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Patterns of hospitalisation before and following initiation of haemodialysis: a 5 year single centre study

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ABSTRACT

Background The utilisation of healthcare resources by prevalent haemodialysis patients has been robustly evaluated with regard to the provision of outpatient haemodialysis; however, the impact of hospitalisation among such patients is poorly defined. Minimal information is available in the UK to estimate the health and economic burden associated with the inpatient management of prevalent haemodialysis patients. The aim of this study was to assess the pattern of hospitalisation among a cohort of haemodialysis patients, before and following their initiation of haemodialysis. In addition the study sought to assess the impact of their admissions on bed occupancy in a large tertiary referral hospital in a single region in the UK.

Methods All admission episodes were reviewed and those receiving dialysis with the Belfast City Hospital Programme were identified over a 5 year period from January 2001 to December 2005. This tertiary referral centre provides dialysis services for a population of approximately 700 000 and additional specialist renal services for the remainder of Northern Ireland. The frequency and duration of hospitalisation, and contribution to bed day occupancy of haemodialysis patients, was determined and compared to other common conditions which are known to be associated with high bed occupancy. In addition, the pattern and timing of admissions in dialysis patients in relation to their dialysis initiation date was assessed.

Results Over the 5 year study period, 798 haemodialysis patients were admitted a total of 2882 times. These accounted for 2.5% of all admissions episodes; the median number of admissions for these patients was 3 (2–5) which compared with 1 (1–2) for non-dialysis patients. The majority of first hospitalisations (54%) were within 100 days before or after commencement of maintenance dialysis therapy. In all clinical specialties the median length of stay for haemodialysis patients was significantly longer than for patients not on haemodialysis ($p=0.004$). In multivariate analysis with adjustment for age, gender, and other clinically relevant diagnostic codes, maintenance haemodialysis patients stayed on average 3.75 times longer than other patient groups (ratio of geometric means 3.75, IQR 3.46–4.06).

Conclusions Maintenance haemodialysis therapy is an important risk factor for prolonged hospitalisation regardless of the primary reason for admission. Such patients require admission more frequently than the general hospital population, particularly within 100 days before and after initiation of their first dialysis treatment.

INTRODUCTION

Bed utilisation within the National Health Service is an important and underutilised methodology for investigating the importance of specific disease processes on healthcare resources.^{1–3} The Department of Health has recognised the importance of discharge pathways in resource allocation and is cognisant of the different characteristics of patient groups and how they affect bed occupancy.^{4–6} In 2006 the NHS Institute for Innovation and Improvement published strategies with the aim of improving NHS efficiency and productivity, including reducing hospital length of stay.⁷ Facilitating the rapid discharge and care in the community of patients with chronic diseases is central to this strategy.

This work continues previous analysis which demonstrated that older patients with multiple comorbidities stay longer in hospital. In practice, patients requiring haemodialysis often have complicated medical conditions that require the input of several clinicians, and as such are more likely to require prolonged inpatient admission.⁸ As renal physicians we are aware that inpatient episodes for those on dialysis are often in specialties other than nephrology, and the impact of this patient group on health service resources may be underestimated due to a failure of identification of this cohort for analysis.

The reported costs of dialysis have often been limited to the actual provision of the therapy itself without further analysis of the associated consumption of healthcare resources by this cohort of patients. The figure of £20 000 (€23 000, US \$32 000) to £30 000 (€35 000, \$48 000) is often quoted in the UK to describe the average annual cost of providing haemodialysis, but it has been estimated that approximately 40% of costs associated with end stage renal disease (ESRD) are related to inpatient care⁹; more careful analysis in an elderly dialysis population in 2003 suggested an annual sum of between £15 000 (€17 000, \$24 000) and £58 000 (€67 000, \$92 000) to be more accurate.¹⁰ Reports from the USA are consistent in suggesting that inpatient care for persons with dialysis dependent renal disease represent a substantial financial burden.^{11 12}

Chronic kidney disease (CKD), most often the precursor to ESRD, has been the subject of increased attention in recent years as awareness of the prevalence, medical consequences, and economic implications of this illness has risen.^{13 14} We have a high prevalence of CKD in Northern

Ireland and we have previously demonstrated this condition's significant association with increased morbidity and mortality.¹⁵ It therefore seemed likely that patients with renal disease requiring dialysis (ESRD) would represent an even greater clinical challenge leading to additional resource utilisation.

