A STUDY FOR THE ESTABLISHMENT OF A CENTRALIZED IV ADDITIVE PROGRAM IN THE METHODIST HOSPITAL OF DALLAS

A Problem Solving Thesis

Submitted to the Faculty of

Baylor University

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Hospital Administration

By

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Waco, Texas

August 1972

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ABSTRACT

A STUDY FOR THE ESTABLISHMENT OF A CENTRALIZED IV ADDITIVE PROGRAM IN THE METHODIST HOSPITAL OF DALLAS

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The problem considered in this study was to determine the most effective means for the pharmacy service of the Methodist Hospital of Dallas to establish and administer a centralized IV additive program.

A work-load study form was distributed to the nurse supervisor of the various wards and a six-day survey was conducted to determine the number of IV solutions given with additives, the times required at the nursing station, the number given per shift, and time saved for nursing personnel. Incompatibilities were researched through the literature, and approximate costs were furnished by contacting the manufacturers involved.

It was determined that the most effective means for the pharmacy service of the Methodist Hospital of Dallas to establish and administer a central IV additive program was to purchase a laminar flow unit, utilize existing personnel and space, and implement the program by providing this service to a single nursing unit initially.

A recommendation was made to purchase an Abbott Clean Air Center Laminar Flow Horizontal Console Model and to initiate the program in Ward 3L.

ACKNOWLEDGMENTS

This study was undertaken to determine the most effective means for the pharmacy service of the Methodist Hospital of Dallas to establish and administer a centralized IV additive program.

Grateful acknowledgment for assistance rendered is given to Captain Earl McKinstry, pharmacist, Brooke General Hospital; Guy T. Kelly, Director of Pharmacy, Methodist Hospital of Dallas; Miss Mildred F. Lee, Director of Nursing Service, Methodist Hospital of Dallas; Glenn Scott, Administrator, Methodist Hospital of Dallas; James L. Luker, Assistant Administrator, Methodist Hospital of Dallas; Norman St. John, Abbott Drug Company Detail Man; and Diane J. Carroll, wife. Without their able assistance much of the material included in this study would have been unavailable.

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CHAPTER I

INTRODUCTION

History and Present Situation

Sir Christopher Wren, the great English architect, astronomer and chemist, performed the first intravenous injection in 1656.[1] Early intravenous injections were administered for the transfusion of blood. Then simple intravenous solutions such as normal saline, dextrose and water, and Ringer's solution were used to replace the body fluids lost during and after surgery. Next, potassium chloride was added to these solutions to restore potassium lost during surgery and the first IV additive (Appendix A) solution was administered.

Intravenous infusions are now commonly used as vehicles for the dispensing of a variety of drugs. Many of these IV admixtures cannot be supplied premixed by their manufacturers because of problems of drug stability, dosage variations, patent restrictions, and the large number of drug combinations that are required. Since hospitals cannot commercially obtain such admixtures, someone must extemporaneously compound them. The responsibility is generally assumed by nurses and physicians, neither of which are qualified by education to compound these solutions. The preparation of IV additives presents problems of pharmaceutical mathematics, incompatibility, labeling, sterility, solubility, buffering, and drug stability that are all pharmaceutical functions in nature.

In recent years a small number of progressive hospital pharmacists

have developed centralized intravenous additive services in the pharmacy. These services have been based on the safety and economical benefits that they offer to the medical and nursing staffs and, most important of all, to the patient.[2] In 1963 the first centralized IV additive services in the pharmacy were initiated by personnel of St. Joseph Mercy Hospital in Ann Arbor, Michigan, and at the University of Arkansas.[3] Since then, a survey of 337 hospitals, conducted by Robert L. Ravin, indicated that the installation of an IV additive service was their main objective in 1969.[4]

The IV additive system is an exciting challenge to the hospital pharmacist. No longer can he be content with counting tablets, capsules, and decanting liquids for bulk dispensing of pharmaceuticals to the wards. We are now entering an era of hospital unit-dose systems, intravenous additive systems, and an increasing demand for the pharmacist to fulfill his neglected role of drug consultant.[5]

The professional purpose of pharmacy can be described in many ways, "but essentially it is to provide pharmaceutical services as an integral part of the total patient care concept and the interest, safety, and welfare of the public health."[6] In 1966 Brodie noted that:

> the ultimate goal of the services of pharmacy must be the safe use of drugs by the public. In this context, the mainstream function of pharmacy is clinical in nature, one that may be identified accurately as drug-use control. Drug-use control can be defined as the sum total of knowledge, understanding, judgments, procedures, skills, controls and efforts that assures optimal safety and the distribution and use of medication. This definition relates professional function to patient welfare in the form of drug safety; it is patient oriented. Pharmacists should guard this function with the same dedication and zeal that physicians guard their patient-physician relationship and lawyers that with their client.[7]

The hospital pharmacist also has both a legal and a professional responsibility to be interested in extemporaneous-type prescription

orders such as intravenous admixtures. He can legally fill a prescription that alters the approved Federal Drug Administration's dosage form; but, when he does, he assumes the responsibility for ensuring that the new dosage form is safe for the patient, and the physician assumes the responsibility that the drug is proper medication for the patient.[8]

The future of pharmacy lies in the ability of the pharmacist to constantly improve his professional status and service to other members of the health team by providing the best possible pharmaceutical services to the patient. One step in this direction is returning the IV additive service, which nurses have inherited by default, to the pharmacy. This change would permit nurses to devote more time to functions that are uniquely theirs and would enable the hospital to comply with the Joint Commission on Accreditation of Hospital's Standard III pertaining to pharmaceutical services, the interpretation of which states that all parenteral medications, to include intravenous admixtures--when feasible--that are manufactured in the hospital, should be prepared in the pharmacy.[9]

Statement of the Problem

The problem is to determine the most effective means for the pharmacy service of the Methodist Hospital of Dallas to establish and administer a centralized IV additive program.

Development of the Problem

The Methodist Hospital of Dallas is a 500-bed community hospital in which intravenous additives are currently the responsibility of nursing service. The director of the pharmacy service has foreseen for

quite some time the opportunity to provide greater professional supportive services to nursing service and the medical staff by establishing a centralized IV additive service in the pharmacy. Each year the director has submitted to the assistant administrator the long-range and short-range goals of the pharmacy. Establishment of a centralized IV additive service in the pharmacy has been a long-range goal of the department, but money was not available until recently to make it feasible. On July 1, 1970, finances were appropriated for the pharmacy and now establishing a centralized IV additive service has moved from a long-range goal to a short-range goal.

Criteria

An effective central IV additive program should produce the following results:

1. Preparation of IV additive solutions under more aseptic conditions than the present system employs.

2. Reduced occurrence of drug incompatibilities and errors in pharmaceutical calculations.

3. Reduced errors in labeling of finished preparations.

4. A significant savings in time for nursing personnel.

Limitation

A financial limitation of $2,000 has been placed on the pharmacy by the administrator for implementation of the central IV additive service.

Assumptions

It is assumed that:

1. The six days surveyed in the work-load data will be typical of future IV additive usage in the hospital.

2. Funds for the implementation of the recommendations of this study will be made available.

Literature Review

A review of the current literature brings forth three important aspects pertaining to the IV additive program. The areas to be discussed are parenteral prescription problems concerning compatibilities and incompatibilities, laminar flow and the need for sterile compounding techniques, and the actual implementation of a central IV additive service.

In the literature there is concern for compatibilities and incompatibilities because of the high percentage of intravenous solutions to which drugs are added. Howe and Rasero, University Hospital, University of Michigan, found that drugs are added to approximately 70 percent of all intravenous fluids administered.[10] In a study by Holysko and Ravin at St. Joseph Mercy Hospital, Ann Arbor, Michigan, covering approximately 45 percent of the total intravenous order additives written for a period of one week, it was found that 48 percent contained one drug, 30 percent contained two drugs, 19 percent contained three drugs, and 3 percent contained four or more drugs.[11] At the clinical center of the National Institutes of Health, approximately half of the administered intravenous solutions contained additives of either commercially available or investigational drugs.[12] There exists many possibilities for incompatibilities in the extemporaneous compounding of

intravenous additive solutions.

