Variation in Quarters Dispositions

A Force Protection and Readiness Issue

Explanations and Control Method

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Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
AUG 1999	**Final**	**Jul 1998 - Jul 1999**

4. TITLE AND SUBTITLE

Variation in Quarters Dispositions A Force Protection and Readiness Issue Explanations and Control Method

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

Major Troy McGilvra

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

PacfiCare of Texas 8200 IH-10 West, Suite 1000 San Antonio, TX 78230-3878

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

US Army Medical Department Center and School Bldg 2841 MCCS-HRA (US Army-Baylor Program in HCA) 3151 Scott Road, Suite 1412 Fort Sam Houston, TX 78234-6135

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

34-99

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES

The original document contains color images.

14. ABSTRACT

Objective: This paper attempts to quantify the extent and magnitude of the portions of variation linked to the providers behavior, population characteristics and nonhealth factors. A method to monitor and control for unnatural variation is detailed using a control chart system. Methods: A retrospective analysis of a years worth of data for 12 medical facilities was conducted using a Chi-Square method, adjusted by a Multiple Admission Factor, to test the overall hypothesis that there is a variance in quarters rates among medical facilities. A correlation analysis and multiple regression model were conducted using the quarters rate as the dependent variable and demographic data as independent variables was used to examine the relationship between a MTFs quarters utilization rate and demographic factors. Results: There is a greater than threefold variation among the 12 medical facilities under study. The strongest nonhealth factor impacting the quarters rate was if the medical facility had beds or not. Indicating a supply side driver in use of hospital beds, available beds are used rather than sending patients to quarters. Other significant factors include beds per thousand and percentage of population that are black. Conclusion: Statistical control charts used to monitor facility quarters rates will aid in the monitoring of over/under utilization and further aid in the early identification of negative health trends. Additionally, a 10% change in quarters use will save 830 admissions and regain 913 2,740 lost duty days.

15. SUBJECT TERMS

Variation, Practice Patterns, Small area analysis, Quarters, Physician extenders, Control charts, Force Protection, Lost duty time, inappropriate admissions

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**UU**	**55**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

Abstract

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Variation in Quarters Dispositions

A Force Protection Issue

Explanations and Control Method

An important component of successfully enhancing quality and efficiencies in any healthcare system is to control and reduce variation. Specifically, attention directed at nonrandom variation will reduce unnecessary interventions. As the military continues to downsize, and the trend for smaller more agile deployment teams continues, military members are increasingly looked upon to shoulder a greater amount of responsibility. The military's goal to have a smaller theater "footprint" translates into fewer troops forward deployed and requires personnel to be responsible for multiple roles on the deployment team. This deployment environment, because of increased interdependence of service members, is more vulnerable to unnecessary quarters admissions which may disrupt operational activities and hinder mission accomplishment. Furthermore, the increased threat of the use of biological weapons requires diligence of our medical leadership to ensure the epidemiological controls are in place to identify potential biological events.

Lost duty time, from nonrandom variation, for personnel in either a deployed location or at home in a stateside unit is an inefficiency the military healthcare system can ill afford. This lost duty time is compounded greatly when the medical personnel themselves lose duty time to this variation. The potential costs to both medical and line units are enormous.

Military members are missing training opportunities or are required to make up missed training at significant cost to the military. Medical costs increase from additional medical visits that are often required to return to duty, especially in the Personnel Reliability Program and for personnel on flight status.

In military medicine, our healthcare system has a customer beyond the patient undergoing treatment. This other "customer" perceives quality on the number of personnel ready for a mission. The line units look to the medical community to provide health, disease prevention and care for the wounded and sick to support the line mission. These missions vary from stateside technical training to overseas military combat operations. In any case the line expects all physically able personnel to be available for the mission. Medical personnel should support the line's mission by preventing disease, injuries and unnecessary variation, which reduces manpower available for the mission.

Conditions Which Prompted the Study

Quarters dispositions are a unique military convention which allows for the recuperation of military personnel for illness or injuries which makes them too sick to work but not sick enough to be hospitalized. The quarters disposition allows the military member to go home (to quarters) to recuperate for a designated time frame of twenty four, forty eight or seventy two hours. This disposition is the civilian equivalent of a doctor’s excuse for work absence. There is a perception from the line commanders that military personnel will attempt to get out of field exercises, critical training or unpleasant duties by seeking a quarters disposition from the providers at the medical facility. Wide variation in quarters dispositions among providers and treatment facilities may be perceived as a lack of support for the line mission.

Quarters rates have an element of natural variability. Flu season, softball season and other periodic events will cause occasional spikes in quarters utilization. Additional natural variation occurs among population characteristics such as age and morbidity but fail to explain differences in treatments or hospitalizations (Wennberg, 1987). What remains after natural variability are those variability factors associated with professional decisions on the alternative manners of solving clinical problems and non health factors such as the number of physicians and hospital beds available. Quality improvement, efficiency efforts and ultimately programs aimed at improving support for line operations should concentrate on limiting “unnatural” variability factors.

Statement of the Problem

This paper attempts to quantify the extent and magnitude of the portions of variation linked to the provider’s behavior, population characteristics and nonhealth factors. Then a method to monitor and control for unnatural variation is detailed using a control chart system.

Literature Review

Variation in medical treatments is a widely studied topic. A 1987 special edition of "Health Affairs" dedicated the entire issue to discussions of variations in medical practice. John Wennberg (1984) opened this special edition with a three-part plan of action to resolve unnatural variation. The first part of his plan is the outcome monitoring of local markets on an epidemiological basis. Second, additional therapeutic research to resolve unanswered questions concerning medical intervention effectiveness. Finally, he calls upon the medical community to reduce the use of medical interventions for "marginally indicated conditions."

Small area variation studies (Cain & Diehr 1992; Chassin et al. 1986; Diehr, Cain, Connell and Volinn 1990; Gittelson & Powe 1995; McMahon, Wolfe and Tedeschi (1989) and McPherson, Wennberg, Hovid and Clifford 1982) all concentrate variation analysis on surgical rates across geographic areas as defined by counties, states or even countries. These studies documented large geographical variations in the rates of use of medical interventions. Sources of variation suggested by those studies include: lack of consensus on treatment techniques (Chassin et al. 1986; Gittelson & Powe 1995 and McPherson et al. 1982:), variation is independent of healthcare financing method (McPherson et al. 1982) and population characteristics, primarily income, are the main source of variation in discretionary surgeries (Gittelson & Powe 1995).

The principal measure of morbidity, which Blumberg (1987) studied, was “bed-disability day.” In relation to this study the “bed-disability” day is closely aligned with the definition of quarters and is defined as a day “… on which a person stays in bed for all or most of the day because of a specific illness or injury.” He found geographic variation in bed-disability day among regions of the country and type of community defined as central city or other. In relation to variation caused by population characteristics Wennberg (1987) responds to the study by Blumberg (1987). Wennberg asserts that age and morbidity are unrelated to variation in hospital admission rates. In contrast he notes that nonhealth factors have strong statistical relationships to variation. Specifically, he uses Blumberg’s data to show beds per capita are closely tied to inpatient admission rates.