Despite our clinical suspicions, there is little information available regarding the impact of prevalent haemodialysis patients on hospital services in the UK. Extrapolation from private healthcare records in the USA and elsewhere suggest that providing care for patients receiving dialysis is associated with a large financial commitment; the healthcare cost incurred by the USA in 2006 alone was estimated at \$32 billion (£20 billion, €23 billion).¹⁶

The aim of this study was to assess the epidemiology and impact of haemodialysis patients on admission and bed occupancy in a large tertiary referral hospital in a single region in the UK over a 5 year period. In addition we sought to compare the impact of ESRD on bed occupancy in comparison with other chronic conditions which have been previously associated with prolonged hospital stays.

METHODS

Study population

The Belfast City Hospital (BCH) Trust is a university teaching hospital with 744 beds. It provides acute services to the local population and several regional specialties for Northern Ireland, including renal medicine and all acute renal transplant services. The outpatient haemodialysis facility serves a population of 700 000 and has 43 stations. During the 2004–2005 financial year the hospital recorded 24 248 day cases, 47 313 accident and emergency attendances, and 194 729 outpatient appointments.

Data acquisition

Information was obtained from the BCH Patient Administration System (PAS) and the regional renal dialysis information technology system (E-med, Mediqua Health Informatics, Stevenage, UK) and BCH renal unit specific dataset. All admissions data for the period 1 January 2001 to 31 December 2005 were obtained from the PAS system; hospital number, date of birth and age, postcode, gender, admission date, admission unit, mode of admission, diagnoses, date of discharge, and mode of discharge were recorded. The full interrogation details of this database have previously been described.¹⁷ Diagnoses were coded using the International Classification of Diseases (ICD) 10 code; each admission episode had a primary, secondary, and up to five additional diagnoses.

The two renal databases provide accurate information on patients receiving maintenance haemodialysis. The datasets were combined and interrogated to provide information on all individuals who were receiving, or began, renal replacement therapy with haemodialysis in the 5 year study period. The date of commencement of maintenance dialysis therapy was noted. The patients identified as receiving dialysis were matched with the original BCH admissions dataset using unique identifiers. Patients were only included in analysis if they left hospital following their first admission and continued to receive maintenance dialysis in our outpatient facility. We chose not to use the recognised definition of chronic dialysis (>90 days following commencement) as this would have limited our ability to capture ill patients responsible for long inpatient stays who died before reaching this criterion.

Length of stay

The duration of admission was calculated by the interval between admission and discharge in complete days. Using this

database the number of admissions per patient and the duration of those admissions was calculated and documented as the length of stay (LOS). The temporal relationship between admissions and dialysis initiation was identified by calculating time relevant dates.

Diagnostic groups

To facilitate further analysis we grouped specific ICD codes using a procedure identical to that previously described.¹⁷ Defined categories were described based on the presence of certain conditions as evidenced by the primary, secondary, and subsidiary ICD diagnoses. The categories created were heart disease, chronic chest disease, vascular disease, diabetes mellitus, stroke, malignancy, and any fracture. We chose these diagnostic categories as they are common chronic conditions which have all previously been shown to associate with prolonged hospitalisations. Patients identified as requiring maintenance haemodialysis therapy within the study period were identified and labelled 'HD'.

Statistical analysis

Demographic data

Numerical variables are reported as mean with SD or median values with interquartile range (IQR) as appropriate to their distribution. Categorical variables are presented as proportions of sample size. Comparison of individual episode median LOS of stay between dialysis and non-dialysis patients within medical and surgical specialties was carried out using the Wilcoxon sign rank test. The same test was used to compare LOS for admission before and following initiation of haemodialysis in the haemodialysis group.

Multivariate analysis

A general linear model investigating the association of clinical diagnoses with the risk of total cumulative LOS was carried out following log transformation of the original LOS variable. Representation of risk is described in terms of the ratio of geometric mean (RGM). All statistical analyses were carried out using SPSS for Windows v. 14 (SPSS Inc).

RESULTS

Demographic information

Over the 5 year study period 70 808 patients were responsible for a total of 116 915 admissions; 35 414 (50.0%) of the patients were male. There were 798 (1.1%) patients who received maintenance haemodialysis therapy accounting for 2882 (2.5%) of admission episodes. The mean age of the dialysis cohort was 60.4 (17.0) years which was significantly older than the non-dialysis cohort who had a mean age of 55.3 (21.6) years ($p < 0.001$).

Frequency of admission

The median number of admissions for the dialysis patients was 3 (2–5) which compared with 1 (1–2) for non-dialysis patients. Figure 1 demonstrates that 538 of the 798 dialysis patients (74.9%) had a first hospitalisation before the initiation of dialysis. Among this group of patients admission was often closely followed by the commencement of maintenance dialysis. In 155 of the 798 patients, dialysis was commenced for the first time, within 7 days of the first admission to hospital. The majority of first hospitalisations (54%) were within 100 days before or after commencement of maintenance dialysis therapy.