Incompatibilities may be basically divided into pharmacological, physical, or chemical categories. Pharmacological incompatibilities involve antagonistic or unexpected synergistic effects. An example is when heparin and penicillin are administered at the same time. They are physically compatible and there is no problem in administering the two to the patient. However, when the penicillin is discontinued, the action of the heparin upon the prothrombin time changes--it increases--thus causing a change in the pharmacological effect on the patient.[13]

The second category, physical incompatibilities, has been the most thoroughly tested and investigated area. These are changes that can be detected by our senses such as change in color, formation of haze, precipitates, etc. Changes in formula, stabilizers, buffers, or pH range can cause physical incompatibilities. Most of the data presented by pharmaceutical manufacturers in their packaged inserts and, also, the "Physician's Desk Reference," refer to physical incompatibilities and should not be taken as absolute because of the possibility for pharmacological and chemical incompatibilities.

Another area which is receiving increased emphasis is the order of mixing of additives. This aspect of the preparation of parenteral solutions brings back the familiar nostalgia of the old apothecary shop. An example of this would be mixing Solu-Cortef (300 mg), Penicillin G (Abbot's 1,000,000 units), and Surbex-T solution with dextrose 5% (1000 ml). When Solu-Cortef is added to Surbex-T solution, shaken, then penicillin added, the result is incompatibility. In contrast, if penicillin is added to Surbex-T solution, shaken, then Solu-Cortef added, the

preparation is compatible for six hours.[14]

The third type of incompatibility found in the literature is chemical incompatibility. This is probably the most serious of the three because usually the incompatibility goes undetected. In terms of physical compatibility the admixture would be deemed compatible. The IV fluid manufacturers cannot be held responsible for drugs that may be added to their solutions. They have manufactured their parenteral solutions under specific temperatures, atmospheric pressure, pH and with certain solvents. The addition of outside additives could initiate a chemical reaction which would result in the decomposition of the original product even though the solution remains perfectly clear. The Abbott Drug Company's philosophy on admixtures is to advocate immediate use. If they are not used immediately, neither safety nor efficacy is guaranteed.[15]

It is obvious from the above discussion that the pharmacist must be extremely competent and knowledgeable in the areas of pharmacological, physical, and chemical incompatibilities in order to take his place as a professional drug consultant on the health care team.

The second aspect in the review of the literature concerns laminar flow. When they hear the words "aseptic" or "sterile atmosphere", most people think of a hospital or physician's office; but medicine is not the only field which is interested in aseptic techniques. The aerospace industry has been interested in cleanliness for quite some time. The presence of a small dust particle in a space ship's sensitive navigational instruments could mean the difference between a successful moon landing or being lost forever in space. The pharmacy, in setting up an

aseptic area where two sterile products may be mixed with sterility maintained, can borrow the laminar flow concept from the space industry.

What is meant by laminar flow? It is defined by Federal Standard 209 as, "Air flow in which the entire body of air within a confined area moves with uniform velocity along parallel flow lines with a minimum of eddies."[16] The resultant effect is the minimizing of air turbulence and the prevention of airborne external contaminants from entering the work area. The HEPA filter is the backbone of any laminar flow unit because filtration has been found to be the best method for cleaning air. A pictorial illustration of laminar flow is presented in Appendix B. For further reference on laminar flow, Peter P. Lamy's "Laminar Flow and Environmental Control" is an excellent article.[17] Other fine articles concerning aseptic and sterile techniques for use with the IV additive program have been written by Greif and Flack,[18] Gallelli and Skolaut,[19] and Davis, Kitler, and Lamy.[20]

The third aspect in the review of literature is the numerous articles which have been written on the implementation of a central IV additive service in the pharmacy. First of all the question is, why implement it in the pharmacy? Frank J. Sweeney, Jr., MD, summed it up when he stated:

> The physician usually delegates the responsibility of mixing and administering intravenous preparations to the house officer or floor nurse, hardly ever to the pharmacist. Solutions, therefore, are mixed by people whose primary concern is not pharmacy or pharmacology, for the house officer and floor nurse rarely have the necessary background or knowledge to be authoritative in these subjects. In addition, the area in which the solutions are mixed is subject to contamination and, in the hustle and bustle of an active nursing station, errors can be made both from the standpoint of asepsis and in dosage calculations; the latter is true

> particularly if it is necessary to transfer from the apothecary system to the metric system or vice versa. Furthermore, the house officer and the nurse are not trained to observe physical incompatibilities and may miss the changes in the solution. Also, changes may not take place for several hours and by this time the fluids are at the patient's bedside ready to be administered by the first available person.[21]

Fred J. Pang's "A Transition to Centralized IV Additive Service in a Private Hospital,"[22] Sister Mary Virginia's "The Parenteral Prescription,"[23] and Sister Mary Naomi Holysko and Robert L. Ravin's "A Pharmacy Centralized Intravenous Additive Service"[24] are three excellent articles on the implementation of a centralized IV additive program in the hospital pharmacy. The authors feel there are two advantages gained from having pharmacists prepare IV additive solutions. The first is from the viewpoint of patient safety because the pharmacist is best qualified to prevent pharmaceutical incompatibilities from occurring, to perform the necessary pharmaceutical calculations, and to properly label the finished preparation. The second advantage is from a total patient care viewpoint; nursing time saved by being relieved from the responsibility of IV additive preparation could be better spent in direct patient care.[25]

They recommend that the following information be obtained before implementation of a centralized IV additive service:

1. Study the hospital's procedures for, and frequency of, intravenous solutions containing additives.

2. Prepare new IV solution forms and establish policies for the centralized IV additive service.

3. Purchase a laminar flow unit.

4. Implement the IV additive service on a small scale to allow

the nurses time to accept the program and the pharmacists time to obtain proficiency in sterile techniques.

The current literature, also, stresses the necessity for cooperation, coordination, and communication between the pharmacy service and nursing service, especially in the initial stages of the program.[26]

In general the transference of the IV additive responsibility from the nursing service to the pharmacy service has been well accepted by the nursing personnel. This acceptance was best stated by Sister Mary Ann Frances, Director of Nursing Service, St. Joseph Mercy Hospital, Ann Arbor, Michigan, when she commented:

> Historically, nurses have been known to perform every task in the hospital care of patients not already done by someone else. Rightfully, nursing leaders have questioned whether there is truly a 'nursing shortage'. If nurses did nursing and nothing else, they postulate, we might not experience a nursing shortage.
>
> As members of allied health professions in the hospital recognize the roles and functions they fill in relation to patient care, and as they begin more fully to assume these roles and functions, nurses are left free for more nursing care.
>
> A great step forward has been made in our hospital in the doctor-pharmacist-nurse team in which the roles of each are more clearly defined. The pharmacist is far better qualified to prepare IV solutions and to insert additives in them than is the nurse. The nurse's role is to see that the patient receives the IV solutions as ordered, to assure his mental and physical comfort and safety, to record the administration of the solutions, and to make pertinent observations concerning the patient's response to their administration. The patient, then, receives the maximum benefit of the specialized knowledge of the pharmacist and nurse.[27]

In summary, a review of the literature reveals that the hospital pharmacist should be thoroughly knowledgeable and up to date on drug compatibilities and incompatibilities, have a clean, aseptic work area best provided by a laminar flow unit, do a complete work-load study and gain the approval of nursing service before implementation of a central IV additive service in the pharmacy.

Research Methodology

The Methodist Hospital of Dallas presently has twenty nursing units using IV additives. A six-day work-load study was conducted on seventeen of these nursing units to determine the number of IV solutions given with additives, the times required at the nursing station, the number given per shift, and the time saved for nursing personnel. Anesthesiology, surgical recovery, and emergency were eliminated from the survey; because of their activities, they would not benefit from a centralized IV additive service. The required information was obtained by distributing a work-load study form (Appendix C) to the nurse supervisor of the various wards with total effort being coordinated by the director of nursing services.

The approximate cost of equipment required was obtained by contacting the manufacturers involved.

Objectives

Tasks which were accomplished to arrive at the best solution to this problem included:

1. A complete survey of the hospital's existing intravenous additive preparation procedure.

2. A complete work-load study to determine when and from which wards most intravenous fluids are ordered and administered.

3. A review and evaluation of procedures used by IV additive programs in hospitals similar in size and administrative organization.

4. The consideration of all phases of the program, including evaluation of the need for additional space, equipment, personnel, and procedures.

5. The establishment of a procedure guide for the pharmacy IV additive program.

Footnotes

[1]Richard J. Wuest, "Justifying an I.V. Additive Program," Drug Intelligence and Clinical Pharmacy, IV (May, 1970), 125.

[2]Earl R. McKinstry, "Guidelines for Setting Up an Intravenous Additive Service with Application to Smaller Hospitals." A Thesis Submitted to the Graduate Faculty of the North Dakota State University of Agriculture and Applied Sciences, August, 1970, 14-32.

