Impact Of An Integrated Medicines Management Service (IMMS) On Preventable Medicines-related Readmission To Hospital: A Pilot Parallel Cohort Study

Professor Nina Barnett,∗1 Krupa Dave,∗2 Devinder Athwal,∗2 Paresh Parmar,∗2 Sunaina Kaher,∗1 Christine Ward.∗2

1 Consultant Pharmacist, Care of Older People, Northwick Park Hospital, London North West Healthcare NHS Trust & NHS Specialist Pharmacy Service; Honorary Reader, School of Pharmacy, University College London; Visiting Professor, Institute of Pharmaceutical Science, Kings College, London.
2 London North West Healthcare NHS Trust
Correspondence to: nina.barnett@nhs.net.

Abstract

Title
Impact Of An integrated Medicines Management Service (IMMS) On Preventable Medicines-related Readmission To Hospital: A Pilot Parallel Cohort Study.

Author List

Background
Medicines are known to contribute to approximately 10% of hospital admissions and up to half of these may be preventable. A service, known as the Integrated Medicines Management Service (IMMS), was developed at a large general hospital (A) to identify and manage patients at risk of preventable medicines-related readmission (PMRR) in order to reduce the risk of PMRR.

Objectives
This study investigates the effect of the pharmacy IMMS at Hospital A on the rate of PMRR in comparison to a traditional UK hospital pharmacy service at Hospital B within in the same organisation.

Method
Hospital A: Between October 2008 - October 2014, 744 patients were identified using the PREVENT© tool. IMMS pharmacists managed patients at risk of PMRR through medication reconciliation, review, consultation and, where appropriate, undertook post-discharge follow-up.

Hospital B: From February until October 2014, 92 patients were identified as at risk of PMRR who were then managed with a traditional pharmacy service.

Results
Hospital A: 119/744 patients were readmitted within 30 days of discharge. 2/119 patients (0.3%) were assessed as having a PMRR.

Hospital B: Of 92 patients identified 17 (18%) were readmitted within 30 days of discharge of whom 4/17 had a PMRR (4.4%). The difference was statistically significant.

Discussion
The IMMS pharmacists provided interventions to improve safety and efficacy of medicines use, identifying and resolving key concerns which can lead to medicines-related problems post discharge. This is supported by published literature. Consultations included using a coaching approach to support medicines adherence. Cross-sector, multidisciplinary communication with patients, carers and health/social care professionals supported safe transfer of care.

Conclusion
IMMS statistically reduces the rate of PMRR, representing a saving of £3 for every £1 spent on an IMMS pharmacist. Wider provision of this service has the potential to improve safety and reduce cost for the organisation.

Keywords: medicine support, medicine safety, medicines optimisation, pharmacy interventions, medicines-related readmissions.

Introduction
About £12.5 billion was spent in England between 2012-2013 due to emergency admissions.1 This is an important quality outcome measure2 for hospitals in England who may compare their emergency admission with the national figure, which is 5.3% for emergency admissions (2012/2013). In addition, hospitals are liable for penalty payments when patients are readmitted as an emergency within 30 days of being discharged so local readmission rates are also important. Data from the local Trust indicates a readmission rate of 6.4%.3

Approximately 10% of all hospital admissions and readmissions can be linked to medication with up to half being considered preventable.4,5 While there are many reasons for preventable medicines-related admissions and readmissions, common causes include non-adherence, taking specific high risk medicines, poor communication between care settings at care transitions and lack of monitoring.4,5
PREVENT® CHECKLIST

Refer patients with unmanaged complex medicines issues, modifiable through pharmaceutical care.

<table>
<thead>
<tr>
<th>Patient Name:</th>
<th>Name of Referrer:</th>
</tr>
</thead>
<tbody>
<tr>
<td>NHS Number:</td>
<td></td>
</tr>
<tr>
<td>DOB:</td>
<td></td>
</tr>
<tr>
<td>Address/Ward, Bed no</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Name of Referrer:</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Designation:</th>
<th>Contact no:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of Referral:</td>
<td>Site: NPH/ CMH /Ealing /E-CCG</td>
</tr>
</tbody>
</table>

Managed by:

If appropriate
Date of Admission: For Pharmacy Integrated Care Service (PICS) use only:
Date of Discharge:

Referral Accepted: Yes □
No □ Reason ____________________________

Please circle relevant risk factors

**Physical impairment**
Patient has difficulties with swallowing, impaired dexterity, poor vision, hard of hearing or poor mobility which will impact on them taking medication.

**Frailty**
Patient is identified as frail using validated methods e.g. Clinical Frailty Index (1 = very fit, 2 = well, 3 = managing well, 4 = vulnerable, 5 = mildly frail, 6 = moderately frail, 7 = severely frail, 8 = very severely frail, 9 = terminally ill).

**Adherence issues/compliance support**
Patient has not been taking their medicines e.g. various dispensing dates on medicines, no recent dispensing of medication, newly started on all medicines or cannot give names of medicines they are taking.
Patient has decided to stop taking all or some of their medicines which has led, or will lead, to worsening of their clinical condition.
Refer all new requests for compliance support.

**Cognitive impairment**
Patient has a temporary or long-term condition which affects their mental capacity to safely take medicines (including memory loss) e.g. confusion, delirium, dementia.