Finally, he restates that small area studies show that variations of population-based hospitalization rates and surgical incidence are best explained by differences in provider’s clinical judgements. Other studies indicate that population characteristics do play a role in variation. Specifically, Greenfield et al. (1992) found that patient mix was a major determinant in resource use. McLaughlin, Normolle, Wolfe, McMahon and Griffith (1989) found that when you take small area analysis down to the urban, small city and rural level then population characteristics were important factors of explaining variation.

Other studies concentrate on provider’s behavior for the study of variance. Miller,M., Miller,L., Fireman and Black

(1994), Green and Becker (1994), Green (1996), Rosenblatt and Moscovice (1984) all studied the physician's role in hospital admission rates. Green (1996) finds that physician behavior cannot be directly inferred from the geographic type of analysis using population rate produced by typical small area variation studies. Rosenblatt and Moscovice (1984) refine the study of physician behavior by changing the denominator in the rate equation from geographic population measure to how many ambulatory visits a particular provider accomplishes.

Findings from this study show that older and poorer patients result in higher physician admission rates. Findings on nonhealth factors showed solo practitioners, providers with high patient volume and physicians associated with hospitals with high occupancy rates all refer less than other providers. The researchers conclude that the wide variability of admission rates at the provider level indicates that many hospitalizations are "discretionary." Miller, et al. (1994) confirms this with their findings that patients with similar health status had different probabilities of being admitted for inpatient care based on their physician, hospital, healthcare system and geographic region.

The next set of researchers: Reynolds, Chitnis and Roland (1991); Morre and Roland (1989) and Roland, Bartholomew, Morell, McDermott and Paul (1990) looked at variation in referral rates from general practitioners to specialists. Findings in these studies indicate that the referral rate adjustments for age and sex were only significant if the provider has a large portion of the patient population under sixteen years of age or over seventy five (Roland et al. 1990). Because of the small numbers of referrals occurring in a given year, researchers suggest using multiple years to gather enough data on referrals (Roland 1989 and Roland et al. 1990).

Finally Reynolds et al. (1991) indicates that referral of patients for specialty treatment is largely dependent on the providers personal expertise in a particular specialty. Providers with a particular interest in a specialty refer more often to that specialty. De Marco, Dain, Lockwood and Roland (1993) found that when providers were made aware of the differences in referral rates on an individual practitioner level, this information produced significant defensiveness as the variation implied differences in clinical care.

Purpose

The purpose of this study is to identify the existence of unnatural variation in quarters authorizations, estimate the variation’s magnitude and identify possible contributing factors. The first specific objective of the study is the comparison of quarters rates to active duty population among Air Force military treatment facilities (MTFs). This analysis will identify if the existence of variation exists. Next, MTF’s quarters rates were compared to hospital bed size, and beds per active duty population to identify variance attributed to nonhealth factors. Third, population demographic information will be tested against quarters rates for the MTFs. Finally, provider behavior will be measured using number of patient visits versus the provider’s medical specialty.

Method and Procedures

Data Source and Variables

Data for this study concentrated on active duty Air Force personnel. Three sets of data were gathered. One set for population analysis to attempt to identify variation factors for nonhealth factors and population demographic factors. Table 1 shows the descriptive statistics of the twelve Air Force MTFs in Air Education and Training Command (AETC) under study. The data were gathered at Biometrics office in the AETC Surgeon General's office, Randolph AFB TX. Data were taken directly off the Air Force Form 235, Report of Patients (ROP). Fiscal year 1996 and half of Fiscal Year 1997 data were recorded for each MTF in AETC. MTFs submitted this report on a monthly basis providing measures such as: average daily strength (number of active duty on base), patient visits, number of diagnostic exams completed, personnel excused from duty (quarters, inpatient admissions)and other information.

A second data set, used in conjunction with ROP data, includes the active duty population statistics for each of the twelve AETC Air Force bases. This data set includes demographic characteristics of age, sex, education level, marital status and race. Demographic data is collected and reported on an annual basis by the Air Force Personnel Center. Table 2 shows descriptive statistics of these population data.
This data can be found in the Interactive Demographic Analysis

System located at the web site: http://www.afpc.af.mil/sasdemog/default.html

A third data set was used to examine the provider’s role in variation analysis. Data for region six MTFs were taken from the Standard Ambulatory Data Record (SADR). Data were collected from calendar year 1997. Branch of service for the MTFs consisted of thirteen Air Force, four Army and one Navy. Bed size varied from 490 to clinic status facilities. Table 3 shows descriptive statistics of subject MTFs. Data collected includes the number of active duty ambulatory visits with disposition occurring in each medical specialty for each facility. Possible dispositions include: release without duty limits, release with duty limits, quarters, immediate referral, admitted, left against medical advice and expired (death).

Medical specialties under consideration include: general medical officers, family practice physicians, aeromedicine physicians, aeromedicine/family practice physicians, physician assistants, primary care nurse practitioners. Other providers to include dentists, optometrists and physician specialists, can place patients on quarters. However, the concentration of this study is on the primary care interactions that make up the majority of dispositions resulting in quarters.

Methods

A Chi-Square test using a poisson distribution as described by Cain and Diehr (1992) was used to test the overall hypothesis that there is a statistically significant variance in quarters rates among MTFs. Since quarters authorizations can occur for an individual patient more than once, a Multiple Admission Factor (MAF) will be used as an adjustment. The MAF methodolgy is taken from Diehr, Cain, Kreuter and Rosenkranz (1992).

A multiple regression model run with the quarters rate as the dependent variable and demographic data as independent variables will be used to examine the relationship between a MTF's quarters utilization rate and demographic factors (Rosenblatt and Moscovice, 1984, and Siu et al., 1990). Demographic factors chosen for study were based largely on research by McKee et al. (1998) on the lost duty time from Disease and Nonbattle Injuries occurring during Operation Joint Guard. They found the demographic factors of blacks and females, had significantly higher hospitalization risks. Therefore, demographic factors selected for this study includes the percentage of Air Force active duty in the categories: female, black, nonwhite, not married, enlisted, and have only high school education or equivalent.

Additional chi-square tests were run to determine which facilities and provider types have significantly higher quarters rates(Cain and Diehr 1992). Specifically, 2 by 2 tables were used, in which the first row is constructed from the facility or provider type under study using active duty visits with no quarters and active duty visits with quarters compared to all other providers or MTFs placed on the second line. The result from this test was then adjusted for multiple comparison using the Bonforonni adjustment. Finally, the nonhealth variation determination will be calculated based on bed status of the MTF and beds per active duty member population was calculated using a Person's *r* rank correlation statistic.