[3]Fred J. Pang, "A Transition to Centralized IV Additive Service in a Private Hospital," Hospital Pharmacy, V. (December, 1970), 18.

[4]Robert L. Ravin, "Steps in Starting an IV Additive Program," Drug Intelligence and Clinical Pharmacy, IV (January, 1970), 13.

[5]McKinstry, pp. 1-2.

[6]Ravin, p. 13.

[7]Ibid.

[8]Ibid.

[9]John D. Porterfield, Standard for Accreditation of Hospitals (Chicago: Joint Commission on Accreditation of Hospital, 1969), p. 92.

[10]Jules M. Meisler, and Milton W. Skolaut, "Extemporaneous Sterile Compounding of Intravenous Additives," American Journal of Hospital Pharmacy, October, 1966, p. 564.

[11]Ibid., p. 565.

[12]Ibid.

[13]Eugene A. Parker, "Parenteral Prescription Problems," Hospital Pharmacy, I (1966), 11.

[14]Ibid., pp. 12-13.

[15]Ibid., p. 13.

[16]Peter P. Lamy, "Laminar Flow and Environmental Control," Hospital Formulary Management, October, 1968, p. 16.

[17]Ibid., pp. 15-20.

[18]Edward E. Greif, and Herbert L. Flack, "A Space-Age Sterile Technics Laboratory," American Journal of Hospital Pharmacy, August, 1965, pp. 454-66.

[19]Joseph F. Gallelli, and Milton W. Skolaut, "Environment for Sterile Dosage Formulation and Control," Drug Intelligence, I (October, 1967), 311-15.

[20]William L. Davies; Mary E. Kitler; and Peter P. Lamy, "Contamination Control With Laminar Flow Hoods," Hospital Pharmacy, III (1968), 12-20.

[21]Frank J. Sweeney, "Problem of the Parenteral Prescription," Hospital Pharmacy, I (1969), 16.

[22]Pang, pp. 18-20.

[23]Sister Mary Virginia, "The Parenteral Prescription," Hospital Pharmacy, I (1966), 18-26.

[24]Sister Mary Naomi Holysko, and Robert L. Ravin, "A Pharmacy Centralized Intravenous Additive Service," American Journal of Hospital Pharmacy, XXII (May, 1965), 265-71.

[25]Ibid., p. 267.

[26]Pang, p. 18.

[27]Holysko, p. 271.

CHAPTER II

DISCUSSION

Survey of Present System

At present the Methodist Hospital of Dallas is using the IV team concept for the preparation and administration of the IV additives. The physician writes his request for an intravenous solution and/or additive on a NCR Doctors Orders form. The ward nurse then transcribes this order twice, once on an intravenous therapy request form, forwarding it to the centrally located Ward 2C and once on a drug request form, forwarding it to the pharmacy via pneumatic tube. The pharmacy then fills the order and sends the IV solution and/or additive to the ward by dumb-waiter. Once every hour a nurse from the IV team picks up the requests from Ward 2C and makes her rounds. For an IV order requiring immediate administration, the IV team nurse is paged by a loudspeaker system throughout the hospital. She then proceeds to the nursing station, picks up the IV solution and additive, mixes them, delivers the resultant solution to the patient, and performs the venipuncture.

Advantages of present system are:

1. The IV team nurse specializes in venipunctures and becomes extremely proficient; thus injections are more comfortable for the patient.

2. The IV team system saves time for the ward nurse by relieving her of the pharmaceutical responsibility of compounding IV additive solutions.

Disadvantages of present system are:

1. The ward nurse relies heavily on the IV team nurse and loses her proficiency in administering IV solutions.

2. The volume of paper work and numerous people involved creates a considerable potential for error.

3. The IV team nurse compounds a potent intravenous medication, for which she does not have the necessary pharmacological or pharmaceutical background, in a congested, non-sterile nursing station.

4. No double check is made on the nurse after she mixes the solution and labels it.

5. The IV additive label is handwritten instead of typed.

Work-Load Study

A survey of the demand for intravenous fluids and intravenous fluids which contained additives was conducted from February 16 through February 21, 1971. The purpose of this survey was to determine the use of IV additives by the various nursing units and how many were prepared per nursing shift. The results of this study showed that, on an average, 121 intravenous solutions were prepared each day of which 70 percent contained one additive or more. These results are comparable to other hospitals of similar size.[1] A frequency profile for each nursing unit is presented in Appendix D.

This study also revealed that 33 percent of the IV additives were prepared on the 11 P.M.-7 A.M. nursing shift, 38 percent on the 7 A.M.-3 P.M. nursing shift, and 29 percent on the 3 P.M.-11 P.M. nursing shift (see Appendix E).

Review of Hospitals

A review of questionnaires received by Captain Earl McKinstry from seven hospitals ranging in size from 32 beds to 621 beds, that are presently operating centralized IV additive services in the pharmacy, showed this service to be quite successful.[2] All hospitals indicated that the single most important factor in the implementation of such a program was the acceptance by nursing service. There must be close cooperation and coordination between the pharmacy service and the nursing service. At present, the director of nursing service, Methodist Hospital of Dallas, strongly supports the implementation of a centralized IV additive service in the pharmacy. McKinstry's study also revealed the following:

1. Any size hospital can implement an IV additive service in the pharmacy.

2. No additional personnel are required initially.

3. The main piece of equipment needed to implement the IV additive service is a laminar flow unit.

4. The program should start with one nursing unit at a time.

5. This service, after a short breaking-in period, is usually enthusiastically accepted by both physicians and nurses.

6. The end result is a better nurse-pharmacist and physician-pharmacist relationship than existed before the start of the centralized IV additive service.[3]

Pharmacy

The pharmacist is best qualified by education to compound extemporaneous intravenous additive prescriptions and recognize and eliminate pharmacological, physical, and chemical incompatibilities. Every day

he routinely types labels, converts from apothecary to the metric system, and calculates dosages. Repetition normally develops proficiency which in turn reduces the level of errors.

According to a survey conducted at St. Joseph Mercy Hospital, Ann Arbor, Michigan, the average time for a pharmacist to process an IV order containing drug additives is 6.9 minutes.[4] The IV team at the Methodist Hospital of Dallas prepares on the average fifty-seven additive solutions per day during its hours of operation (see Appendix E). If IV additives were prepared by a pharmacist, the IV team would be saved approximately 6.5 hours per day (averaging 57 IV additive orders multiplied by 6.9 minutes). Thus, nursing time currently involved in compounding intravenous solutions would be freed for responsibilities for which nurses are greatly needed.

Prerequisites for Implementation

The four basic components of a centralized IV additive program are personnel, sterile preparation area, equipment, and a written Standing Operating Procedure (SOP) for the pharmacy's IV additive program.

Personnel

There are nine pharmacists employed in the pharmacy service of the Methodist Hospital of Dallas--the director of the pharmacy service, the assistant director, the supervisor of dispensing, and six staff pharmacists. In addition to the professional staff there are two full-time and one part-time clerk typists, two full-time pharmacy helpers, and one pharmacy technician. The pharmacy's hours of operation are from 7 A.M. to 11 P.M., seven days a week. During the hours from 11 P.M. to

7 A.M., the night supervisor of the nursing service has a key to the pharmacy and is responsible for dispensing of needed pharmaceuticals. At present no additional personnel would be needed to initiate an IV additive service in the pharmacy.

Sterile Preparation Area

Another ingredient necessary for an IV additive service is a sterile area or clean room for the preparation of sterile IV additive solutions. The ideal sterile preparation area is a room separate from the main pharmacy, yet close enough to maintain good communication.[5] A location away from the busy operation of personnel and equipment in the main pharmacy aids in the reduction of contamination from airborne dust and bacteria. In the pharmacy of the Methodist Hospital there is a separate room used for prepackaging drugs. It was originally designed to be a clean room, is 15' x 15', has a sink, electrical outlets, and is air-conditioned. Necessary shelving for IV fluids is already built into the room, and the present stock of IV fluids in the pharmacy is just outside of the prepackaging area. This room could easily be converted to a sterile preparation area for the IV additive service and the prepackaging area moved to the bulk compounding room. Appendix F depicts the floor plan used by Ohio State University Hospital and is a good example of an intravenous admixture room.

Equipment

The essential item of equipment required to operate a centralized IV additive service is a laminar flow unit. These units vary in size and style and range in price from a $600 bench-top mounted, horizontal

laminar flow unit to an $8,600 laminar flow clean tunnel. The two basic models are horizontal or vertical. The vertical laminar flow produces the cleanest possible environment because it takes advantage of air flow plus gravity, but it is difficult to train people to use and presents the possibility of washing contaminants down into the IV solution while mixing. Therefore, the horizontal laminar flow unit is the one most commonly used in the pharmacy. For a pictorial illustration of laminar flow and a laminar flow clean bench see Appendix G.

