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The Role of Proximity in the Use of Hospital Emergency Departments

Abstract In Stockholm, greatly increased utilization of hospital emergency departments has caused considerable strain on the emergency services. A similar trend has been reported from cities in other countries. Using record-linkage we studied in a defined population the relationship between visiting rates in the hospital emergency department and a) travelling distance and b) utilization of outpatient clinics and inpatient care. The results indicate that visiting rates are strongly correlated with travelling distance from the hospital and utilization of inpatient and outpatient hospital care. The results have implications for planning and location of resources.

Introduction

According to studies from USA,[1,2,3] Canada,[4,5] England,[6,7] New Zealand[8] and Sweden[9] visiting rates for hospital emergency departments have increased rapidly in recent years causing considerable strain on the emergency services. Utilization has been reported to be strongly correlated with the geographical distance from the hospital,[10,11] It seems reasonable to believe that higher visiting rates will also result in increased a) admission rates, b) out-patient visiting rates and c) technical investigations. If this is true proximity in itself has a major influence on how we allocate our most expensive resources in medical care, the hospitals. Contributing reasons for increased emergency visits are also national and local. Despite the fact that organization of medical care is different between the countries mentioned, many of the proposed explanations are similar.[1,6,10,11] These explanations can be grouped in three main categories: organizational, attitudinal and medico-legal.

Organizational factors: Since many private and family physicians now work regular hours they are less often available at evenings and weekends. During normal working hours they may even be unaccessible because of a combination of appointment systems and secretarial

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protection. Home calls by general practitioners have become less frequent, mainly because they are considered an irrational use of scarce resources. The unavailability may be actual or just perceived by the patient, but both may result in the same type of help-seeking behaviour. The accessibility of hospital emergency departments may be higher due to better location and transportation facilities, compared to health centers and offices of private physicians. Shortage of private and family physicians in combination with increased mobility of the population also puts more strain on the hospital facilities.

Changed attitudes: Patients' attitudes are to a large extent based on experience from previous contacts with health services. They have learned that injuries due to accidents require hospital care and that serious diseases need diagnostic and treatment facilities that are only available there. They may anticipate referral by their general practitioner and find it appropriate to refer themselves directly to the emergency department.[6] Prevailing attitudes in society with increased demands for expert attention and instant care are contributing factors.

Physicians' attitudes, although most important for the availability of care, have been far less studied than patients' attitudes. Holohan et al[6] found that general practitioners in Newcastle upon Tyne believed that the main reason for increased utilization of emergency departments by patients could be ascribed to the attitudes of patients, but accepted that organizational changes in general practice must play a part.[6] Vaughan et al concluded that the physician 'is the key figure in the emergency department utilization', referring to the fact that many patients were found to have gone to the emergency departments because they either could not get hold of their own physician or if they did were instructed to visit the emergency department.[12]

Undoubtedly most general practitioners consider the emergency department an appropriate back-up service when they themselves are unavailable. They may also use it for diagnostic purposes (when they need technical investigations and for consultations) and may feel that patients who have had previous association with the hospital for a certain disease or injury should continue to go there for that ailment.

Medico-legal reasons: The emergency departments are in a difficult position to refuse to see a patient. The risk of missing a serious disease in a patient with an apparently every-day complaint with resultant medico-legal consequences is of concern to doctors in all health care systems.

The Present Role of the Hospital Emergency Department

Torrens and Yedvab[13] suggested that the hospital emergency department serves as:

- centre for treatment of trauma and true emergencies
- back-up services for off duty physicians
- substitute when there is no family physician

While there is a consensus opinion on the role of the hospital emergency department as a centre for trauma and emergencies, its role in the absence of the family physician is more open for discussion. The medical care received in emergency departments is episodic and provided in an impersonal and hectic environment with little or no co-ordination with community and social resources.[2] As most patients are self-referred there is usually no feedback to the primary care physician or the neighbourhood health centre as to reasons for contact, diagnosis and treatment. This tends to isolate emergency departments from the rest of the health care system. Brook and Stevenson[14] concluded that it is probably inefficient to use the emergency departments as the primary care doctor.

Those who live in close proximity to the emergency department use it more frequently as a substitute for family physicians.[11] This raises two important questions: Is the emergency department a patient magnet? If so, what are the immediate and longterm implications for health care planning?

Background to the Study

Visiting rates to the hospital emergency departments in Stockholm increased by 30 per cent between 1973 and 1977. In the South-West District (265,000 inhabitants), one of five Health Care districts within Stockholm County, visiting rates to hospital emergency departments have been particularly high. A new University hospital opened in 1972 in this district with an emergency department planned to receive up to 60,000 visits a year. Only three years later the emergency department was receiving 100,000 visits a year.