Validity and Reliability

The study of small area variation analysis is particularly well suited for the military healthcare system. Enhanced data accuracy is achieved by geographic control of patients, which is not normally found in civilian communities. Specifically, a difficulty in small area analysis seen in research of civilian healthcare is the ability to detail healthcare utilization and population in a meaningful manner. In small market studies, using hospital market communities (HMC), difficulty arises when multiple hospitals are closely located (McLaughlin, et al 1989). Patients have options in where to obtain care and dividing lines in study of the patient population using a particular hospital are unable to be clearly defined. McLaughlin, et al. (1989) further notes wide differences in population size of a HMC, a range of 10,391 to 839,415 people in their study, is a "disadvantage." Even in larger areas, such as counties, difficulty arises as patients often cross county lines for healthcare needs, particularly evident in rural areas of the country McLaughlin, et al. (1989).

In contrast the Air Force bases/MTFs have relatively homogenous population levels and patient demographics. Aston et al. (1999) discussed the benefits in studying federal sector healthcare delivery, noting that physicians are salaried and cannot increase their pay based upon financial incentives. The

Air Force MTFs are largely uniform throughout the country because of centralized budgeting, policies and procedures and administrative control. Enhanced validity of small area analysis is achieved through the study of variation in MTFs. The results from studies such as these help to narrow the focus on factors having the greatest causation of variation in healthcare delivery across the country.

Per Air Force directives each MTF audited data for accuracy monthly. Patient visit counts and quarters dispositions were compared to the patient's actual medical record to ensure the visit occurred and that the patient's disposition was correctly listed. Directives required each clinical department to be audited at five percent of the visits occurring in that clinic. If errors were found then the audit was increased to fifteen percent of visits analyzed against the entries in the medical record for a period of three months. Data were transcribed from the reports after the audits occurred and data corrections made. This audit practice ensures validity and reliability of data presented. The data gathered, although secondary in nature, was used specifically to count patient visits and lost duty time attributed to medical dispositions so it has direct applicability to this study.

The base personnel offices gather population demographic data, to provide base leadership a greater understanding of the cultural and educational diversity of the base populace. Data is taken directly from the member's personnel record and compiled. Since the data is taken directly, 100% of assigned personnel are accounted for. The only errors result from missing or inaccurate information in the personnel record. Missing information accounts for less than one percent of the sample and occurs mainly at the base where new recruits begin service in the Air Force. Inaccurate information is rare, as the personnel data system is reviewed annually by the service member for accuracy and corrections.

Finally, the data obtained from the SADR is pulled from the Ambulatory Data System(ADS)database. These data represents 225,000 patient encounters. Each of these encounters produced a corresponding disposition. The ADS was not fully implemented across the region in 1997. Therefore, the active duty visits gathered for this study are a representative sample of the total visits which occurred in region six in 1997. The particularly large sample size enhances the validity of the study.

Discussions on the validity of this data crossing services were held with medical personnel from each branch of service. After these discussions it was decided to omit the Navy data and the Army data from this study. A single Navy MTF would not necessarily be representative of the entire naval system. The Army information was omitted because of the varying use of specific provider types. Physician Extenders are often used on a stand-alone basis with field units. Additionally Troop Medical Clinics, widely used on Army posts, may skew the patient types or nature of visits occurring for physicians versus those of the physician extender staff. Therefore, this study will concentrate on Air Force MTFs and providers.

Ethical Considerations

No individual patient or provider data were gathered for this study. However, data were gathered in a manner specifically identifying the MTF. To ensure the results were not inappropriately used against the provider staff or MTF leadership, it was decided to leave identifying characteristics of particular MTFs off of the study.

Results

Test 1 - Variation in Quarters Rates

There is more than a threefold variation in population quarters rates from the twelve Air Force MTF's under study. From the highest quarters rate to the lowest there is a 27.51% difference in quarters per thousand active duty members. Figure 1 shows the annual quarters rate per thousand members per year(PTMPY)for each of the MTFs. The Chi Square test confirms the statistically significant variation of quarters dispositions at X^2(11,n=12)= 451.71, p =.0000. Appendix 1 details the chi square calculations. Four MTFs were shown to have statistically significant lower quarters rates and the remaining bases had higher rates when compared to the expected values. Table 4 shows the statistical results and the detailed calculations are provided at appendix 2.

Test 2 - Nonhealth Factors Explaining the Variation

Correlations of nonhealth factors with quarters rates, which may explain the variation were calculated next. Nonhealth factors of bed status (coded as Clinic - 0 and Hospital - 1), bed size (numerical), beds per thousand active duty Air Force, and number of outpatient visits per member per year were analyzed. The strongest nonhealth factor impacting the MTF quarters rate was bed status of the MTF. Indicating a supply side driver in use of hospital beds, available beds are used rather than sending patients to quarters. Beds per thousand active duty and facility bed size, although weaker in correlation but still statistically significant, also confirms that hospitalization is used over quarters for those facilities with inpatient capability. These findings are consistent with Wennberg's (1987) and Ashton et al.(1999)findings. Table 5 details the statistical results.

Test 3 Demographic Factors Affecting Variation

Correlation analysis was further accomplished on demographic categories listed in table 5. The only statistically significant factor in population demographics impacting quarters rates was the percentage of population who are black. A combined nonhealth and demographic factor linear regression model was then developed and explains 90% of the variance in population quarters rates. Table 6 presents the estimates of the regression equation.

Test 4 Provider Type Affects on Variation

The final analysis centered on the provider type as a potential source of variation in quarters rates. There is a statistically significant difference in the prescription of quarters by type of provider. The difference between nonphysicians quarters rates compared to physician quarters rates is as high as eight percent. Figure 3 shows the differences between provider type for each of the MTFs under study. Further analysis of individual provider types against all others resulted in all provider types except for physician assistants being significantly different when compared to all others. Detailed calculations are provided at appendix 3 and a summary of data is presented in table 7.

Discussion

Examples of widespread variation in procedures and interventions can be seen across all medical communities in the world. The military healthcare system is not exempt. Variation in the use of quarters dispositions is a part of a larger set of practice pattern variations which impacts the quality and efficiency of the health services the military provides its active duty personnel. The loss of personnel attributed to unnecessary quarters admission results in lost training opportunities, inefficiencies in operations and impede mission accomplishment.

This study shows the prevalence and magnitude of the variation and attributes at least a portion of that variation to nonhealth factors, patient demographics and practice pattern differences between physician and nonphysician providers. The control chart method detailed in the recommendations section of this study provides an “instrument panel” approach to monitoring and controlling practice pattern variation in the use of quarters authorizations.

The existence and magnitude of the nonhealth variation factors based on the bed status of the MTF, bed size and beds per thousand active duty members indicates that inappropriate admissions may be occurring at bedded facilities. Rather than prescribing quarters dispositions it appears that providers are admitting patients because the beds are available. Under the capitation budgeting methodology, inappropriate admissions are a costly inefficiency. This supplier-induced demand is consistent with the findings of Roos & Roos (1982), Wennberg & Gittleson (1982) & Wennberg (1987). Roos et al. (1988), indicated: "...that professional uncertainty has been solved by pragmatic adjustment of local decision rules to the point at which available inpatient beds are consumed."