Additional equipment needed by the pharmacy of the Methodist Hospital to initiate a centralized IV additive service would be a refrigerator, IV additive labels (Appendix H), IV call cards (Appendix I) and an incompatibility file. Syringes, needles, and alcohol wipes are already available and the labels and IV call cards can be made in the hospital's print shop.

Standing Operating Procedure (SOP)

In order to ensure the successful implementation of a centralized IV additive program, a written SOP needs to be established. The purpose of this guide is to prescribe standard procedures for the operation, staffing, and maintenance of the pharmacy service intravenous additive program (see Appendix J).

Actual Implementation

After studying the present system, analyzing the results of the work-load study, reviewing IV additive programs in hospitals of similar size, evaluating the need for additional space, equipment, personnel, and establishment of a written SOP, there are three possible approaches for introducing the centralized IV additive service into the hospital system.

The pharmacy can initiate this new service in all seventeen nursing units at once, in several nursing units, or in a single nursing unit. A review of present IV additive programs in hospitals of similar size indicates the best solution is for the pharmacy to initiate the service in only one nursing unit.[6] This allows the pharmacy to check out its new policies and procedures and to revise as necessary. It also enables the nurses to become familiar with the new system and to offer suggestions for improvement. The result is better cooperation, coordination, and communication between nursing service and the pharmacy service. It should always be kept in mind, however, that the centralized IV additive service will be expanded to cover the remaining nursing units as soon as practical.

Footnotes

[1]Earl R. McKinstry, "Guidelines for Setting Up an Intravenous Additive Service with Application to Smaller Hospitals." A Thesis Submitted to the Graduate Faculty of the North Dakota State University of Agriculture and Applied Sciences, August, 1970, 14-32.

[2]Ibid.

[3]Ibid.

[4]Sister Mary Naomi Holysko, and Robert L. Ravin, "A Pharmacy Centralized Intravenous Additive Service," American Journal of Hospital Pharmacy, XXII (May, 1965), 268.

[5]McKinstry, p. 50.

[6]Ibid., pp. 14-32.

CHAPTER III

CONCLUSION

Conclusion

The most effective means for the pharmacy service of the Methodist Hospital of Dallas to establish and administer a central IV additive program is to purchase a laminar flow unit, utilize existing personnel and space, and implement the program by providing this service to only one nursing unit as a pilot study in order to gain more experience.

Recommendations

Successful implementation of this program will involve:

1. Moving the prepackaging area to the bulk-compounding area and converting this room to the sterile preparations area for IV additives.

2. Purchasing an Abbott Clean Air Center Laminar Flow Horizontal Console Model for $1,295. Abbott Laboratories is unique in offering a full field certification at the hospital within a few months after delivery of the clean air center. This is in addition to the factory certification made prior to the time each unit is shipped. The cost of this field certification visit by a qualified technician is included in the purchase price of the Abbott Clean Air Center.

3. Purchasing an average size household refrigerator for approximately $300.

4. Having IV additive labels and IV call cards printed in the hospital print shop.

5. Preparing and keeping a current, written file on incompatibility data as well as current information pertaining to additive reconstitution and stability. This can be accomplished by using information from manufacturer's inserts, pharmaceutical literature, and experience.

6. Preparing a written Standing Operating Procedure (SOP) for the pharmacy's IV additive program (see Appendix J).

7. Implementing the centralized intravenous service on Ward 3L. Presently 13 percent of all the IV additives are administered on this small 29 bed ward. The nurses on 3L are receptive to new concepts because of a recently installed unit-dose system on their ward.

8. Operating the centralized IV additive service sixteen hours daily (7 A.M.-11 P.M.). This will cover 67 percent of all IV additives presently administered. The majority of the remaining IV additives administered on the 11 P.M.-7 A.M. shift should be prepared in the pharmacy prior to 11 P.M. Orders written or changed after 11 P.M. will be carried out by the IV team until such time as the pharmacy can extend its hours of operation.

9. Conducting a meeting of pharmacists, nurses, physicians, and other personnel involved before actual implementation to ensure that everyone is familiar with the proposed system.

10. Sending out an informative letter from the director of the pharmacy service to the departments involved as to the actual starting date of the centralized IV additive service (see Appendix L).

APPENDIX A

DEFINITIONS

DEFINITIONS

Aseptic: preventing or not involving infection; free or freed from pathogenic microorganisms by special methods.

Drug: a substance used as a medicine or in making medicines.

Extemporaneous: composed, performed, or uttered on the spur of the moment.

HEPA: high-efficiency particulate air.

Incompatibilities: pharmacological, chemical, and physical incimpatibilities of drugs when they are mixed together in an intravenous solution.

IV: intravenous

IV additive or IV admixture: addition of drugs to intravenous solutions.

IV team: three-member team of registered nurses who specialize in the preparation and administration of intravenous solutions.

NCR: no carbon required.

Nurse: one skilled or trained in caring for the sick or infirm especially under the supervision of a physician.

Parenteral: injected or for injection subcutaneously, intramuscularly, or intravenously.

Pharmaceutical: of or relating to pharmacy or pharmacists.

Pharmacist: one skilled or engaged in pharmacy.

Pharmacology: the properties and reactions of drugs, especially with relation to their therapeutic value.

Pharmacy: the art or practice of preparing, preserving, compounding, and dispensing drugs.

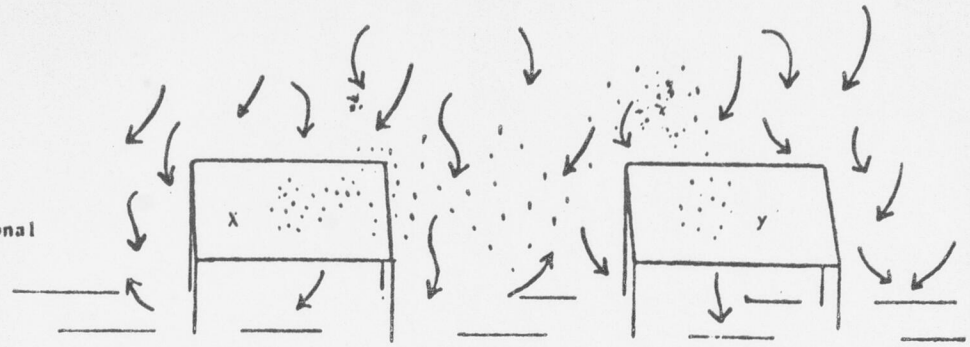
Sterile: free from living organisms and microorganisms.

Synergistic: cooperative action of discrete agencies such that the total effect is greater than the sum of the two effects taken independently.

APPENDIX B

LAMINAR FLOW

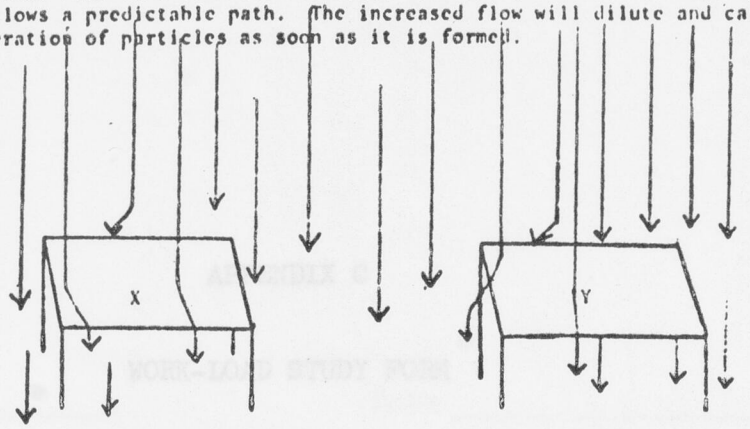
Conventional



Air currents are not forced to follow a predictable path. Particle generation at "X" can migrate to "Y". Particles which have "fallen-out" of the air can be re-entrained by movement of the foot on the floor.