In 1976 a survey was started to examine the utilization of the emergency department. It was based on the geographically defined catchment area population for internal medicine and surgery. The study population had access only to this one emergency department.

Accessibility has been defined as 'the time required to receive attention or reach a source of care'.[16] The two most important factors in order to quantify accessibility are distance and distribution of means of transportation. In the present study travelling distance in minutes by the public transportation system was used as a measure of proximity.

Data was collected on the utilization of the emergency department during a period of 15 months. Sociodemographic information and

hospital care utilization data were obtained through linkage to the Stockholm County's Medical Information System.[15] The present paper covers the relationship between distance and utilization of hospital facilities with main emphasis on the utilization of the hospital emergency department.

Objectives

The objectives were to study in a defined population the relationship between 1) travelling distance and visiting rates to the hospital emergency department 2) visiting rates to the hospital emergency department and utilization of outpatient clinics and inpatient care.

Our hypotheses were: 1) Visiting rates to hospital emergency departments decrease with the distance from the hospital. 2) There is a positive correlation between visiting rates to the emergency department and the utilization of hospital outpatient clinics and inpatient care.

Material and Methods

Sampling: The material is based on a sample of visits to the Huddinge Hospital Emergency Department (ED) between January 1976–March 1977. Each visit is registered in a logbook in which date, name and birth number (date of birth plus four digits) are listed. The sample was defined as those born on the 5th, 15th or 25th day of the month. In 6.4 per cent of the sampled visits the birth number was incomplete. The great majority of these were later completed using the surname and christian name initials, leaving only 1.5 per cent of the sampled visits with incomplete birth numbers. These 190 visits were excluded from the study, which finally comprised 9,632 visits. Of our sample population (17,004 persons) 4,927 (29 per cent) accounted for these 9,632 visits while 12,077 were non-users.

Linkage: Since 1965 the Stockholm County Health Board has operated a computerized Medical Information System. The core of this system is the *Main File*. It contains:

Census information
Inpatient care utilization
Outpatient care utilization
Critical medical data
X-ray examinations

Utilization of hospital emergency departments is *not* registered in the Medical Information System. The census information consists of the following items:

birth number
name
address
zip code and post office
occupation
nationality
civil status
date of latest change of civil status
minor (under 18 years of age)
birth number of husband/wife/parents
codes of district, parish

The census information is permanently linked to the Medical Information System and regularly updated by means of magnetic tapes from the Central Population Register.

After obtaining written permission from the Swedish Data Inspection Board (State institution by law responsible for surveillance and monitoring of data usage when any kind of personal identification is used) our file containing the sampled visits was run together with the Main File. Thus we identified a 10% sample of persons living within the catchment area, including non-users, and could relate their Medical Information System data to their emergency department attendances.

Area comparisons: The linkage made it possible to compare hospital utilization rates for different areas within the catchment area of the hospital. The catchment area had 166,000 inhabitants in 1976. Our 10% sample contained 17,004 persons. The municipal area division was used to divide the entire catchment area into 20 subareas. Whenever aggregation was considered necessary, the two subareas that were geographically closest to one another were aggregated. The area comparison is based on 14,227 people or 84 per cent of the original sample from the catchment area. 15 per cent had moved and for technical reasons could not be included. The remaining one per cent were living scattered and could neither be included in one subarea nor aggregated to other subareas.

The dependent variable for comparing utilization of the hospital emergency department was the number of visits per 100 population in each subarea (visiting rate).

The independent variables were:

1/ travelling distance in minutes
2/ proportion of immigrants (nationality other than Swedish)
3/ mean age in each area

Tables of the travelling distance in minutes from each subarea to the hospital emergency department were supplied by the Stockholm County Council Regional Planning Office. The travelling distances

were computed by the Planning Office using timetables for the daytime public transportation system.

To test the existence of an association between emergency visiting rates within a subarea and utilization of a) outpatient clinics and b) inpatient care we used the number of outpatient visits per 100 population and number of hospital admissions per 100 population.

In 1976 there were 7 health centres within the entire catchment area with a total of 17 primary care physicians. In addition 6 private physicians had offices in the area of which 5 were in the same subarea. By excluding this latter area and combining two subareas where the catchment areas of the health centres overlapped we obtained five health centre areas. Our hypothesis that availability of primary care physicians decreases utilization of the hospital emergency department was tested by comparing the number of primary care physicians per 100 population in each health centre area with the visiting rates to the hospital emergency department.