Additionally, patient's race may play a part in quarters or hospitalization decisions. Specifically, as the black population percentage increases there is a corresponding decrease in quarters. Therefore, either these service members are admitted or returned to duty more often then their white counterparts. The data suggests that the black service members are admitted to the hospital more often, and this finding is consistent with the findings of McKee et al. (1998). Further research, such as that conducted by Siu et al. (1990), should focus on the impact of patient's race and gender compared to provider demographic factors to explain the factors affecting provider medical decisions.

In contrast to the hospitals, it appears that some clinic size MTFs may overuse quarters. Differences among clinic size facilities vary by 27.61 percent, from a high of 63.47 PTMPY to a low of 35.86 PTMPY. To identify common cause and special cause variations in quarters rates it is therefore recommended that each medical facility, regardless of service, monitor its quarters dispositions on control charts.

Analysis of the provider's role in the variation shows that all provider types have significantly different from expected quarters rates except for physician assistants. There was predictable under use of quarters by Flight Medicine Physicians most likely due to the nature of their patients. The difference in quarters rates between physician extenders and physicians requires further study. When the group's rates are compared as in figure 2 the widest variation, 7.9%, occurs at the MTF which has the greatest population quarters rate as seen in figure 1. Provider practice style appears to have significant impact on quarters dispositions. Further study is required at the individual provider level to aid in the further understanding of practice styles on variation in quarters prescriptions.

Impact

If MTFs with under utilization of quarters make just a 10% change from hospitalization to use of quarters an estimated 830 admissions could be saved. Likewise, if high use MTFs reduce overuse of quarters by 10% then a range of 913 - 2,740 lost duty days can be regained depending on how many days of quarters are prescribed. The greatest impact, however, is the early identification of negative health trends to enhance preventative medicine capabilities as described in the recommendations section.

Recommendations

Providers desire to improve their practice, they want to know how they are doing and they want to do things right. Without information on key indicators like quarters rates they rely on personal experience, training, and policies and procedures for guidance on admitting to quarters. Most facilities lack guidance on the latter three sources of clinical input. Most providers are unaware if their quarters rates are too low or too high. Improvement requires measurement and communication of what is measured. Providers don’t have the time to reflect on their practices and systematically collect the data needed for evaluation of practice pattern variations (Nelson, Splaine, Batalden and Plume 1998). The control chart presentation to the provider increases awareness and will most likely result in the self-monitoring of the use of quarters authorizations.

It is important to note that this instrument panel information does not have to be maintained on a name by name basis for each provider. In fact it is advised that the provider name be masked from the control chart information. The effectiveness of the tool is not lost when the data is shared with the provider staff in aggregate. Wennberg (1984) documents the change in practice styles by providing feedback to providers on utilization rates in their own and neighboring regions. Rather than measuring for accountability the emphasis should be placed on measuring for improvement. Reductions in unnecessary admissions to quarters or hospitalizations would improve the efficiencies of the MTF and the line units they support.

The proposed instrument has the added benefit of enhanced force protection. Medical unit commanders using this tool will have an epidemiological measure to evaluate the health of the military community supported. This measure will help to warn the medical staff of unusual spikes in degraded health status due to disease, environmental conditions, biological or chemical warfare, poor sanitation and occupational hazards. Public health personnel can then investigate and pinpoint the source of illness or injury to control or prevent future medical problems.

By filtering out the noise of the data, a control chart will be particularly useful to a deployed medical unit commander. Using the example of an increase in twelve quarters cases for the weekly totals of a deployed Wing, a commander using the control chart system would be able to identify if this increase is a potential signal for serious health hazards or just natural variation in illness. If the weekly total is outside of the control limits the commander can then direct investigations to identify potential systemic causes in the population characteristics, provider's behavior or health factors which may have caused the excessive variation.

Control charts have been advocated by Shewhart and Deming and used in industrial processes for years (Berwick 1991). More recently control charts have been used in the medical community beyond the "engineering or industrial" applications to include clinical and epidemiological applications (Benneyan,1998).

To initiate a control chart each MTF gathers data of the number of active duty members placed on quarters and the number of active duty personnel on base to establish the quarters rate. Ideally this would be accomplished on a weekly basis, especially if at a deployed location. To check to see if the process is in control then at least 16-25 data points are needed (Carey and Lloyd, 1995). These points can then be graphed into two line charts. The first chart graphs the points interconnected by lines and has a straight line representing the mean rate. The second chart takes the difference between the weekly values and then graphs them on a second chart displayed beneath the first. This second chart shows the moving range of the values and a straight line is placed on the chart showing the average moving range. According to Wheeler (1993) the Upper Control Limit for the range chart is calculated by multiplying the Average range times 3.27. Wheeler (1993) then shows that the natural process limits for the individual values are then calculated by using the following formulae:

$$\text{Upper control limit} = X + (2.66 \text{ X } R) \qquad (1)$$

$$\text{Lower control limit} = X - (2.66 \text{ X } R) \qquad (2)$$

The chart at figure 4 shows an actual example from one of the MTFs under study. In this sample you can see that data point seventeen is out of control limits for both the moving range and the actual value. In this example the medical facility Commander could then require the analysis of any unusual health hazards. This example uses monthly data which may be sufficient for stateside bases. But, if done on a weekly basis in a deployed location this information may be crucial for the early identification of any range of potential health threats from food contamination to biological weapons.

Conclusions

This paper shows that there is significant variation in the use of quarters among the twelve Air Force medical facilities in AETC. Variation sources are primarily nonhealth factors, demographic and provider type. Specifically, nonhealth factors are medical facility bed status, bed size and beds per thousand members. The lower quarters rates for hospital size MTFs suggests inappropriate hospital admissions versus quarters use. The demographic factor, of percentage of black population, has an inverse relationship to the use of quarters. Finally, five of six provider types have statistically different quarters rates from all others.

Ideally, this would just be part of a larger set of "instrument panels" which would communicate provider performance on a variety of quality and value measures. Professionals often defend variation for the autonomy it represents (Berwick 1991). However, the intent here is not to handcuff provider's practices but to communicate those variations, which are controllable and prevent quarters dispositions or hospital admissions that could be considered unnecessary.

In his book "Demanding Medical Excellence" Millenson (1997) asks, "...why the (medical) profession as a whole tolerates such widespread variation from achievable excellence?" My answer to his question is: "primarily because of lack of awareness of the issue and that many high variation activities are unknown to providers." This paper shows that quarters dispositions are a high variation patient disposition. This disposition has the effect of removing soldiers, sailors, marines and airmen from their primary responsibility thereby negatively impacting force readiness. Particularly crucial is the service person's absence from duty in deployed location or during critical readiness training where the mission could be hampered through absence or lack of training. The control chart method combined with sharing the medical facilities quarters information with provider staff will serve to give knowledge to the providers of practice variations and the potential impacts on readiness. Finally, force protection is enhanced through a simple epidemiological measure that can be used in a deployed location.

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Tables

Table 1

Descriptive Statistics of AETC Air Force Military Treatment Facilities (N=12)

Facility Characteristics		Median	Minimum	Maximum
1. Bed Status (N=12)				
Clinics	7			
Hospitals	5			
2. Hospitals (N=5)				
Bed Size		60	25	490
Beds/1000 Active Duty		16.41	5.02	44.54
3. Visits Per Member per Year		9.81	7.91	26.26

Note: Source is fiscal year 1996 and 1997 Automated Air Force Form 235 (ROPMS Feb 96) from Air Education and Training Command Biometrics office, Randolph AFB TX.

