Impact of 'Virtual Wards' on hospital use: a research study using propensity matched controls and a cost analysis

Geraint H. Lewis,[1] Theo Georghiou,[1] Adam Steventon,[1]Rhema Vaithianathan,[2] Xavier Chitnis,[1] John Billings,[3] Ian Blunt,[1] Lorraine Wright,[1] Adam Roberts,[1] and Martin Bardsley[1]

[1]Nuffield Trust
[2]University of Auckland
[3]New York University

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Address for correspondence:

Dr. Geraint H. Lewis
Chief Data Officer
NHS England
Quarry House
Leeds LS2 7UE

Email: geraint.lewis@nhs.net

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National Institute for Health Research
Evaluation, Trials and Studies Coordinating Centre
University of Southampton
Alpha House, Enterprise Road
Southampton SO16 7NS

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Criteria for inclusion

Reports are published if (1) they have resulted from work for the SDO programme including those submitted post the merge to the HS&DR programme, and (2) they are of a sufficiently high scientific quality as assessed by the reviewers and editors. The research in this report was commissioned by the SDO programme as project number 09/1816/1021. The contractual start date was in May 2010. The final report began editorial review in January 2012 and was accepted for publication in October 2012. The authors have been wholly responsible for all data collection, analysis and interpretation, and for writing up their work. The SDO editorial team have tried to ensure the accuracy of the authors' report and would like to thank the reviewers for their constructive comments on the final report documentation. However, they do not accept liability for damages or losses arising from material published in this report.

Glossary of terms/abbreviations

Case management – coordination of health and social care services on behalf of a patient

CPM – Combined predictive model or "combined model": a predictive risk model that uses a combination of inpatient, outpatient, A&E and GP data to identify individuals at high risk of an unplanned hospital admission in the next 12 months

Community matron - a specialist nurse providing case management

DPM - Devon predictive model - a local variant of the combined model that has been weighted for Devon data

DH – Department of Health

EMIS - Egton medical information systems limited (a primary care software provider)

Emergency admission – we use the terms "emergency", "non-elective" and "unplanned" admissions interchangeably, having excluded maternity admissions from this definition

Exeter data - database of all patients registered with a GP practice in England

GP – General practitioner

HES – Hospital episode statistics (a research database of pseudonymous secondary care data)

HESid – Hospital episode statistics identifier (a unique, pseudonymous identification number of all patients with a Hospital Episode Statistics record)

IC - NHS Information Centre for health and social care

INR - International normalised ratio - a blood test measuring the degree of anticoagulation

LTC - Long term condition or chronic disease

NHS - National Health Service

NHS number - unique identification number for NHS patients in England

Non-elective admission - we use the terms "emergency", "non-elective" and "unplanned" admissions interchangeably, having excluded maternity admissions from this definition

ONS – Office for National Statistics

PARR – Patients at Risk of Readmission: a predictive risk model that uses SUS data to identify individuals at risk of an unplanned hospital admission in the next 12 months

PCT – Primary Care Trust

PPV – Positive predictive value (percentage of at-risk patients identified by a predictive model who experience an unplanned admission to hospital)

Predictive modelling – models based on routine data that identify individuals in a population who are at high risk of a certain future event

Prognostic matching – a method for identifying controls based on similar risks of experiencing a future outcome such as unplanned hospitalisation

Propensity matching - a method for identifying controls based on similar likelihood of receiving an intervention such as admission to a virtual ward

Pseudonymous data – data from which personal identifiable fields have been removed or collapsed, and in which the unique identifier has been replaced by a unique but meaningless pseudonym

Read code data–data from primary care electronic medical record that have been coded using a system developed by Dr. James Read

ROC curve– Receiver operating characteristics curve that illustrates the trade-off between true positives (sensitivity) and false negatives (1 – specificity) for a predictive model

Risk stratification– assigning risk of a particular outcome (e.g. future unplanned hospital admission) to each person in a population

Sensitivity - percentage of people who experience an unplanned readmission to hospital who are correctly identified by the model as being at risk

SHA – Strategic Health Authority

STROBE - Strengthening the reporting of observational studies in epidemiology (guidelines for reporting observational studies)

SUS – Secondary Uses Service

Unplanned admission – we use the terms "emergency", "non-elective" and "unplanned" admissions interchangeably, having excluded maternity admissions from this definition

Virtual wards – a form of preventive hospital-at-home for patients at high predicted risk of unplanned hospital admission

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Executive Summary

Background

Health care systems in many developed countries are currently under financial strain because of ageing populations, the rising prevalence of various chronic diseases, and budgetary constraints resulting from the global economic downturn.

The costs of providing health care are highly skewed across the population, with a small number of patients accounting for a large proportion of expenditure. Since unplanned hospital admissions account for a high proportion of costs, considerable resources could potentially be invested in providing preventive care for a relatively small number of costly patients and yet still potentially yield net savings overall from averted future hospital costs. In practice, however, such savings have been difficult or impossible to demonstrate.

One reason why preventive interventions may be unsuccessful at reducing demand is if they are offered to patients who are at insufficiently high risk of future unplanned hospital admission. In 2005, the Department of Health commissioned two "case finding" tools for improving the identification of high-risk patients in England. Known as "PARR" and the "Combined Model", these predictive risk tools are now used in many parts of the country to select which high-risk patients should be offered a hospital-avoidance intervention.

One such intervention is the "virtual ward". This model of care uses the staffing, systems and daily routines of a hospital ward to deliver preventive care to patients in their own homes in the aim of mitigating their risk of unplanned hospitalisation. Whilst virtual wards have been introduced in many parts of the UK and overseas, their efficacy and cost-effectiveness has yet to be determined.