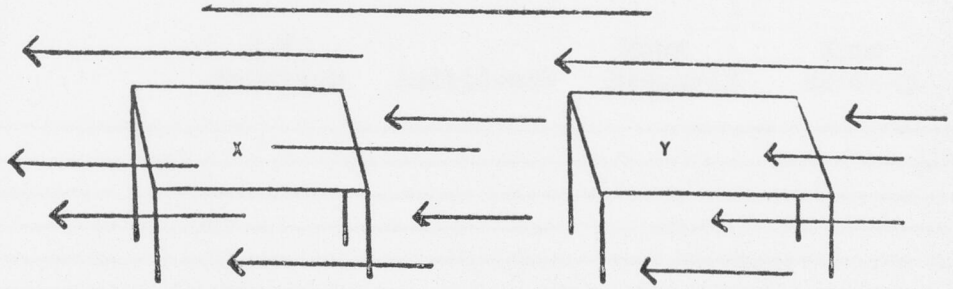
With Laminar Flow in a down flow or cross flow room, the air flow through the room follows a predictable path. The increased flow will dilute and carry away any generation of particles as soon as it is formed.

Down Flow



Particle generation at "X" is completely isolated from "Y" or any other spot by a "curtain" of air.

Cross Flow



Particle generation at "X" moves downstream within stream lines where the generation took place. Downstream areas will have higher contamination levels than upstream areas.

APPENDIX C

WORK-LOAD STUDY FORM

Ward No. _____ Date _____

Nurse's Signature _____

Patient	I.V. Solution	Additives*	Hour Prepared	Hour Hook-up	Preparation time (minutes)

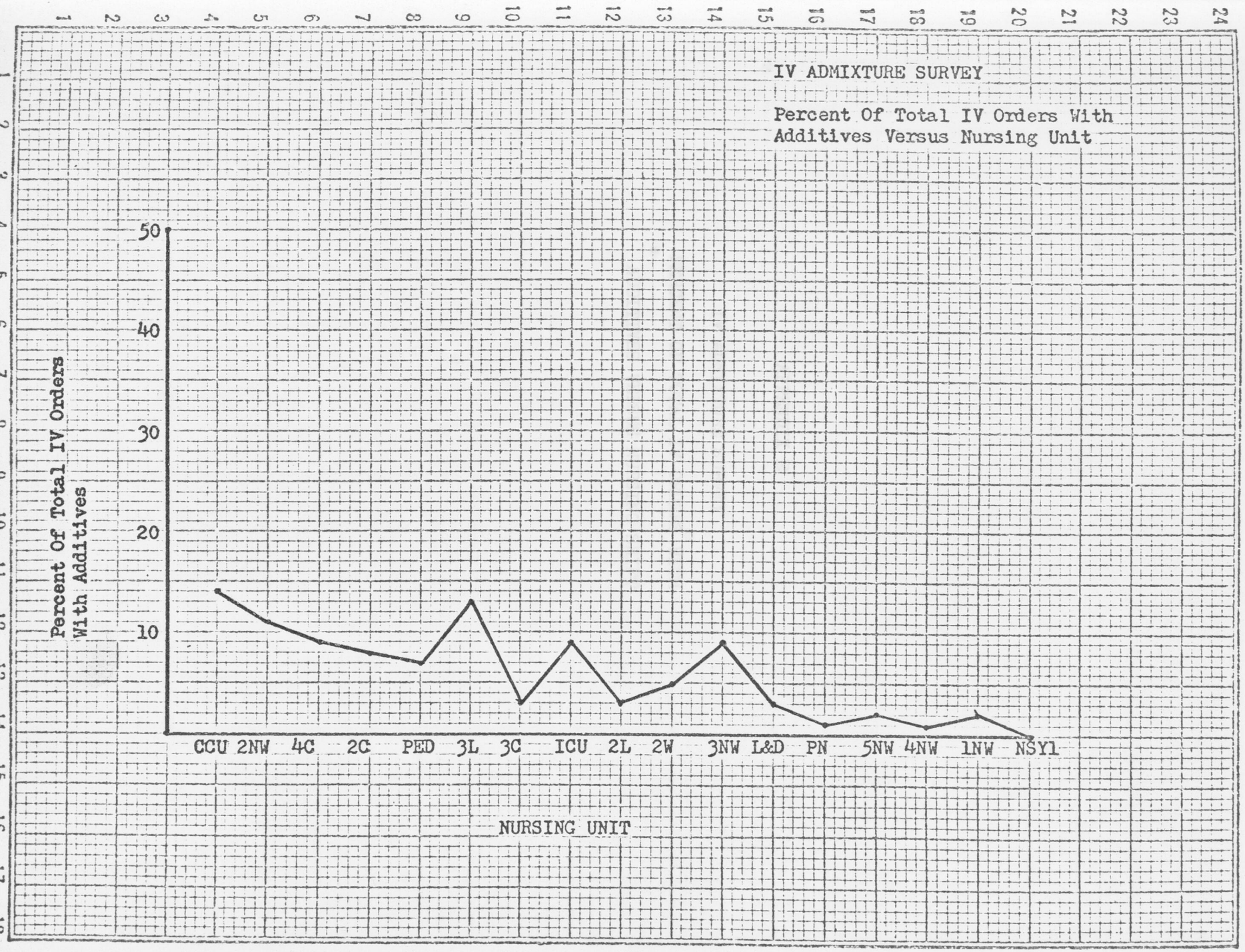
*Use more than one line if necessary

WORK LOAD STUDY FORM

APPENDIX D

IV ADMIXTURE SURVEY

PERCENT OF TOTAL IV ORDERS WITH ADDITIVES VERSUS NURSING UNIT


IV ADMIXTURE SURVEY
Percent Of Total IV Orders With Additives Versus Nursing Unit
Percent Of Total IV Orders With Additives
50
40
30
20
10
CCU 2NW 4C 2C PED 3L 3C ICU 2L 2W 3NW L&D PN 5NW 4NW 1NW NSY1
NURSING UNIT