Table 2

Sociodemographic Profile (N=64,045)

Characteristics		n	%
SEX	Men	47,501	76.83%
	Women	15,831	25.60%
		63,332	
AGE	17-19	11,873	18.75%
	20-24	15,630	24.68%
	25-29	10,671	16.85%
	30-34	10,693	16.88%
	35-39	8,675	13.70%
	40-44	4,205	6.64%
	45-49	1,269	2.00%
	50+	316	0.50%
		63,332	
MARITAL STATUS	SINGLE	24,718	38.59%
	MARRIED	35,683	55.72%
	DIVORCED/ANNULLED	3,644	5.69%
		64,045	
EDUCATION LEVEL	HS DIPL/CERT/GED	17,317	28.81%
	1-3 yrs college	20,755	34.53%
	Assc Degree	6,173	10.27%
	3-4 yrs college	904	1.50%
	BA/BS	8,472	14.09%
	MA/MS	4,468	7.43%
	PhD	109	0.18%
	Professional Dgr	1,891	3.15%
	Unknown	26	0.04%
		60,115	
RACE	Amer Ind/Alaskan	300	0.50%
	Asian/Pac Isle	1,208	2.01%
	Black (non-hisp)	8,610	14.32%
	Hispanic	3,100	5.16%
	White (non-hisp)	46,033	76.57%
	Other/Unk	864	1.44%
		60,115	
RANK	Officer	12,333	19.47%
	Enlisted	50,999	80.53%
		63,332	

Note: Source - FY 1997 Interactive Demographic Analysis System (Http://www.afpc.af.mil/sasdemog/default.html). Missing data accounts for 6% of data for some measures.

Table 3

Descriptive Statistics of Region Six Military Treatment Facilities

Factor	Measure		
Bed Status	6 Clinics		
	12 Hospitals		
Branch of Service	1 Navy		
	4 Army		
	13 Air Force		
Hospital Utilization Data (excludes clinics)			
	Median	Minimum	Maximum
Bed Size	38.5	12.0	490.0
Avg Length of Stay	2.4	1.4	4.9
Avg Daily Census	34.3	2.3	310.7

Note: N=18 for factors of bed status and branch of service. N=12 for hospital data. From 1997 Region Six Regional Health Services Plan.

Table 4

Results of 2 by 2 Chi-Square Analysis to Determine MTFs with Higher Than Expected Quarters Rates

Facility	X^2	P-Value	Over or Under Utilization
a	116.45	.0000	Under
b	17.36	.0000	Under
c	10.14	.0014*	Under
d	75.89	.0000	Under
e	278.66	.0000	Over
f	415.45	.0000	Over
g	808.72	.0000	Over
h	2,911.27	.0000	Over
i	721.07	.0000	Over
j	1,203.79	.0000	Over
k	519.54	.0000	Over
l	1,732.87	.0000	Over

Note: $p < .01$, adjusted for multiple comparisons to $p < .0008$
*$p < .05$, adjusted for multiple comparisons to $p < .0041$

Table 5

Correlations

Variable	Correlation (Pearson *r*)
Non Health Factors	
Bed Status (coded 0-Clinic 1 - Hospital	-.753*
Bed size (number of Beds)	-.618**
Beds per 1,000 Active Duty	-.690**
Visits Per Member Per Year	-.188
Population Factors	
% Population Not Married	-.298
% Population Enlisted	-.558
% Population Nonwhite	-.500
% Population Black	-.703**
% Population Education Level Only High School/GED	-.543

Note: N= 12, *p < .01, **p < .05, others not significant

Table 6

Regression Model

Variable	Standardized *B*	*p* Level
Non Health Factors		
Bed Status (coded 1 or 0)	-.422	.112
Population Factors		
% Population Not Married	.808	.042
% Population Enlisted	.229	.371
% Population Black	-.412	.047
% Population Education Level HS/GED only	-1.217	.015

Note: R = .949, R^2 = .900, *p < .01

Table 7

Results of 2 by 2 Chi-Square Analysis to Determine Provider Types with Higher Than Expected Quarters Rates

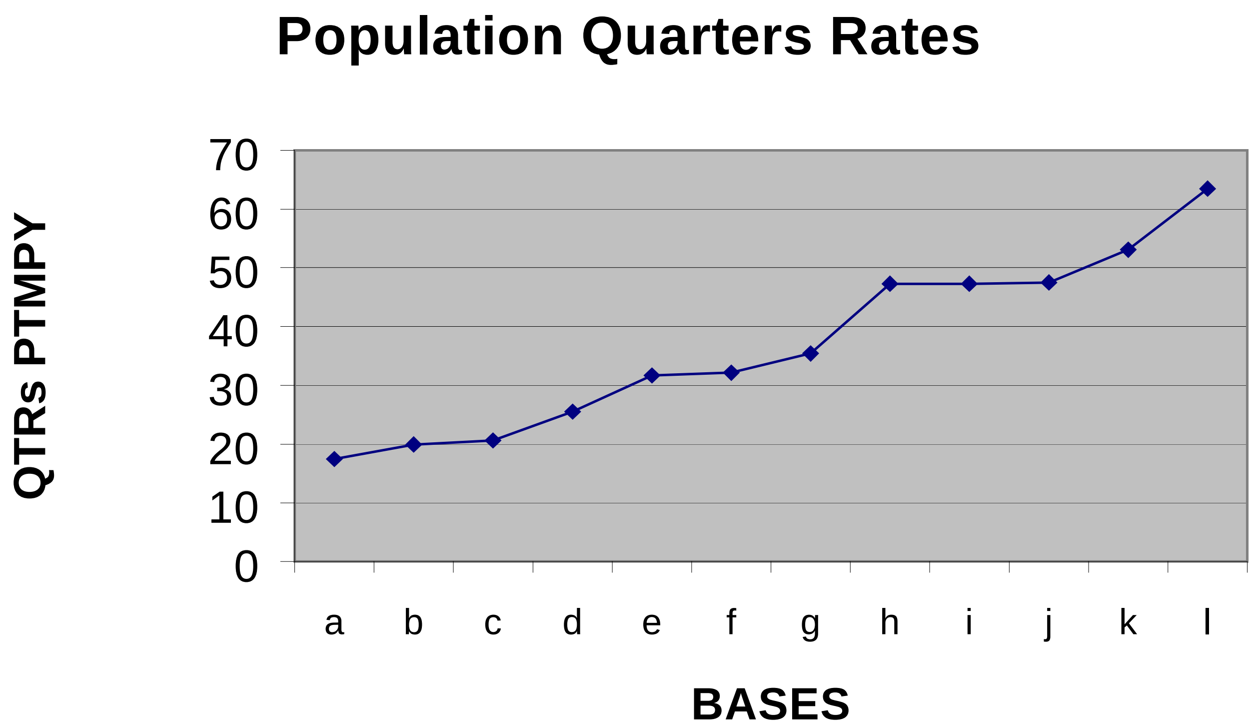
Provider Type	X^2	P-Value	Over or Under Utilization
GMO Physician	309.89	.0000	Over
Family Practice	682.06	.0000	Over
Aeromed Physician	1,407.17	.0000	Under
Aeromed/Family Physician	350.64	.0000	Under
Family Nurse Practitioner	15347.36	.0000	Under
Physician Assistant	.32	.5688*	Over

