What is already known on this topic

The results of trials on the use of metoclopramide to prevent postoperative nausea and vomiting have been contradictory

What this study adds

This large randomised trial showed that the addition of 25 mg or 50 mg metoclopramide to dexamethasone (given intraoperatively) reduces postoperative nausea and vomiting

The optimal dose will depend on the hospital's policy on prophylaxis for postoperative nausea and vomiting

Additional drugs can then be given after surgery, but the patient's risk profile should be taken into account. Rescue drugs should be given after postoperative nausea and vomiting to prevent repeat episodes.

The role of different types of surgery and of alcohol consumption should be investigated further. Timing of administration should also be investigated, and a suitable dose of metoclopramide should be compared with a 5-hydroxytryptamine receptor antagonist (both combined with dexamethasone).

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Ethical approval: Ethics committee of the Medical Faculty of the University of Leipzig and the medical associations of the German states of Saxony and Saxony-Anhalt.

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Case finding for patients at risk of readmission to hospital: development of algorithm to identify high risk patients

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Abstract

Objective To develop a method of identifying patients at high risk of readmission to hospital in the next 12 months for practical use by primary care trusts and general practices in the NHS in England.

Data sources Data from hospital episode statistics showing all admissions in NHS trusts in England over five years, 1999-2000 to 2003-4; data from the 2001 census for England.

Population All residents in England admitted to hospital in the previous four years with a subset of "reference" conditions for which improved management may help to prevent future admissions.

Design Multivariate statistical analysis of routinely collected data to develop an algorithm to predict patients at highest risk of readmission in the next 12 months. The algorithm was developed by using a 10% sample of hospital episode statistics data for all of England for the period indicated. The coefficients for 21 most powerful (and statistically significant) variables were then applied against a second 10% test sample to validate the findings of the algorithm from the first sample.

Results The key factors predicting subsequent admission included age, sex, ethnicity, number of previous admissions, and clinical condition. The algorithm produces a risk score (from 0 to 100) for each patient admitted with a reference condition. At a risk score threshold of 50, the algorithm identified 54.3% of patients admitted with a reference condition who would have an admission in the next 12 months; 34.7% of patients were "flagged" incorrectly (they would not have a subsequent admission). At risk score threshold levels of 70 and 80, the rate of incorrectly "flagged" patients dropped to 22.6% and 15.7%, but the algorithm found a lower percentage of patients

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who would be readmitted. The algorithm is made freely available to primary care trusts via a website.
Conclusions A method of predicting individual patients at highest risk of readmission to hospital in the next 12 months has been developed, which has a reasonable level of sensitivity and specificity. Using various assumptions a "business case" has been modelled to demonstrate to primary care trusts and practices the potential costs and impact of an intervention using the algorithm to reduce hospital admissions.

Introduction

Improving the management of patients for whom care is costly, especially those with long term conditions, is an important strategy for improving health outcomes and controlling healthcare expenditure.[1] An essential component of any strategy to improve care and services for these patients is the development of a case finding mechanism to identify the patients so as to enable interventions to be targeted before costs have been incurred and health status has deteriorated. High rates of previous admissions alone do not necessarily mean continued high risk of future admission.[2]

We developed a case finding algorithm as part of a project commissioned by Essex Strategic Health Authority on behalf of the 28 strategic health authorities, the Department of Health, and the NHS Modernisation Agency. In this paper we describe the development of the tool (the patients at risk for re-hospitalisation (PARR) case finding algorithm), assess the "business case" for the algorithm under different scenarios and assumptions, and discuss the implications for policy makers and practitioners interested in implementing effective programmes to manage high risk patients.

Methods

We used five years of hospital episode statistics data (1999-2000 to 2003-4). We examined admissions in 2002-3 to identify a "triggering" admission for each patient and considered data on previous hospital resource use for each patient for the three previous years to predict whether an admission would occur in the 12 months after the triggering admission. We excluded from the analysis patients known to have died in hospital during the triggering admission.

Defining characteristics of PARR algorithm

Focus on reference conditions for which improved management can help prevent future admissions
The PARR case finding algorithm focuses on a range of "reference" conditions (such as congestive heart disease or chronic obstructive pulmonary disease) for which timely and effective ambulatory care, case management, or social services have the potential to help reduce the risks of readmission. These conditions, listed in the appendix on bmj.com, represent almost a third of all emergency medical admissions.

Use of hospital admission as "triggering" event and identifying patients at risk of future admissions
The PARR case finding algorithm uses an emergency hospital admission for a reference condition as a "triggering" event. The algorithm incorporates diagnostic information from that admission and then examines data on previous resource use, characteristics of the patient, contextual information on the patient's electoral ward of residence, and the hospital of admission to create a "risk score" for the probability of another admission in the next 12 months. The risk score ranges from 1 to 100; higher scores indicate a greater risk of admission in the next 12 months.