The association between dependent and independent variables was tested by correlation and regression analysis.[17]

Results

Emergency visits and distance: The emergency visiting rates, travelling distances, immigrant proportions and mean ages for the twenty areas including averages and standard deviations are shown in table 1. There is a significant negative correlation between visiting rates and travelling distance (table 2) indicating that the visiting rate decreases when travelling distance increases. There is a significant positive correlation between proportion of immigrants and emergency visiting rates. Subareas with a large proportion of immigrants also have a lower mean age.

The number of visits per 100 population is plotted against travelling distance for each of the 20 areas in figure 1.

The relation between the variables could be satisfactorily described by a straight line having a negative slope, but such a model does not turn out to be very useful if it is to be used as a basis for forecasting or extrapolating the ED visiting rate. Any line with a negative slope intersects the horizontal axis, implying that the ED visiting rate in areas at a sufficiently large distance from the hospital will become negative. Since there is reason to believe, that an area has a minimum demand, albeit unknown, and since we have already established that utilization is inversely proportional to the distance, it seems better to choose as our model the function:

$$Y = A + \frac{B}{X}$$

Table 1 For all subareas: 1) sample size 2) emergency department visiting rates 3) mean age 4) immigrant proportion 5) travelling distance to the emergency department

Subarea	Sample size (inhabitants)	Visiting rate (per 100 inhab.)	Mean age (years)	Immigrant proportion (%)	Travelling distance (minutes)
A	405	116	31	33	5
B	309	107	29	20	13
C	720	76	28	24	41
D	741	70	25	32	30
E	535	66	25	40	25
F	525	65	23	29	51
G	747	61	30	17	35
H	909	58	26	23	42
I	845	56	32	22	44
J	669	53	35	10	46
K	382	52	30	23	46
L	722	51	35	19	48
M	541	51	36	14	51
N	405	51	30	25	53
O	1013	50	36	8	24
P	899	48	33	13	50
R	1943	45	35	7	48
S	1204	44	30	15	72
T	299	43	26	2	38
U	414	39	28	9	70
Mean		60.1	30.2	19.3	41.6
Standard deviation		19.5	3.8	9.6	16.1

Table 2 Correlation coefficients between the variables: emergency department visiting rates, mean age, immigrant proportion and travelling distance

	Mean age	Immigrant proportion	Travelling distance	Visiting rate
Mean age				
Immigrant proportion	−0.5116*			
Travelling distance	0.0732	−0.3928		
Visiting rate	−0.2206	0.5754**	−0.7889***	

* $p<0.05$
** $p<0.01$
*** $p<0.001$

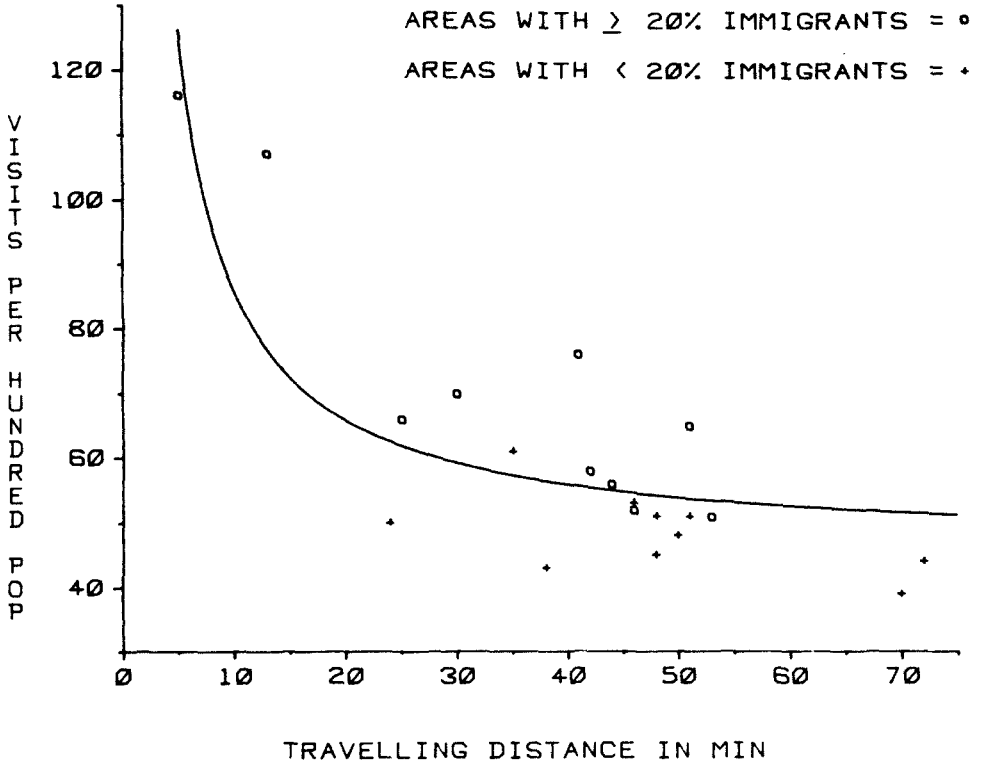

Figure 1 Emergency department visiting rates for each subarea plotted against travelling distance to the emergency department with the function:

$$Y = A + \frac{B}{X}$$ fitted to the data.