Note: $p < .001$, adjusted for multiple comparisons to $p < .0002$
*not statistically significant

Figures

Figure 1

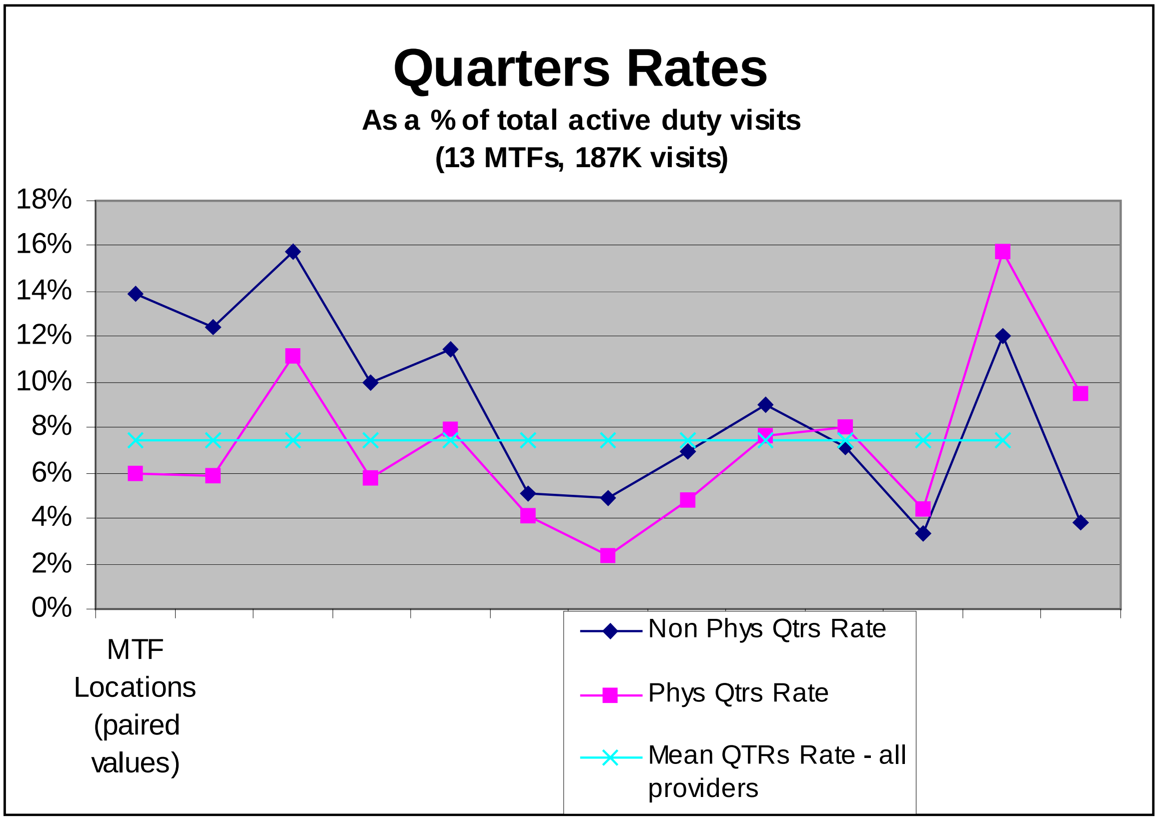
Annual Quarters Rate per Thousand Active Duty Members per Year (PTMPY) for Each AETC Air Force Medical Treatment Facility



Note: N=12 MTFs on 12 Bases

Figure 2

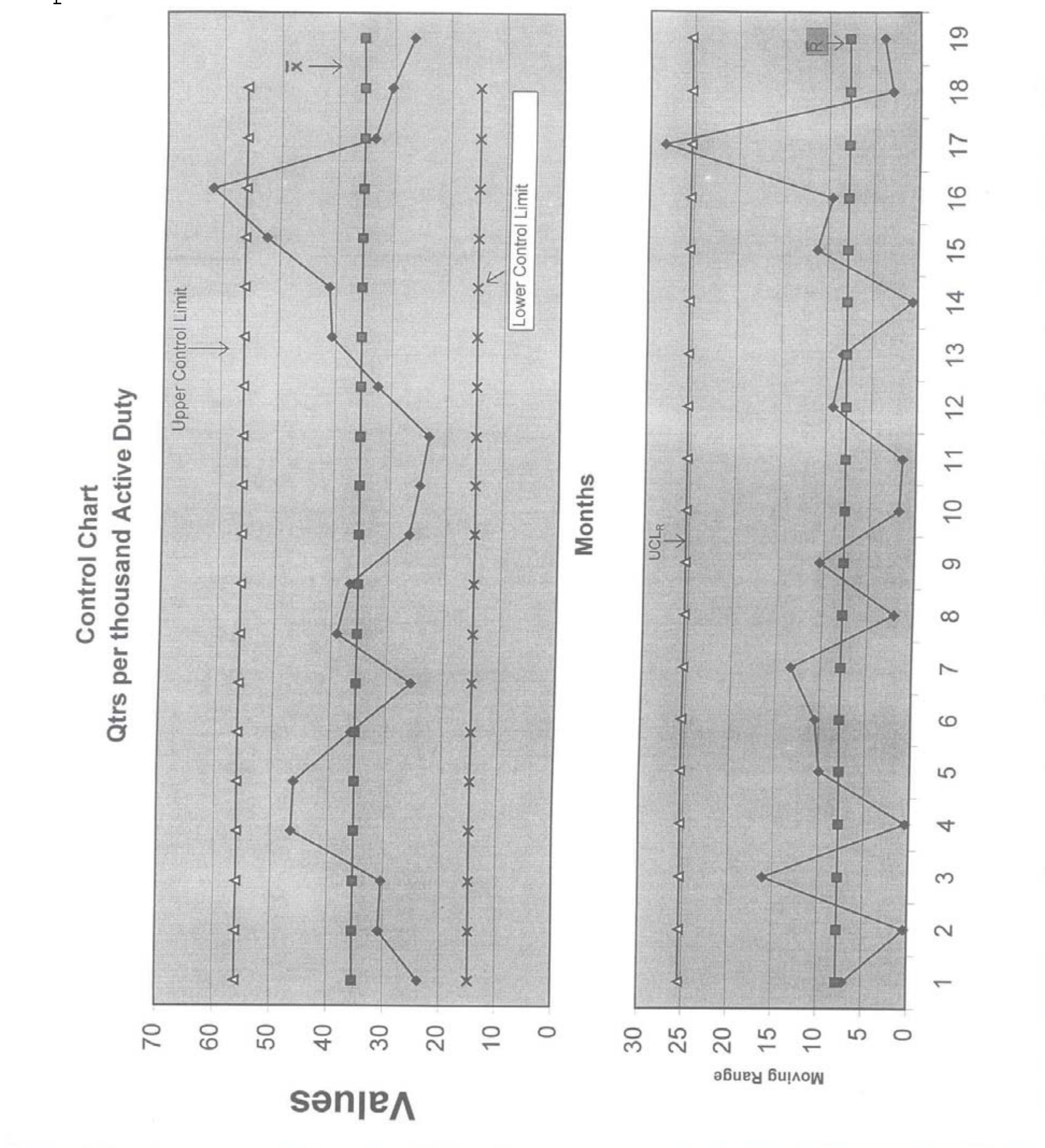
Differences Between Physician's and Physician Extender Quarters Rates for Air Force MTF's in Region Six