Designed to be used in real time or with archival analysis only
Because effective discharge planning is likely to be an essential component of many intervention strategies,[3 4] the algorithm is designed primarily for application in real time while the patient is still in the hospital. Two "archival" approaches that do not entail real time application have also been developed, involving analysis of archived admission data on a monthly or annual basis, and are intended for use where local information technology capacity is limited or where obtaining real time data on admissions is difficult or not feasible.

Variables selected

We created a set of variables on previous hospital resource use and diagnostic history from hospital episode statistics data for the triggering admission and the previous three years. We also created a variable to identify emergency admissions that occurred in the 12 months after discharge for the triggering admission.

Variables included in the patients at risk for rehospitalisation (PARR) case finding algorithm

- Alcohol related diagnoses
- Cerebrovascular disease
- Chronic obstructive pulmonary disease
- Connective tissue disease/rheumatoid arthritis
- Developmental disability
- Diabetes
- Ischaemic heart disease
- Peripheral vascular disease
- Renal failure
- Sickle cell disease
- Previous admission for respiratory infection
- Number of different treatment specialists seen
- Age 65-74, age 75+
- Sex
- Ethnicity
- Previous admission for a reference condition
- Number of emergency admissions in previous 90, 180, and 365 days
- Number of non-emergency admissions in previous 365 days
- Total number of previous emergency admissions in previous three years
- Average number of episodes per spell for emergency admissions
- Observed:expected ratio for practice style sensitive admissions in ward of residence
- Observed:expected ratio for rate of readmissions for hospital of current admission
- Diagnostic cost groups/hierarchical condition category

Ability of PARR algorithm to identify patients with reference condition at risk of readmission in next 12 months, at different risk score thresholds

Characteristic	Risk score threshold		
	50	70	80
No of patients	17 455	4810	2011
Sensitivity	0.543	0.178	0.081
Specificity	0.722	0.950	0.986
Positive predictive value	0.653	0.774	0.843
Emergency admissions in next 12 months	1.47	2.23	3.00
Emergency admissions in previous 12 months*	2.22	3.43	4.59
Emergency admissions in previous 13-24 months	0.93	1.84	2.80
Emergency admissions in previous 25-36 months	0.73	1.48	2.25

*Includes reference admission.

We combined these data with data on demographics and hospital resource use characteristics of the patient's ward of residence. We did a series of stepwise logistic regressions to identify which variables were helpful in predicting a subsequent admission in the next 12 months. Initially, we tested a set of 69 variables; 21 variables were significant predictors, and we included them in the model to produce the algorithm (box).

We developed the algorithm by using a 10% reference sample of hospital episode statistics data for all of England for the period indicated. We then applied the coefficients for the 21 variables against a second 10% test sample to validate the findings of the algorithm from the first sample. Rates of case finding, specificity, and sensitivity differed by only 1-2% in the two samples, and data reported here are for the test sample. A full report detailing the development and performance of the algorithm and a specification document with regression coefficients for each variable used in the algorithm are available at www.kingsfund.org.uk/health_topics/patients_at_risk/index.html. A Microsoft Access program implementing the algorithm for use with admitted patient care or hospital episode statistics data sets is also available at the site at no charge.

Results

At a risk score threshold of 50, the PARR algorithm identified 54.3% of patients admitted with a reference condition who would have an admission in the next 12 months; 34.7% of patients were flagged incorrectly (who would not have a subsequent admission) (table). The receiver operating characteristic curve in the figure illustrates the trade-offs for users between sensitivity (true positives) and 1 – specificity (false negatives) for the algorithm. There was a 68.5% probability that a randomly selected patient with a future admission will receive a higher risk score than a randomly selected patient who will not have a future admission.

In developing the algorithm, we aimed to help potential users to assess the "business case" for various risk score thresholds and for different assumptions about the impact of the intervention. Focusing on patients with risk scores above 70 (where 22.6% of flagged patients do not have subsequent admissions) results in net savings for almost all assumptions about admission rates where intervention costs are £750 (€1080; $1380) or less per patient. For all of England, a risk score cut-off level of 70 would flag 50 000 patients annually (about 130 per primary care trust). See bmj.com for details.