Subareas with high and low immigrant proportion are marked differently.

where X is the travelling distance (measured as minutes), Y is the number of visits per 100 population and A and B are parameters defining the relationship. If we fit the above function by linear regression[17] of Y on 1/X, we obtain the curve in Figure 1.

The model accounts for 68% of the original variation in visiting rates. The fit is reasonably good but there is a disturbing scattering about the centre of the curve. The scattering seems random enough, however in another study[18] we found that immigrants use the hospital emergency department significantly more often than Swedes. Therefore we dichotomized our 20 areas into: those with an immigrant proportion which is less than 20% and those with an immigrant proportion which

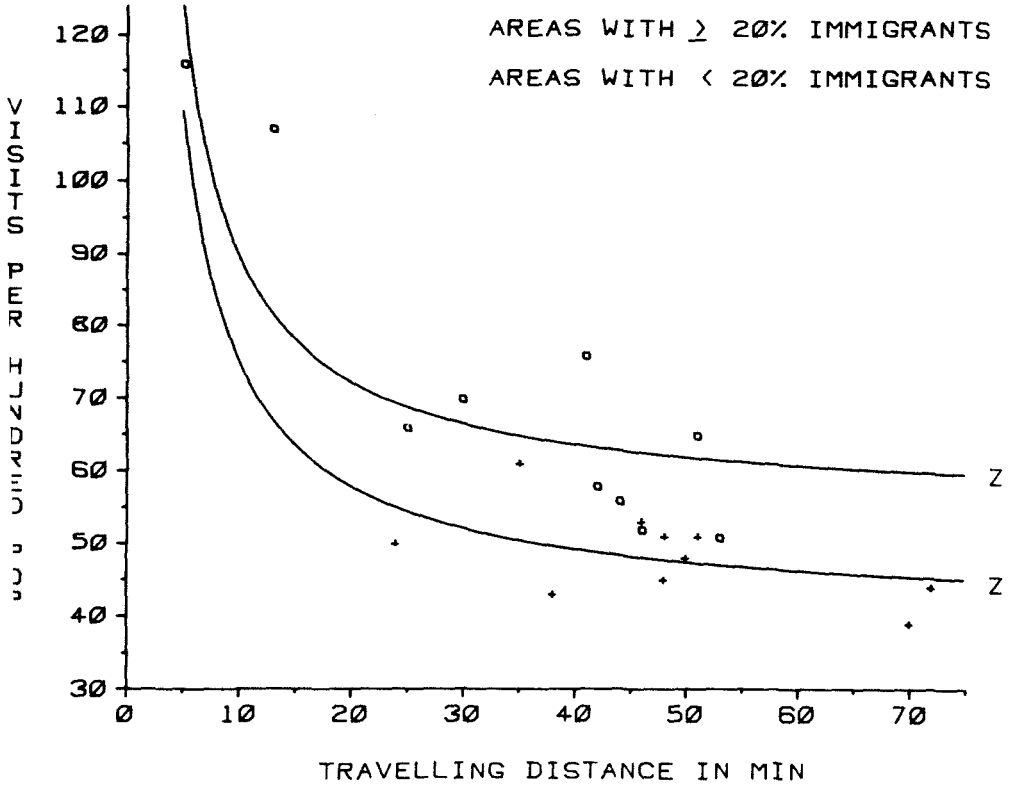

Figure 2 Function $Y=A+BZ+C/X$ fitted to the data in fig. 1 $Z=0$ for subareas with low immigrant proportion, $Z=1$ otherwise. The vertical distance between the two curves is B= visiting rate increment due to high immigrant proportion.

is 20% or more (under and over the median respectively) and used different markings for the two types of areas, as shown in figure 1. Generally areas with 'small immigrant proportion' fall below the curve, while areas with 'large immigrant proportion' gather above it.

In order to pay proper consideration to the influence of immigrant proportion, we make a slight expansion of our model, arriving at:

$$Y = A + BZ + \frac{C}{X}$$

where X and Y are the same variables as above and Z is a dummy variable, defined thus:

$Z = 1$ if immigrant proportion is $\geq 20\%$

$Z = 0$ otherwise

Thus B is the contribution in visits per 100 population due to large immigrant proportion.