Overall, just over half, 1624 (56%), of all of the 2882 admission episodes among the 798 patients within the dialysis cohort occurred following the initiation of dialysis.

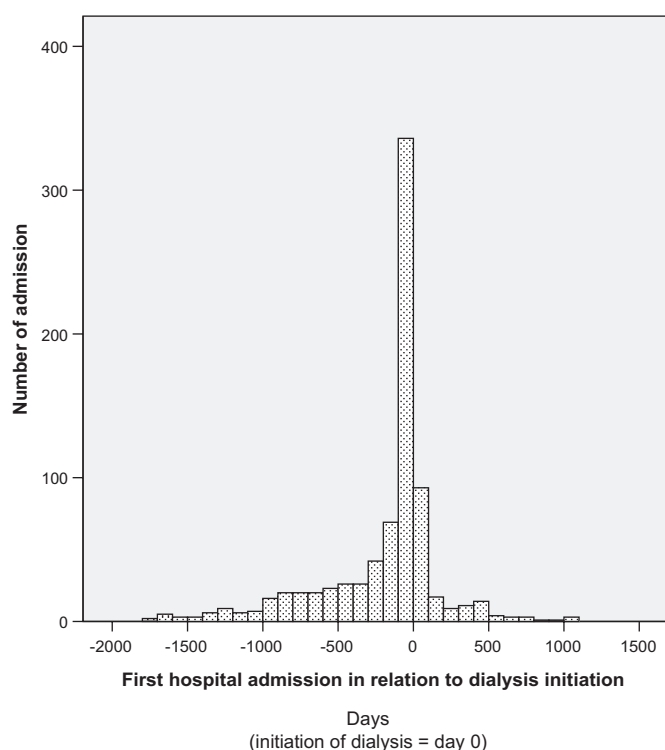


Figure 1 First admission to hospital in relation to dialysis initiation date.

LOS

The total number of bed days occupied within the study was 919 212, of which 32 437 (3.5%) were occupied by patients who received maintenance haemodialysis therapy. The median (IQR) LOS for all admissions was 4 (1–12) days; it was longer for those on dialysis, 5 (2–13) days, and shorter for non-dialysis patients, 3 (1–8) days. The median combined LOS for all admissions in the study period for each dialysis patient was 25 (9–55) days, and for each non-dialysis patient it was 4 (1–11) days. The LOS for admissions that occur following the initiation of dialysis are longer than those which are before initiation of dialysis (median 6 v 5 days, $p < 0.001$).

The median LOS for dialysis and non-dialysis patients within the most frequently admitting clinical subspecialties is recorded in table 1. The median LOS for ESRD patients was higher within all clinical specialties compared to non-affected patients ($p = 0.004$).

Table 1 Median length of stay (LOS) per admission episode comparing patients with and without end stage renal disease (ESRD) within different hospital specialties

Specialty	% of ESRD admissions*	Dialysis patients LOS (days) Median (IQR)	Non-dialysis patients LOS (days) Median (IQR)
Cardiology	3.8	2 (1–7)	1 (1–2)
Elderly care	0.9	22 (10–46)	13 (7–29)
General medicine	12.7	9 (4–13)	4 (2–10)
General surgery	3.2	6 (4–13)	3 (2–8)
Haematology	1.4	12 (5–24)	9 (4–21)
Nephrology	67.2	4 (1–10)	3 (1–10)
Urology	5.2	6 (3–14)	4 (2–7)
Vascular surgery	3.2	16 (8–35)	9 (3–18)

*Miscellaneous multiple ESRD admitting specialties representing (2.4%) of admission episodes not shown.

LOS based on comorbid conditions

Table 2 displays the total number of admissions with particular ICD coded diagnoses potentially associated with prolonged hospitalisation, and the difference in median LOS of patients with and without these recorded conditions. For each disease considered there was a significant difference between those with and without the diagnosis with regard to median LOS ($p < 0.001$). This was investigated further by multivariate analysis utilising a model adjusted for age, gender, and the other comorbidities listed. The associated risk is reported as RGM. Age was included as a continuous variable within the analysis, and was found to have a significant association with overall LOS ($p < 0.001$) with an RGM reported as 0.017 (IQR 0.017–0.18)/per year. Gender was also significantly associated, with female patients on average staying 15% longer than male patients ($p < 0.001$; RGM 1.15, IQR 1.13–1.17). Following adjustment, being in the haemodialysis cohort was associated with the greatest risk for cumulative LOS (RGM 3.75, IQR 3.46–4.06) compared to all other major diagnostic groups. This suggests that, on average, admissions among patients receiving or going on to receive dialysis are 3.75 times longer than admissions among other groups of patients.