Discussion

Potential limitations

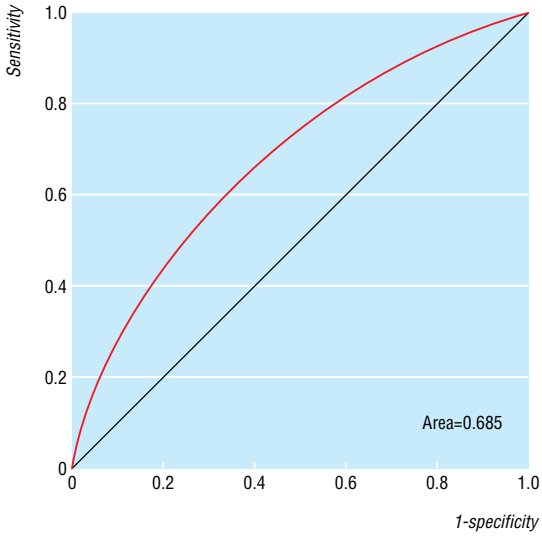
Missing data and inaccurate coding (especially in diagnostic fields) can be a problem in computerised hospital admission data, as is the dependence on the "method of discharge" field to identify patients who die (the reliability of the field is not well established and many patients die outside the hospital). These data limitations generally tend to err in the direction of under-prediction rather than over-prediction.

In addition, we cannot predict the future admissions of patients with no previous admissions. Other characteristics of patients' health status are likely to be needed to improve the predictive power sufficiently to identify emerging risks of admission, and these factors are being explored in the next phase of the project. The PARR model also helps to account for the dynamic nature of risk. Although patients with a high risk today may have lower risk tomorrow, this approach does allow the user some ability to compensate for dynamic risk as risk score thresholds for intervention can be set at higher levels when patients have a history of frequent admission and are at risk of a substantial number of future admissions (see previous and subsequent admission history in the table).

Finally, although the focus on "reference conditions" is meant to target patients for whom some expectation of preventing or avoiding future admissions exists, the ability of intensive case management or other intervention strategies to have an impact on these patients has not been fully established.

Designing interventions

A rational approach to crafting the most effective intervention strategy for high risk patients identified by the PARR algorithm would be to interview a sample of patients flagged by the algorithm and their providers, to learn more about the factors that contributed to any preventable or avoidable admission and obtain a better



Receiver operating characteristic curve for the PARR algorithm

What is already known on this topic

Several published studies, principally in the United States, have used statistical modelling to predict the future risk of hospital admission in individual patients

What this study adds

A reasonably sensitive and specific algorithm has been developed to identify patients at high risk of readmission to hospital in the next 12 months

The algorithm can be used to provide a "business case" that shows the potential costs and impact of an intervention to reduce hospital admissions

The factors that were most influential in predicting future admissions for reference conditions in the NHS included age, sex, previous admission, and clinical condition

understanding of the range of their needs. This information could then be incorporated into efforts to design interventions, whether the services are ultimately "made" or "bought" by the primary care trust or strategic health authority; in the second case, the information would be used in developing the specifications to tender proposals for delivery of services from potential providers. Once the intervention has begun, primary care trusts and strategic health authorities could also consider randomising patients into intervention and non-intervention arms to learn as much as possible about the effectiveness and costs of the intervention.

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Competing interests: DW is the president and chief operating officer of a private company, Health Dialog Analytic Solutions, which has developed similar algorithms in the United States.

Ethical approval: Not needed.

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Spironolactone and risk of upper gastrointestinal events: population based case-control study

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Abstract

Objective To confirm and quantify any association between spironolactone and upper gastrointestinal bleeding and ulcers.
Design Population based case-control study.
Setting A primary care information database in the Netherlands.
Participants All people on the database who were aged 18 or more between 1 January 1996 and 30 September 2003. Patients with a history of alcoholism or gastrointestinal cancer were excluded. Ten controls were matched to each case of gastroduodenal ulcer or upper gastrointestinal bleeding by age (year of birth), sex, and index date.
Main outcome measures The occurrence of an upper gastrointestinal event (bleeding or ulcers), adjusted for potential confounders with conditional logistic regression analysis.
Results Within the source population of 306 645 patients, 523 cases of gastric or duodenal ulcer or upper gastrointestinal bleeding were identified and matched to 5230 controls. Current use of spironolactone was associated with a 2.7-fold (95% confidence interval 1.2 to 6.0) increased risk of a gastrointestinal event.
Conclusion The risk of gastroduodenal ulcers or upper gastrointestinal bleeding is significantly increased in patients using spironolactone.

Introduction

Case reports indicate a possible association between spironolactone, an aldosterone receptor antagonist, and upper gastrointestinal bleeding and ulcers.[1 2] One study found that spironolactone may inhibit the healing of ulcers when combined with carbenoxolone, an established ulcer healing drug. [3] Ulcer healing was not impaired in patients treated with loop diuretics and carbenoxolone, although in another trial, ulcer healing was impaired when amiloride was added to carbenoxolone.[4]

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