Note: N=13 MTFs, High % = 16%, Low % = 2.3%, High difference 7.96%, Low difference -5.63%

Figure 3

Sample Statistical Control Chart



Appendices

Appendix A

Calculation of Chi-Square Test

The methods used in this appendix follow those procedures listed in Cain and Diehr (1992) article "Testing the Null Hypothesis in Small Area Analysis," and the follow-up article by Diehr et al. (1992) "Can Small Area Analysis Detect Variation in Surgery Rates?"

CALCULATION OF X^2_B

Y_j= 20730 AVG or m^ = 0.35450946

N_j= 58475.16667

j	Base Pop n_j	Qtrs Y_j	N_jm^	Bernoulli distribution $(Yj-Njm^\wedge)^2$ / $N_j m^\wedge(1-m^\wedge)$	Poisson distribution $(Yj-Njm^\wedge)^2$ / $N_j m^\wedge$
a	7231	1508	2563.43	673.20	434.55
b	6211	1487	2201.86	359.55	232.09
c	11001	2743	3899.96	531.72	343.22
d	8485	2554	3007.95	106.14	68.51
e	3655	1390	1295.88	10.59	6.84
f	4982	1916	1766.05	19.72	12.73
g	5388	2296	1910.10	120.78	77.97
h	5586	3171	1980.29	1109.16	715.95
i	1475	835	522.78	288.87	186.46
j	2471	1393	876.05	472.58	305.04
k	698	446	247.27	247.44	159.72
l	1293	991	458.38	958.78	618.88
TOTAL	58475	20730	20730	4898.53	3161.96

MAF =	7	DF = 11		adj X^2	451.71	P value w/MAF adjustment 6.24E-90

Definition of variables: j = Base, N_j = 12 month average Air Force active duty population serviced by the medical facility, Y_j = Total quarters for the fiscal year, MAF = Multiple Admission Factor, DF = 12–1.

Selection of distribution: If no multiple admission are possible then Bernoulli distribution otherwise Poisson distribution applies.

Selection of MAF: Since no data was found in research regarding the data distribution for multiple admissions to quarters and there was insufficent time for an empirical study the factor of seven was selected based on Diehr et al. (1992) page 502. “If no information is available to the investigator about multiple admissions, it is probably conservative to use the value of 7 as the multiple admission factor.”

Appendix B

The methods used in this appendix follow those procedures listed in Cain and Diehr (1992) article "Testing the Null Hypothesis in Small Area Analysis." This method, described on page 282, identifies those facilities with quarters rates which are significantly different than the other MTFs. The Bonferroni adjustment is used for the multiple comparisons used in this method.

Differences between MTFs (with Bonferroni adjustment)

Quarters / MTF	Qtr's	population	Total		
a	1508	5723	7231	1892.51	5338.40
All Others	19222	52752	71974	18837.49	53136.76
Total	20730	58475	79205		

DF = 1

Chi Sq Calc
116.451

critical value = .05/12 or 0.004166667
@ .01 /12 0.000833333
If Calc Value>Critical value Reject null

Chi Sq P-Value
3.78578E-27

Differences between MTFs (with Bonferroni adjustment)

Quarters / MTF	Qtr's	population	Total		
b	1487	4724	6211	1625.58	4585.42
All Others	19243	53751	72994	19104.42	53889.74
Total	20730	58475	79205		

DF = 1

Chi Sq Calc
17.363

critical value = .05/12 or 0.004166667
@ .01 /12 0.000833333
If Calc Value>Critical value Reject null

Chi Sq P-Value
3.08829E-05

Differences between MTFs (with Bonferroni adjustment)

MTF \ Quarters	Qtr's	population	Total			
c	2743	8258	11001		2879.24	8121.76
All Others	17987	50217	68204		17850.76	50353.41
Total	20730	58475	79205	DF = 1		

Chi Sq Calc
10.141

critical value = .05/12 or 0.004166667
@ .01 /12 0.000833333
If Calc Value>Critical value Reject null

Chi Sq P-Value
0.001450463

Differences between MTFs (with Bonferroni adjustment)

MTF \ Quarters	Qtr's	population	Total			
d	2554	5931	8485		2220.70	6264.14
All Others	18176	52544	70720		18509.30	52211.03
Total	20730	58475	79205	DF = 1		

Chi Sq Calc
75.890

critical value = .05/12 or 0.004166667
@ .01 /12 0.000833333
If Calc Value>Critical value Reject null

Chi Sq P-Value
2.99949E-18

Differences between MTFs (with Bonferroni adjustment)

MTF \ Quarters	Qtr's	population	Total			
e	1390	2265	3655		956.72	2698.70
All Others	19340	56210	75550		19773.28	55776.47
Total	20730	58475	79205	DF = 1		

Chi Sq Calc
278.655

critical value = .05/12 or 0.004166667
@ .01 /12 0.000833333
If Calc Value>Critical value Reject null

Chi Sq P-Value
1.47473E-62

Differences between MTFs

(with Bonferroni adjustment)

MTF \ Quarters	Qtr's	population	Total		
f	1916	3066	4982	1303.83	3677.84
All Others	18814	55410	74224	19426.17	54797.33
Total	20730	58475	79205		

DF = 1

Chi Sq Calc
415.451

critical value = .05/12 or 0.004166667
@ .01 /12 0.000833333
If Calc Value>Critical value Reject null

Chi Sq P-Value
2.38546E-92

Differences between MTFs

(with Bonferroni adjustment)

MTF \ Quarters	Qtr's	population	Total		
g	2296	3092	5388	1410.18	3977.82
All Others	18434	55383	73817	19319.82	54497.34
Total	20730	58475	79205		

DF = 1

Chi Sq Calc
808.722

critical value = .05/12 or 0.004166667
@ .01 /12 0.000833333
If Calc Value>Critical value Reject null

Chi Sq P-Value
6.8494E-178

Differences between MTFs

(with Bonferroni adjustment)

MTF \ Quarters	Qtr's	population	Total		
h	3171	2415	5586	1462.00	4124.00
All Others	17559	56060	73619	19268.00	54351.16
Total	20730	58475	79205		