DISCUSSION

We have demonstrated the impact of admissions among patients with renal disease who are receiving, or will need, haemodialysis. These patients are older and stay on average 2 days longer on each admission compared to all-comers. They are admitted more frequently and over the course of 5 years they spend almost five times as long in hospital compared to the average hospitalised patient. Even when compared to patients with chronic conditions such as stroke, cancer, chronic chest disease, and dementia they have the greatest risk of prolonged hospital admission.

While hospital administrators and service providers may not appreciate the clinical burden associated with caring for patients on dialysis, they do understand the significant financial implications of prolonged hospitalisations. The approach of this study was to use a surrogate marker of costs, hospital LOS, to provide a better understanding of the resource consumption associated with dialysis patients. Ham and colleagues used a similar approach when they analysed the LOS in comparable diagnostic groups between the UK and a Californian healthcare provider.¹ However, renal disease was not considered as an independent condition in that study and data in this area are limited.

In our institution, prevalent dialysis patients accounted for just 1.1% of individuals admitted to hospital, but 2.5% of admission episodes, and occupied 3.5% of bed days. Thus this cohort of patients consumes a disproportionate amount of inpatient resources due to both an increased frequency and duration of hospitalisation.

We have previously demonstrated that older patients with multiple comorbidities are responsible for increased bed occupancy due to prolonged hospital stays,¹⁷ and that patients admitted for management specifically of ESRD have frequent hospitalisations. Therefore it is unsurprising to report that patients on dialysis have a disproportionately long LOS compared to patients not receiving dialysis. Not only are prevalent dialysis patients more likely to have frequent admissions for renal related issues, but when admitted for other reasons they stay longer in hospital than those not on dialysis.

Implications

Previous work has demonstrated that patients with reduced renal function have worsening outcomes as their condition

Table 2 Multiple regression model assessing risk of cumulative length of hospitalisation associated with various clinical conditions

Comorbid diagnosis	Number of admissions with coded comorbidity Count	Age Mean (SD)	Admission duration Median (IQR)	Adjusted model* Ratio of geometric means (95% CI)
Haemodialysis				
No	114033	56.8 (20.9)	3.0† (1.0–8.0)	Ref 1.00‡
Yes	2882	58.1 (17.6)	5.0 (2.0–13.0)	3.75 (3.46 to 4.06)
Cancer				
No	97058	55.5 (21.5)	3.0† (1.0–7.0)	Ref 1.00‡
Yes	19857	63.2 (15.5)	6.0 (3.0–13.0)	2.90 (2.82 to 2.97)
Stroke				
No	110376	55.9 (20.8)	3.0† (1.0–8.0)	Ref 1.00‡
Yes	6539	72.1 (13.2)	8.0 (3.0–17.0)	2.57 (2.46 to 2.68)
Vascular disease				
No	110558	56.1 (20.9)	3.0† (1.0–8.0)	Ref 1.00‡
Yes	6357	69.6 (12.4)	7.0 (3.0–16.0)	2.28 (2.18 to 2.38)
Fracture				
No	115168	56.6 (20.7)	3.0† (1.0–8.0)	Ref 1.00‡
Yes	1747	72.8 (18.2)	9.0 (2.0–26.0)	2.26 (2.08 to 2.45)
Dementia				
No	113832	56.2 (20.7)	3.0† (1.0–8.0)	Ref 1.00‡
Yes	3083	79.4 (11.4)	8.0 (4.0–20.0)	2.21 (2.08 to 2.35)
Chest disease				
No	98936	55.9 (21.1)	3.0† (1.0–8.0)	Ref 1.00‡
Yes	17979	62.2 (17.9)	5.0 (2.0–10.0)	1.89 (1.85 to 1.95)
Diabetes				
No	104615	55.8 (21.1)	3.0† (1.0–8.0)	Ref 1.00‡
Yes	12300	65.5 (15.1)	5.0 (2.0–12.0)	1.35 (1.30 to 1.39)
Heart disease				
No	69331	49.9 (21.7)	3.0† (1.0–7.0)	Ref 1.00‡
Yes	47584	67.0 (14.3)	4.0 (1.0–9.0)	1.11 (1.09 to 1.13)

*Model adjusted for age, sex, cancer, chest disease, dementia, diabetes, end stage renal disease, history of fracture, heart disease, stroke, and vascular disease.

†Comparison of median length of stay ($p < 0.001$).

