factor alpha and interleukin-12 in response to intracellular Bacillus anthracis spores

Cluster Metrics

Authors

moayeri, m 4; leppla, sh 4; merkel, tj 3; young, ha 2; wiggins, jf 2; tang, wj 2; popova, tg 2; popov, sg 2; pickering, ak 2; little, sf 2

Sources

infection and immunity 12; biochemical and biophysical research communications 3; zhurnal mikrobiologii epidemiologii i immunobiologii 1; vaccine 1; journal of medical microbiology 1; journal of immunology 1; journal of clinical investigation 1; european journal of pharmacology 1; cellular microbiology 1; cell biology and toxicology 1

Keywords

immunology 13; infectious diseases 12; lethal toxin 7; mice 6; bacillus-anthracis 6; tnf-alpha 5; pathology 5; adenylate-cyclase 5; bacillus-anthracis 4; anthrax 4

Country

usa 18; india 2; france 2; sweden 1; south korea 1; japan 1; italy 1; england 1

Institution

niaid 4; usa 3; us fda 3; usaf 2; univ chicago 2; nci 2; jawaharlal nehru univ 2; inst pasteur 2; george mason univ 2; adv biosyst inc 2