Aims

The purpose of this study was to assess the extent to which multidisciplinary case management in the form of virtual wards led to changes in the use of health care and social care by patients at high predicted risk of future unplanned hospital admission.

Our primary aim was to determine whether virtual wards have led to changes in rates of unplanned hospital admission compared to matched controls, and if so at what cost. Our secondary aims were to assess the impact of the intervention on rates of A&E attendance, social care provision, GP practice visits, and the use of community health services.

Methods

We studied a hospital avoidance intervention called "virtual wards" in three sites in England, namely Croydon, Devon and Wandsworth. We compared the health care and social care use of patients who received the intervention to those of matched controls. We used a range of matching techniques including prognostic matching and propensity score matching to draw controls from (a) national, and (b) local, individual-level pseudonymous administrative data. National data included Hospital Episode Statistics (HES), and mortality data from the Office for National Statistics (ONS). Local data included Secondary Uses Service (SUS) data, primary care clinical data from GP electronic systems, community health services data, and social care data from local operational systems.

We controlled for the observed differences between VW patients and control patients by selecting one or more control patients for each VW patient on the basis that they were similar in terms of a range of observed characteristics prior to the start of the intervention. The primary endpoints for this study were the comparative rates between VW patients and controls of unplanned hospital admission and mortality. The secondary endpoints were the rates and cost of A&E attendances, cost of social care provision, rates and cost of GP visits, and cost of community health services.

We determined the costs of establishing and running virtual wards in the three study sites from the perspectives of the NHS and local authorities using a combination of administrative data, interviews and diaries.

The study was designed to test the pooled results from all sites. However, the sample studied was highly unbalanced with the vast majority of cases coming from one site, Croydon.

Results

We found that each of the study sites had implemented variants on the virtual ward model as originally described. In Croydon, which was by far the largest of our three study sites, multidisciplinary preventive care was only offered during a short initial pilot period before changing to standard case management by community matrons. Our findings are therefore predominantly related to patients who received "standard" case management by a community matron rather than multidisciplinary case management from a virtual ward team.

It is important to remember that the pooled analysis may mask different results at the level of individual sites. The relatively small number of cases we were able to study in Devon and Wandsworth meant that it was not possible for us to determine any statistically significant changes at the individual study site level.

We found difficulties in identifying sufficient matched controls from within the local study areas, therefore our conclusions on impact are based on our analyses using controls derived from national data. Compared with these matched controls, we found no evidence of a reduction in emergency

hospital admissions for patients who received this type of care in the six months after starting the intervention. Nor did we find evidence of a reduction in ambulatory care sensitive hospital admissions in this period, nor in mortality.

We did, however, observe a reduction in elective hospital admissions and in outpatient attendances in the six months after starting the intervention. Both of these findings were significant at the $p<0.05$ level. However, we found no evidence of an overall reduction in hospital costs.

The direct costs of the interventions varied considerably between the three sites, ranging from approximately £3 per patient-day in Croydon and Devon to £17 per patient-day in Wandsworth, reflecting the heterogeneous nature of the interventions being studied. Over the 6 month follow up period of analysis these direct costs were of the order of £510-£2,890 per patient. These costs are approximations and the intervention in Wandsworth included a wider range of inputs to care, in particular in terms of GP support.

Conclusions

Whilst all three sites used the name "virtual wards" for their interventions, in fact most patients in this study received case management from a single provider undertaking standard case management activities. For this type of intervention, our principal conclusion is that we were not able to detect the anticipated reduction in unplanned hospital activity over a six-month period.

The significant reduction we did observe in outpatient attendances within the six-month timeframe could be attributable to better coordination of care for patients on a virtual ward. Similarly, the relative reduction we observed in elective admissions could reflect the fact that services were being undertaken by the virtual ward staff where ordinarily they would have required the patient to attend hospital. Alternatively, patients might have been making better informed choices where there was a degree of discretion over the need for an elective admission. Or another possibility is that the reduction in outpatient attendances might have lessened the use of inpatient services by stemming the so-called 'diagnostic-therapeutic cascade'.[1]

Using linked datasets, we were able to look at the broad range of services used by patients across the health and social care economy. The largest service costs were associated with emergency hospital admissions, and so the lack of a reduction in these admissions meant that overall, there was not a net reduction in the health and social care service use of patients who received the intervention.

It is important to note that in our analysis of national data, the controls were drawn from matched areas of England. While we were careful to ensure that these matched areas did not have a virtual ward intervention or equivalent in place during the study period, our analysis shows that emergency admission rates were declining for matched control patients in these matched areas as well as for cases, having adjusted for the predicted

risk score and other characteristics of the individuals concerned. This overall decline in admission rates suggests that there might have been other interventions or initiatives in place at the matched areas occurring at the same time as our study. It is therefore important to be cautious about interpreting the neutral findings in our analysis with regard to unplanned hospital activity.

The largest contributor of cases to our study was Croydon where, other than during an initial pilot period, the virtual wards delivered standard case management rather than multidisciplinary case management. One of the lessons for the health service from this evaluation therefore is that short term reductions in unplanned hospital admissions may not be amenable to reduction through standard case management. For areas Devon and Wandsworth we are aware that this initiative has also undergone some changes – particularly in Devon where the intervention has since expanded and consolidated. There is therefore a strong case to revisit some of our analyses with more recent and larger sample sizes.

Policymakers are attracted by the possibility that case management may generate net savings from averted unplanned hospital admissions whilst improving the quality of life for high-risk patients. This study forms part of a growing body of evidence that realising these benefits presents a major challenge. Further research may be needed to determine the characteristics of individual patients who are particularly amenable to preventive care and to tailor different preventive interventions to such characteristics - so-called "impactibility modelling".