When fitting the above function by the method of least squares, we obtain the two curves in fig. 2, where the upper curve corresponds to large immigrant proportion areas ($Z = 1$), and the lower one to remaining areas ($Z = 0$).

A substantial improvement of fit is obtained. Our new model does account now for 81% of the original variation in visiting rates.
The values of the parameters are:

$A = 40.66 \qquad B = 14.47 \qquad C = 344.16$

yielding the model:

$$Y = 40.66 + 14.47Z + 344.16/X$$

Availability of primary care: Health centre areas with higher doctor/patient ratios had lower visiting rates at the emergency department. The correlation coefficient was -0.8236 which is significant at the 5 per cent level in one direction with 3 Degrees of Freedom.

Emergency visits, out- and inpatient care: Outpatient visiting rates and hospital admission rates for each of the twenty areas are shown in table 3. There is a positive and significant correlation between emergency visiting rates and utilization of outpatient and inpatient care (table 4). There is also a significant correlation between outpatient visiting rates and hospital admission rates.

Discussion

Emergency care utilization was shown to be inversely proportional to the travelling distance to the hospital emergency department. Our model, using visiting rates and travelling distances, explains as much as 68 per cent of the original variation between the twenty areas. Slightly expanded, taking into account the proportion of immigrants in each area, the model explains 81 per cent of the variation between areas. The model could be used to forecast changes in visiting rates and for planning purposes. If for example a new housing area is to be built within the hospital catchment area the number of new emergency visits can be estimated given the number of inhabitants and travelling distance to the hospital. Such a projection can be useful for an overview of the possible impact on the emergency services. A key factor in the model is the travelling distance. The measure 'travelling distances in minutes' had been prepared for other purposes than our study and can be criticized. People make their way to the emergency department in a variety of ways. Whether or not they possess a car, the time of day or the day of the week, and the urgency of the medical problem are some of the major factors that are bound to influence what means of transportation will be used. Our intention in using travelling distance in minutes by public transport was to establish defined means of trans-

Table 3 Hospital outpatient clinics visiting rates and hospital admission rates for all subareas together with averages and standard deviations

Subarea	Outpatient visiting rates (per 100 inhab.)	Hospital admission rates (per 100 inhab.)
A	183	41
B	213	41
C	159	35
D	131	27
E	137	34
F	145	29
G	150	24
H	124	25
I	138	29
J	134	31
K	121	27
L	150	32
M	167	31
N	174	24
O	185	27
P	137	31
R	146	26
S	119	25
T	135	18
U	138	18
Average	149.3	28.8
Standard deviation	23.7	6.0

Table 4 Correlation coefficients between the variables: emergency department visiting rates, outpatient visiting rates and hospital admission rates.

	Outpatient visiting rates	Hospital admission rates
Emergency visiting rates	0.6076**	0.8034***
Hospital admission rates	0.5504*	

* $p<0.05$
** $p<0.01$
*** $p<0.001$

portation common to all areas. The frequency of services are included in the calculations of the travelling distances. It is reasonable to assume that areas with long travelling distances by public transport also have longer travelling distances by private cars. If private cars are used more often in areas with long travelling distances this would increase the accessibility of the emergency department and counteract our attempts to establish an inverse relationship between visiting rate and travelling distance.

The results show a significant and positive correlation between emergency visiting rates and utilization of outpatient and inpatient care which is in agreement with our hypothesis.

Two alternative explanations of our findings would be that areas are heterogeneous as to morbidity and/or availability of primary care services. It is possible that morbidity is higher in areas close to the hospital. From our present data we can neither accept nor reject that hypothesis. However, we find it hard to believe that differences in morbidity are sufficiently large to explain our findings.

As regards availability of primary care physicians we found a significant correlation between high doctor/patient ratios in health centres and low emergency visiting rates, indicating that our findings may at least partly be explained by actual unavailability of general practitioners.

When planning new hospital emergency departments it is important to be aware of the possible effects on the existing balance between hospital and primary care services in the area and be able to undertake necessary steps to minimize influx of patients to emergency departments that can and should be treated by primary care physicians. From what we know it is definitely difficult to change the pattern of usage away *from* the hospital.

In areas with a shortage of general practitioners unmet demands will inevitably be channeled to the emergency departments. The customary response to increased strain on emergency departments is expansion, larger facilities and more medical staff. In our view this is ignoring the available evidence that the increase is largely due to patients who should be treated outside the hospital by primary care physicians.

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