DF = 1

Chi Sq Calc
2911.275

critical value = .05/12 or 0.004166667
@ .01 /12 0.000833333
If Calc Value>Critical value Reject null

Chi Sq P-Value
0.00000000000

Differences between MTFs (with Bonferroni adjustment)

Quarters / MTF	Qtr's	population	Total
i	835	640	1475
All Others	19895	57836	77731
Total	20730	58475	79205

385.96	1088.71
20344.04	57386.46

DF = 1

Chi Sq Calc
721.073

critical value = .05/12 or 0.004166667
@ .01 /12 0.000833333
If Calc Value>Critical value Reject null

Chi Sq P-Value
7.8236E-159

Differences between MTFs (with Bonferroni adjustment)

Quarters / MTF	Qtr's	population	Total
j	1393	1078	2471
All Others	19337	57397	76734
Total	20730	58475	79205

646.77	1824.40
20083.23	56650.77

DF = 1

Chi Sq Calc
1203.785

critical value = .05/12 or 0.004166667
@ .01 /12 0.000833333
If Calc Value>Critical value Reject null

Chi Sq P-Value
9.1784E-264

Differences between MTFs (with Bonferroni adjustment)

Quarters / MTF	Qtr's	population	Total
k	446	252	698
All Others	20284	58224	78508
Total	20730	58475	79205

182.55	514.95
20547.45	57960.22

DF = 1

Chi Sq Calc
519.540

critical value = .05/12 or 0.004166667
@ .01 /12 0.000833333
If Calc Value>Critical value Reject null

Chi Sq P-Value
5.33E-115

Differences between MTFs (with Bonferroni adjustment)

Quarters / MTF	Qtr's	population	Total		
i	835	640	1475	385.96	1088.71
All Others	19895	57836	77731	20344.04	57386.46
Total	20730	58475	79205		

DF = 1

Chi Sq Calc
721.073

critical value = .05/12 or 0.004166667
@ .01 /12 0.000833333
If Calc Value>Critical value Reject null

Chi Sq P-Value
7.8236E-159

Differences between MTFs (with Bonferroni adjustment)

Quarters / MTF	Qtr's	population	Total		
j	1393	1078	2471	646.77	1824.40
All Others	19337	57397	76734	20083.23	56650.77
Total	20730	58475	79205		

DF = 1

Chi Sq Calc
1203.785

critical value = .05/12 or 0.004166667
@ .01 /12 0.000833333
If Calc Value>Critical value Reject null

Chi Sq P-Value
9.1784E-264

Differences between MTFs (with Bonferroni adjustment)

Quarters / MTF	Qtr's	population	Total		
k	446	252	698	182.55	514.95
All Others	20284	58224	78508	20547.45	57960.22
Total	20730	58475	79205		

DF = 1

Chi Sq Calc
519.540

critical value = .05/12 or 0.004166667
@ .01 /12 0.000833333
If Calc Value>Critical value Reject null

Chi Sq P-Value
5.33E-115

Differences between MTFs (with Bonferroni adjustment)

MTF \ Quarters	Qtr's	population	Total			
I	991	302	1293		338.41	954.59
All Others	19739	58173	77912		20391.59	57520.58
Total	20730	58475	79205	DF = 1		

Chi Sq Calc
1732.869

critical value = .05/12 or 0.004166667
@ .01 /12 0.000833333
If Calc Value>Critical value Reject null

Chi Sq P-Value
0.0000000000

Appendix C

The methods used in this appendix follow those procedures listed in appendices A and B. The only difference is that rather than population based data the tables contain total patient visits and compares them to the disposition of the patient to quarters yes or no. Again the comparison method was used to identify those provider types with quarters rates which are significantly different than the other providers. The Bonferroni adjustment is used for multiple comparisons.

CALCULATION OF X^2_B

Y_j= 13198

N_j= 186515

j	N_j	Y_j	$N_j m^\wedge$	Bernoulli distribution $\frac{(Y_j-N_j m^\wedge)^2}{N_j m^\wedge(1-m^\wedge)}$	Poisson distribution $\frac{(Y_j-N_j m^\wedge)^2}{N_j m^\wedge}$
GMO Physician	14706	1566	1040.612	285.458919	265.2595
Family Practice	75038	6728	5309.769	407.653405	378.8074
Aeromed Phys	28052	500	1984.989	1195.53175	1110.935
Aeromed/Fam Pract	10963	288	775.7536	330.027183	306.6741
Nurse Practitioner	1256	89	88.8759	0.00018649	0.000173
Physician Assistant	56500	4027	3998	0.2263711	0.210353
TOTAL	186515	13198	13198	2218.89781	2061.886

DF= 5
MAF = 7
Adj X^2= 294.55518
P-value= 1.483E-61

Differences between provider types (with Bonferroni adjustment)

Provider Type \ Quarters	Yes	No	Total		
GMO Physician	1566	13140	14706	1040.61	13665.39
All Others	11632	160177	171809	12157.39	159651.61
Total	13198	173317	186515		

DF = 1

Chi Sq Calc
309.89

critical value = .001/6 or 0.0001667

If Calc Value>Critical value Reject null

Chi Sq P-Value
0.00000000000000

Provider Type \ Quarters	Yes	No	Total
Fam Pract	6728	68310	75038
All Others	6470	105007	111477
Total	13198	173317	186515

5309.77	69728.23
7888.23	103588.77

DF = 1

Chi Sq Calc
682.06

critical value = .001/6 or 0.0001667

If Calc Value>Critical value Reject null

Chi Sq P-Value
0.00000000000000

Provider Type \ Quarters	Yes	No	Total
Aero Med Phys	500	27552	28052
All Others	12698	145765	158463
Total	13198	173317	186515

1984.99	26067.01
11213.01	147249.99

DF = 1

Chi Sq Calc
1407.17

critical value = .001/6 or 0.0001667

If Calc Value>Critical value Reject null

Chi Sq P-Value
0.00000000000000

Provider Type \ Quarters	Yes	No	Total
Aero Med/FP Phys	288	10675	10963
All Others	12910	162642	175552
Total	13198	173317	186515

775.75	10187.25
12422.25	163129.75

DF = 1

Chi Sq Calc
350.64

critical value = .001/6 or 0.0001667

If Calc Value>Critical value Reject null

Chi Sq P-Value
0.00000000000000

Provider Type \ Quarters	Yes	No	Total
Physician Assistant	4027	52473	56500
All Others	9171	120844	130015
Total	13198	173317	186515

3998.00	52502.00
9200.00	120815.00

DF = 1

Chi Sq Calc
0.32

critical value = .001/6 or 0.0001667

If Calc Value>Critical value Reject null

Chi Sq P-Value
0.56877046316595

Quarters / Provider Type	Yes	No	Total
Nurse Practioner	1256	89	1345
All Others	11942	173228	185170
Total	13198	173317	186515

DF = 1

95.17	1249.83
13102.83	172067.17

Chi Sq Calc
15347.36

critical value = .001/6 or 0.0001667

If Calc Value>Critical value Reject null

Chi Sq P-Value
0.00000000000000