APPENDIX E

IV ADMIXTURE SURVEY

PERCENT OF TOTAL IV ORDERS WITH

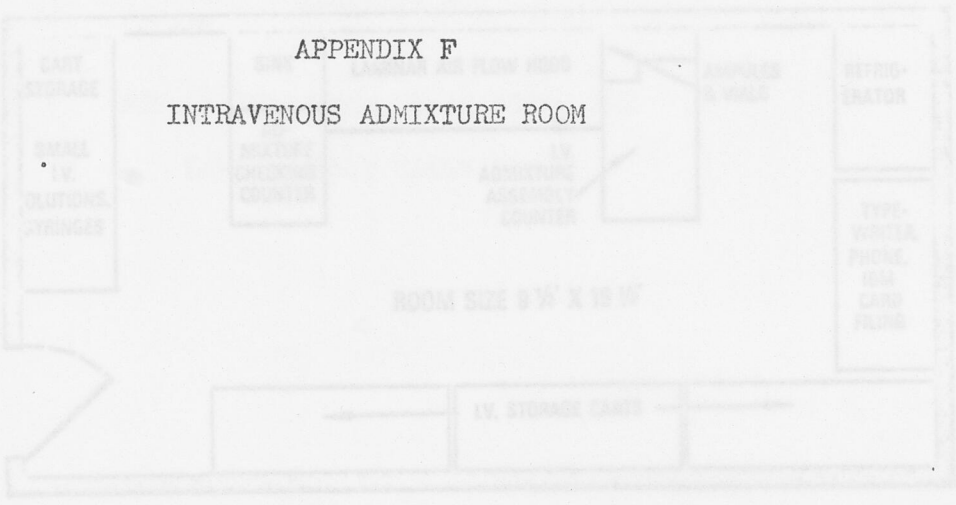
ADDITIVES VERSUS NURSING SHIFT

IV ADMIXTURE SURVEY

Percent Of Total IV Orders With Additives Versus Nursing Shift

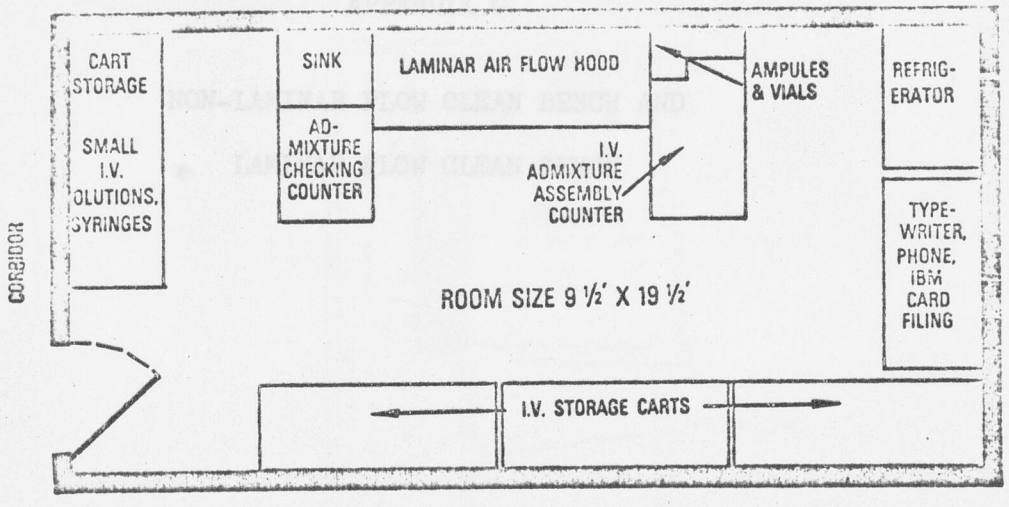
APPENDIX F

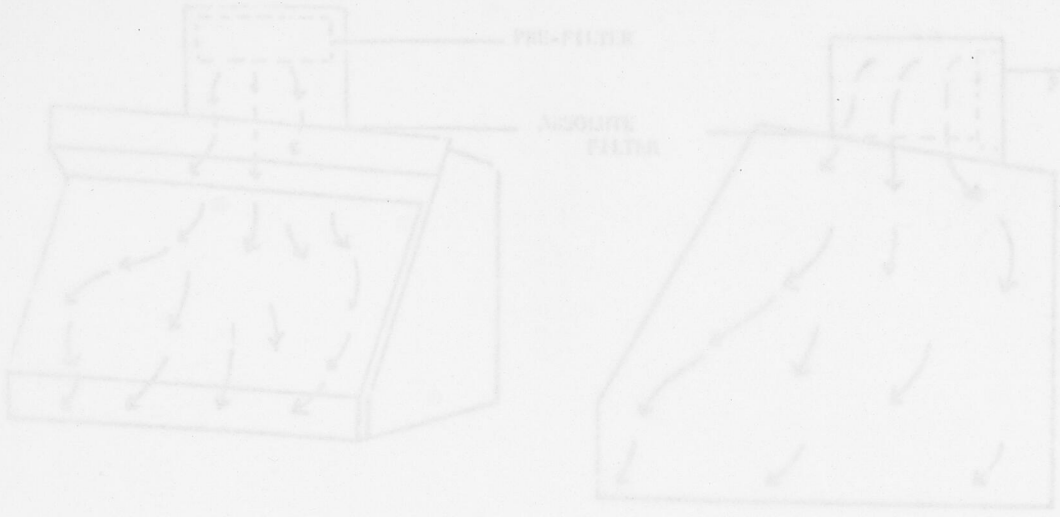
INTRAVENOUS ADMIXTURE ROOM



INTRAVENOUS ADMIXTURE ROOM

Floor Plan





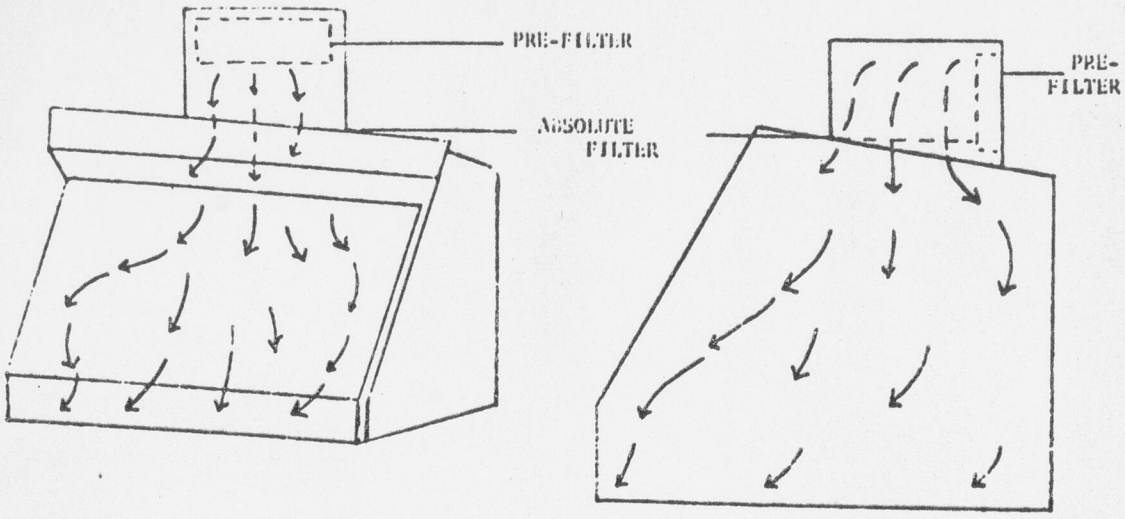
Non-Laminar Flow Clean Bench

APPENDIX G

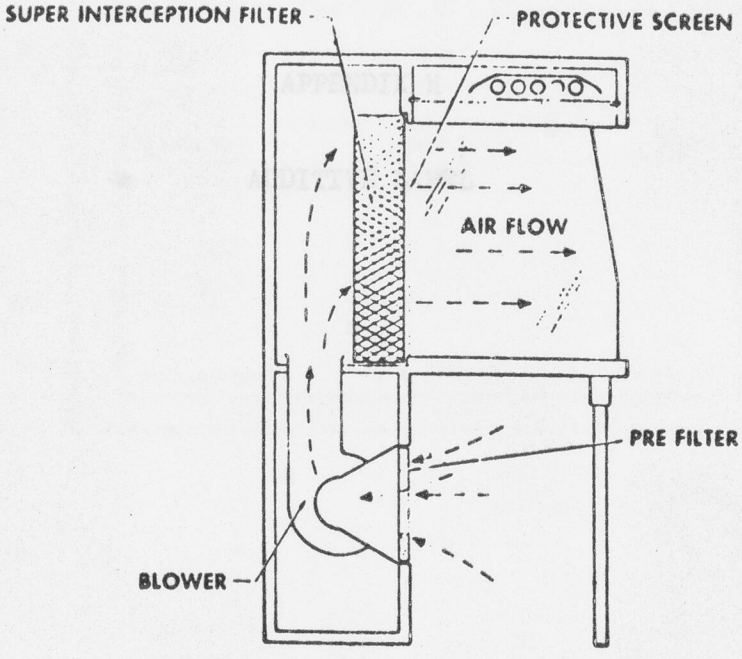
NON-LAMINAR FLOW CLEAN BENCH AND

LAMINAR FLOW CLEAN BENCH

LAMINAR FLOW CLEAN BENCH



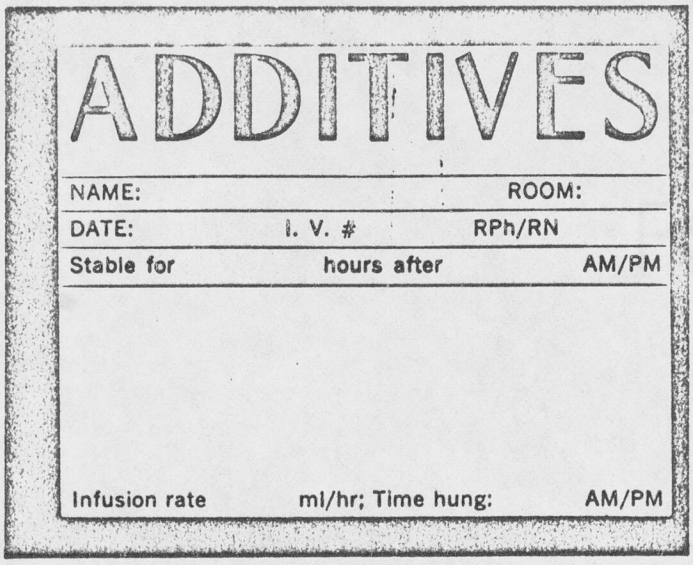
Non-Laminar Flow Clean Bench



LAMINAR FLOW CLEAN BENCH

APPENDIX H

ADDITIVE LABEL


ADDITIVES
NAME:
ROOM:
DATE:
I. V. #
RPh/RN
Stable for
hours after
AM/PM
Infusion rate
ml/hr; Time hung:
AM/PM

APPENDIX I

IV CALL CARD

ST. JOSEPH MERCY HOSPITAL
Ann Arbor, Michigan

IV CALL CARD

Pt. _____ Time Wanted _____

Room _____ P.B. # Primary # _____ Stability _____ hours

VOLUME

1000 ml _____ 500 ml _____
250 ml _____ 100 ml _____
50 ml _____ Other _____

SOLUTION

DEXTROSE:
- 5% in Water
- 5% in ¼ strength Saline
- 5% in ½ strength Saline
- 5% in Saline
- 5% in Lactated Ringer's
- 10% in Water
- 10% in Saline

NORMISOL: _____

MISCELLANEOUS:
- Aminosol 5%
- Aminosol 5%/Dextrose 5%
- Dextrose 50%
- Lactated Ringer's
- Inpersol /w___Dextrose
- Sodium Chloride Inj.