‡ $p < 0.001$.

progresses.¹⁵ This study highlights that as patients enter the phase of their illness when dialysis is needed, they require additional support, often in a hospital setting. The reasons for this have been commonly discussed in renal literature and include: poor planning for dialysis initiation, difficulties with vascular access, complications of vascular access, complications of dialysis initiation, and the unpredictable effect of patients who ‘crash land’ onto dialysis. At the time of this study our unit, like most in the UK, had a high prevalence (>50%) of semi-permanent catheters as the primary method of vascular access among our dialysis population. This factor, along with the increasing comorbidity with which it associates, is widely considered to be the greatest risk for hospitalisation and morbidity among the dialysis population.^{18–20}

The analysis indicates that haemodialysis patients are often hospitalised under the care of other specialties related to comorbid conditions. Thirty-two per cent of inpatient episodes for dialysis patients were within a specialty other than nephrology, with the most frequent admitting specialties being general medicine, urology, vascular surgery, and elderly care. They are significantly more likely to have a longer LOS than other patients regardless of which clinical specialty is responsible for their care. During this period BCH had a standard admission policy with regard to haemodialysis patients. Patients admitted during a scheduled dialysis session, with a related clinical problem, were normally admitted to a nephrology inpatient bed. At all other times patients were admitted through casualty, to the relevant specialty, based on their clinical presentation. This study has demonstrated patients admitted to a nephrology bed

stayed for a shorter period of time. The possible explanation for this finding most likely relates to the additional clinical information readily available to the admitting nephrology team. This facilitates an immediate understanding of the clinical history, making diagnostic and treatment decisions more straightforward.

Additionally nephrologists have the ability to readily review patients on routine dialysis sessions; this increased interaction with patients provides renal clinicians with an added safeguard when arranging discharge.

Renal disease requiring dialysis is a powerful predictor of prolonged hospitalisation. This analysis, considering the frequency and cumulative LOS of patients receiving dialysis over a 5 year period, has highlighted the financial burden associated with this condition. Such information is important when planning service provision and when establishing or expanding an outpatient dialysis facility.

Limitations

The major limitation to this study is its retrospective, single centre design. The use of a single centre limits the transferability of information to regions with a different basic population demographic or to other trusts with an alternative sub-specialty provision. However, most inpatient nephrology units are located within large district general hospitals or within university settings, and the BCH Trust contains many of the subspecialties which manage seven of 11 diagnoses described by Ham as being responsible for the greatest LOS.¹ The results presented in this study, although transferable in most aspects to other trusts, may

Main messages

- ▶ Patients with renal dysfunction requiring dialysis have multiple hospital admissions around the time of initiation of therapy.
- ▶ These patients have multiple health problems and are admitted under many different specialists.
- ▶ Regardless of their admission specialty, haemodialysis patients stay longer and have more admissions in comparison to patients with other chronic illnesses.

Current research questions

- ▶ Can identifying patients receiving dialysis, who are at high risk of multiple complicated admissions, enable strategies to be developed within the NHS to target resources more effectively?
- ▶ Could the intelligent combination of information technology systems in the NHS increase awareness of the total cost of providing care for patients with chronic conditions in receipt of inpatient and outpatient services?

be biased in specific circumstances. The LOS for patients in cardiology in the BCH Trust is very short, both for dialysis and non-dialysis patients. This may reflect the tertiary nature of the cardiology service in BCH, with patients from small rural hospitals being transferred for definitive intervention and therefore staying for short periods. Importantly, we have not been able to account for the affect of inter-specialty transfer on LOS within this study.

Next steps

The NHS routinely collects information which, if appropriately analysed, could inform our practice and improve the level of care we provide to our patients. The fact that this is not routinely done undermines our ability to target resources accurately. The UK Renal Registry (UKRR) currently records some of the outcomes associated with the provision of dialysis in our population, such as mortality and biochemical data. To appreciate fully the impact of this population on our service we need to consider mandatory reporting of relevant information additional to that already collected by the UKRR. This study has demonstrated that caring for our dialysis population is not limited to the outpatient setting. Gathering this relevant information pertaining to admissions would strengthen our ability to argue credibly for increased funding within renal services in the UK.

CONCLUSION

Patients on dialysis are admitted more frequently to hospital and stay longer than comparative patients without dialysis

dependent renal disease. The median LOS is significantly longer even when such patients are hospitalised for clinical problems unrelated to their renal disease. Using data collected over this 5 year study period has demonstrated the disproportionate and cumulative burden of this population, relative to its size, on inpatient bed utilisation. This information is of importance in the appropriate planning and provision of healthcare for this group of patients.

Competing interests None.

Provenance and peer review Not commissioned; externally peer reviewed.

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