CHEMOTHERAPY

5-Fluorouracil _____ mg.
Cytoxan _____ mg.
Methotrexate _____ mg.

PRICE:

ADDITIVES

Potassium Chloride _____ mEq.
Sodium Bicarb. _____ mEq.
Sodium Chloride _____ mEq.
NEUT _____ vial

MVI _____ Amp
Solu B & C _____ Vial
Solu B Forte _____ Vial

		P.B. Conc.
Heparin	_____ mg.	_____
Ampicillin	_____ mg.	_____
Chloromycetin	_____ Grams	_____
Erythromycin	_____ mg.	_____
Gantrisin	_____ Grams	_____
Keflin	_____ Grams	_____
Lincomycin	_____ mg.	_____
Penicillin G	_____ Units	_____
Prostaphlin	_____ mg.	_____
Staphcillin	_____ Grams	_____
Tetracycline	_____ mg.	_____

Aminophyllin _____ mg.
Sodium Iodide _____ mg.

Aramine _____ mg.

Mannitol _____ Grams
Serum Albumin _____ Grams

Aqua-Mephyton _____ mg.
Calcium Gluconate _____ Grams
Histamine Acid PO_4 _____ mg.
Insulin _____ Units
Solu-Cortef _____ mg.
Xylocaine _____ Grams

34-07 (REV. 8/69)

APPENDIX J

SUGGESTED STANDING OPERATING PROCEDURE (SOP)

FOR THE PHARMACY IV ADDITIVE PROGRAM

SUGGESTED STANDING OPERATING PROCEDURE (SOP)
FOR THE PHARMACY IV ADDITIVE PROGRAM

Purpose

The purpose of this procedure guide is to prescribe standard procedures for operation, staffing, and maintenance of the Methodist Hospital of Dallas, Pharmacy Service intravenous additive program.

General

The pharmacy operates an IV admixture service in the sterile preparations area adjacent to the main pharmacy. The purpose of the IV additive service is to improve patient safety by preparing IV additives in a sterile environment under the professional supervision of a registered pharmacist.

Staffing and Hours of Operation

The IV additive section is normally staffed by one registered pharmacist. Hours of operation are sixteen hours daily (7A.M. to 11 P.M.).

Laminar Flow Hood

A. The laminar flow hood will run continuously from 7 A.M. to 11 P.M. except for filter changes and other required maintenance.

B. Prefilters will be changed at least once every month or as required by work load. Date of change and initials of person changing the filters will be recorded.

C. Each pharmacist will check the static pressure gauge

periodically to determine that the air flow velocity is in the recommended range. The manufacturer's representative will make periodic checks and repairs on the HEPA filter.

D. Blood agar culture plates shall be exposed in the laminar flow working area according to the following schedule. On a monthly basis, three plates are exposed for twenty minutes across the work bench midway back and three plates are exposed for twenty minutes held at right angle to air flow. In addition, one plate is deliberately contaminated for control and one plate is not exposed for control. In the event of any growth on the plates, the area will be cleaned thoroughly and other appropriate action as necessary. (Ex. repair HEPA filter.) Additional plates will be exposed until cultures are negative. Plates are obtained from laboratory service, exposed, and returned with request form.

E. Only containers and equipment actually needed for preparation of a specific IV additive solution will be kept on the laminar flow work bench.

Administrative Policies

A. Transcription of IV Orders

All intravenous orders will be transcribed from the NCR Doctors' Orders form by a registered pharmacist, to an IV call card. Only one order per card is authorized. The pharmacist will insure that the following is on each IV call card:

1. Patient's name.

2. Time wanted.

3. Ward and room number.

4. To be administered piggy-back or primary.

5. Stability in hours.

6. The specific additives required and quantity of each.

7. The volume and identity of intravenous solution to be used.

8. The word CONTINUOUS if the IV is to be administered continuously.

9. Name of physician writing the order and initial of pharmacist preparing it.

10. Price.

B. Discontinued Additive Solutions

When the additive pharmacist is notified that a solution is discontinued, he shall write the letters DC on the face of the IV call card, the time and date of receipt of notification and his initials.

C. IV Additive Labels

Labels shall be affixed to the immediate container of additive solutions over the original solution label so that it may be read in the inverted position during administration to the patient. The additive label should not cover up the name of the original solution. Labels shall include the following information:

1. Patient's name.

2. Ward and room number.

3. Date.

4. IV number.

5. Initials of pharmacist preparing solution.

6. Stability in hours.

7. Additives contained.

8. Volume and identity of primary fluid.

9. Time and date solution is to be administered.

D. Telephone Orders

When the need arises, STAT IV orders may be accepted over the telephone. The pharmacist taking the call should write the order on an IV call card while taking the order. Telephonic orders will be verified for accuracy with the nurse at the time of delivery to the ward, and the NCR Doctors' Orders form sent back to the pharmacy.

E. Files

The following files shall be maintained in the IV additive section:

1. Intravenous Call Cards

This file should be kept in the pharmacy for one year, then retired.

2. Permanent IV call Cards

A permanent file will be kept on any order that is unusual to prepare and that may be reordered in the future. Complete instructions for preparation will be in this file.

3. Incompatibility, Stability, Preparation Information

This is a permanent file which refers to pharmacological, physical, and chemical incompatibilities.

Standard Procedures

All personnel working in the IV additive section will observe the following procedures:

A. Receipt of Orders

Upon receipt of the NCR Doctors' Orders form, the pharmacist will check for completeness and accuracy, then transcribe to an IV call card. If there is any doubt as to dosage, stability, or incompatibility, immediately telephone the requesting nurse or physician. Do not leave it for the next shift, because the problem will still exist, and they may not be able to contact the nurse or physician that ordered it.

B. Routine IV Additive Orders

IV call cards with typed labels attached will be sorted in accordance with time needed on ward for administration to patient (file box with twenty-four-hour dividers). All IV fluids will be delivered to ward by dumb-waiter, one hour prior to administration.

C. STAT or Emergency Orders

These orders are processed and prepared immediately, then delivered to ward promptly.

D. Labels

Each shift will prepare labels for all IV additive solutions received during the shift and also for IV additive solutions received but required for administration during subsequent shifts. After labels are typed, they are attached by paper clip to the IV call card and filed in the twenty-four-hour divider box.

E. Preparation

1. The pharmacist first washes his hands with soap and water.

2. He then swabs the working area of the laminar flow hood with 70 percent isopropyl alcohol.

3. The IV call card is pulled from the card file and the pretyped

label is checked against the IV call card to insure accuracy.

4. He then checks dosage, stability, and incompatibilities.

5. The IV call card and label are placed on the outside of the plexiglass side of the hood, where they can easily be referred to while filling the IV additive order. The order is prepared from the IV call card, not the label. Only one IV additive solution is prepared under the laminar flow hood at any one time. No other ingredients should be in the work area.

6. The finished preparation is then checked for any sign of incompatibilities such as particulate matter, precipitation, color change, etc.

7. The finished preparation and the label are then checked against the IV call card.

8. After preparation of the IV additive solution, the pharmacist will place a bright red plastic tape with the word ADDITIVES on it, around the bottle-set area of the bottle.

9. The IV call card is refiled in the file box under the hour it is next scheduled to be administered.

See Appendix K for IV admixture flow chart.

F. After-hours Service

If possible, all IV additive orders for the 11 P.M. to 7 A.M. shift will be prepared prior to 11 P.M. All other IV additive solutions needed during this period will be prepared by the IV team nurse as in the past. She will have a key to the sterile preparation area of the pharmacy.

G. Restocking Solutions and Supplies

At the end of each shift the pharmacist on duty will restock the shelves with solutions, needles, syringes, and other supplies for the next shift.

H. General Cleanliness and Appearance of the IV Additive Room

1. Smoking or eating is not permitted in the IV additive room at any time.

2. Each shift is responsible for keeping the area in a neat and orderly condition at all times. The top and sides of the inside of the laminar flow hood will be swabbed with 70 percent isopropyl alcohol at the start of each shift.

3. No radio, TV, or similar distraction is allowed in the IV additive room.

4. The floor will be wet mopped with a germicidal solution during the evening shift, by the hospital janitor.

Footnote

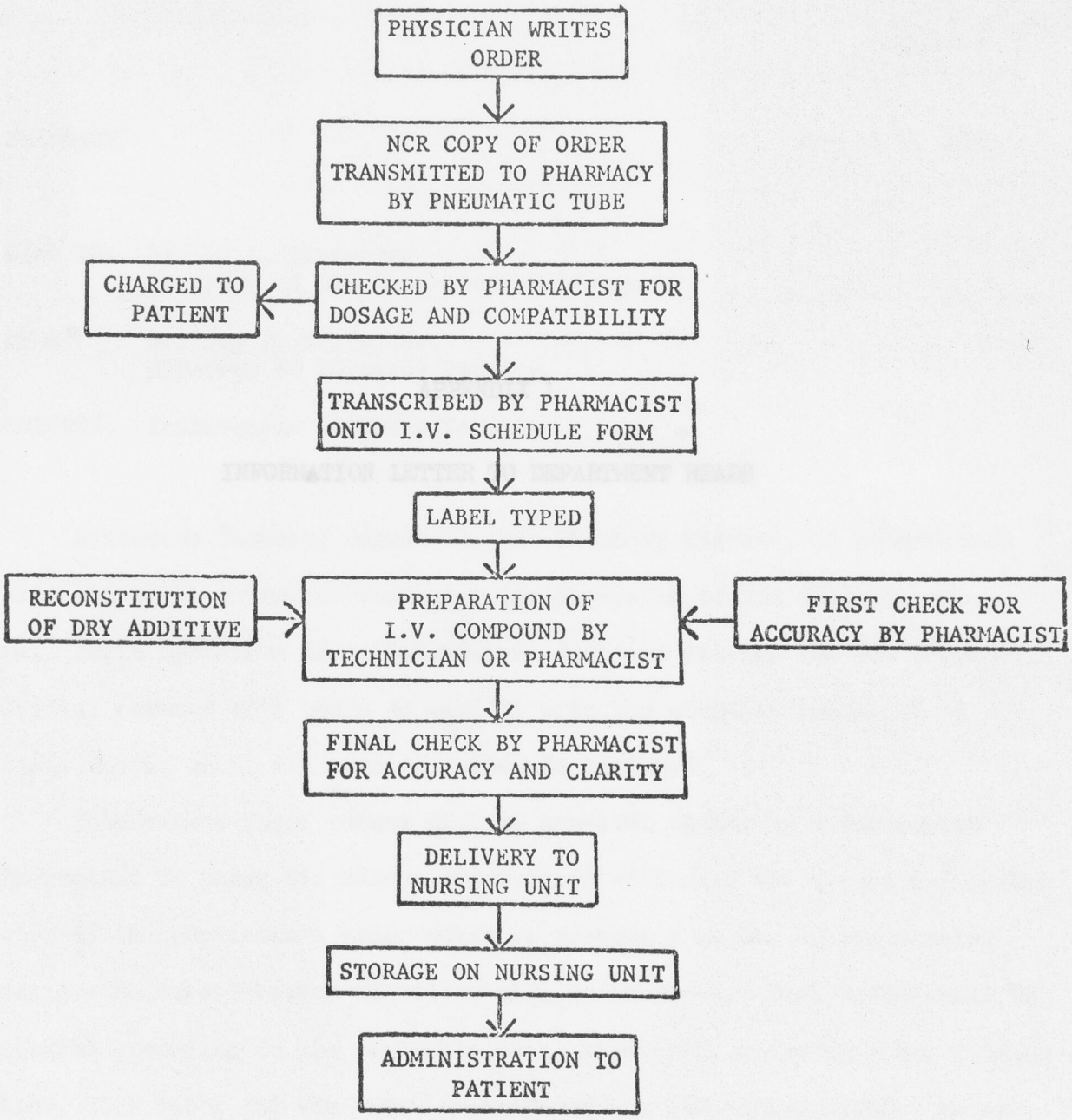
[1]Procedure Guide for Sterile Technique and the Preparation of an Intravenous Additive Solution, Pharmacy Service, Brooke General Hospital, Brooke Army Medical Center, Fort Sam Houston, Texas, November 24, 1970; Procedure Guide for the Pharmacy Service IV Additive Program, Pharmacy Service, Brooke General Hospital, Brooke Army Medical Center, Fort Sam Houston, November 24, 1970.

APPENDIX K

FLOW CHART FOR INTRAVENOUS ADMIXTURE

COMPOUNDED BY PHARMACY

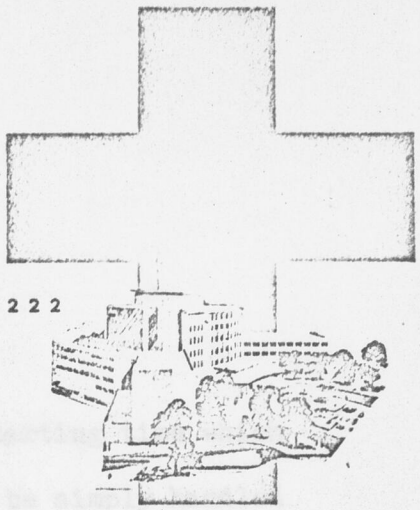
FLOW CHART FOR INTRAVENOUS ADMIXTURE COMPOUNDED BY PHARMACY



APPENDIX L

INFORMATION LETTER TO DEPARTMENT HEADS

Methodist
HOSPITAL of DALLAS
P. O. BOX 5999 • 301 WEST COLORADO • DALLAS, TEXAS 75222
TELEPHONE: WHitehall 6-8181, Area Code 214



PHARMACY

August 4, 1971

MEMO TO: Dr. L. A. Arnspiger
Chairman of the Department of Surgery

FROM: Mr. Guy T. Kelly, Jr.
Director of Pharmacy Service

SUBJECT: Intravenous Additive Service

Effective Tuesday, August 11, the Pharmacy Service, in cooperation with the Nursing Service and under the direction of Jim Coleman, RPh., will begin operation of an Intravenous Additive Service for the hospital. Initial service will begin on ward 3L with the stepwise inclusion of other units, until all nursing units are included.

Intravenous fluid orders will be prepared either by a Registered Pharmacist or under his direct supervision utilizing the direct non-carbon copy of the physician's order which is presently in use on the nursing units. No transcription of orders will be involved. Each bottle will be labeled according to the patient's name, physician, starting time, running time, flow rate, and the exact contents of any medication added. An expiration date will be given to each bottle. Each bottle will be delivered to the nursing unit one hour before the scheduled starting time and will

be stored there under refrigeration. Any change in starting time which would result in an earlier or later delivery date can be simply handled by a phone call from the nurse involved.

Due to the limited hours of operation of the pharmacy, initial service will be extended from 7:00 a.m. until 11:00 p.m. Monday through Friday with no Saturday or Sunday coverage. In the near future, however, the pharmacy will be in operation 24 hours a day, seven days a week.

Fluids will be mixed up to 24 hours in advance, and even with the present limited coverage, the pharmacy should be able to mix all fluids except those ordered or changed after 11 p.m.. Orders written or changed after 11 p.m. will be carried out by the IV team until such time as the pharmacy can extend its hours of operation.

The cooperation of the residents, interns and physicians who write intravenous fluid orders is essential to the success of the service. Any one who has a question or who would like to discuss any aspect of this memo can do so by contacting myself or Mr. Jim Coleman in the pharmacy.

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BIOGRAPHICAL SKETCH

Major William F. Carroll [redacted]. He attended elementary school and high school in Healdsburg, California and was accepted on a swimming scholarship at the University of Wyoming in 1954. Upon graduation in June, 1958, he received a Bachelor of Science in pharmacy and a commission as a second lieutenant in the Medical Service Corps. After six months of active duty, he re-entered civilian life and practiced pharmacy for four years.

In January, 1963, he came back on active duty and began flight training at Fort Rucker, Alabama. Upon completion of the course, he was awarded the silver wings of an army aviator in October, 1963.

Major Carroll, in 1965, served his first tour in the Republic of Vietnam as a medical evacuation pilot with the 498th Medical Company (Air Ambulance). He returned to the same company in March, 1969, to serve his second tour in the combat zone, this time as medical evacuation pilot, Standardization Instructor Pilot, Instrument Examiner, and unit commander. Between combat tours, various service schools and flying schools were attended by Major Carroll.

The writer is a registered pharmacist in the states of California and Wyoming, a commercial pilot, and a senior army aviator.