**New diagnosis/exacerbation of disease**
Admission is related to poor management of medication for a long-term clinical condition or deterioration of organ system function e.g. renal, cardiac, epilepsy, diabetes.
Previous admission or A&E attendance within 30 days.
Depression, high level of stress, other mental health, alcohol or drug abuse.
Falls - include disease and medication related (exclude mechanical/alcohol related falls).

**Medicines related admission/risk from specific medicines**
Patient is taking a high risk medicine: anticoagulants/antiplatelets, insulin/oral hypoglycaemias, NSAIDs, benzodiazepines, antihypertensives, diuretics, beta blockers, opioids, methotrexate, injectable medicines or drugs requiring therapeutic drug monitoring especially with no monitoring which the patient is unable to manage.
Patient has a complex of medicine regimen, recent stop, start or change in medicines.
Polypharmacy or patient is unable to manage.

**Cultural/social**
Patient cannot manage daily activities independently or has carers to help with daily activities but not medicines.
Patient has cultural beliefs around illness and treatment impacting on medication adherence.
Patient has social issues such as no fixed abode, unkempt, etc which impacts on them taking medication.
Smoker.

Figure 1: PREVENT® - current version at the time of publication
A local referral tool was created from the literature and informed by pharmacy practice, known as the PREVENT© tool (see Figure 1, current version at the time of publication. For the version used in the study, please contact the author). This tool has been designed and was developed over time to identify risk factors for preventable medicine related readmissions (PMRR)4-9 and, while the literature offers a number of methods to target patients at high risk of readmission, there is no nationally accepted or validated method.10,11,12

The literature describes integrated medicines management (IMM) services in the USA, Northern Ireland and Sweden which reduce preventable medicines-related readmissions.13-16 In 2008, an IMM service was introduced to Hospital A, a 658 bedded district general hospital with one whole time equivalent (WTE) experienced pharmacist (provided by two half time pharmacists) during weekday and working hours. The service was managed and supervised by a Consultant Pharmacist for Older People and key components of the service, which has been described in the literature,17 are described in Box 1.

Objective
To pilot a comparison of the effect of a traditional United Kingdom (UK) Clinical Pharmacy Service with IMMS on reduction in preventable medicines-related hospital readmissions within 30 days of the first discharge across two hospital sites.

Method
In Hospital A (active site, Northwick Park Hospital), patients meeting the referral criteria for a PMRR from any ward were referred to and managed by the IMMS team using the method outlined in Box 1. This constituted the active group. Patients who had risks not modifiable by pharmacy were referred to the appropriate service.

In Hospital B (control site, Central Middlesex Hospital), an approximately 200 bedded hospital within the same Trust without IMMS, patients who met the PREVENT© criteria for referral were managed as per the standard clinical pharmacy service. This constituted the control group.

Pharmacy staff involved in the pilot were trained to use the PREVENT© tool (both sites).

Data collection
In order to achieve statistical significance for the comparison, retrospective data was collected on the 744 patients referred to IMMS in Hospital A between October 2008 and October 2014. Full year data was available from October 2008 - March 2010 but information technology challenges meant that only samples of data were available thereafter.

Data was compared with Hospital B where a statistician was consulted and it was calculated that 92 patients from Hospital B were required to compare to the 744 in Hospital A. The data from Hospital B was collected between February and October 2014.

“Approximately 10% of all hospital admissions and readmissions can be linked to medication with up to half being considered preventable.”

- Medicines reconciliation on admission.
- Medicine optimisation e.g. stopping or starting medicines, titrating medicines to clinically effective doses.
- Patient-centred medicines consultations, including discussion of newly prescribed, stopped and changed medicines. All members of the team received formal training in health coaching during 2014.
- Full documentation of medicines changes and monitoring required on the discharge notification sent to GPs and/or pharmacies.
- Medicines-related discharge planning with patients, carers, health and social care teams in primary and secondary care, including medicines compliance aid assessment where appropriate and medication counselling.
- Pre-discharge referral to primary care health and social care professionals as well as carers where necessary, including referrals to community pharmacists for the New Medicines Service (NMS) or discharge Medicines Use Review (MUR) where appropriate.
- Post discharge telephone follow-up with patient and/or carers to support medicines-related care.

Box 1: Key components of the IMMS
Readmission review

Using the Trust Hospital Admissions data, information on readmissions at 30 days was obtained for both Hospital A and B for the periods studied. Data were reviewed from the electronic discharge summary for patients readmitted as an emergency (excluding A&E visits only) by two IMMS senior member pharmacists and the reason for readmission was classified according to clinical, social and medicines-related. The readmission was also classified as preventable or non-preventable. Note that some patients had more than one classification (see Box 2).

A Consultant Geriatrician, blinded to the cause of readmission and hospital site, peer reviewed all readmissions including cause of readmission as preventable or non-preventable and clinical, social or medicine-related classification.

In addition, the Consultant Geriatrician reviewed a random sample (1 in 10), of all patients readmitted from both hospitals and classified according to the same criteria.

A flow chart to illustrate Hospital A and Hospital B data collection is presented in Figures 2 and 3.

Statistics

A statistician was engaged to review the data. Fisher's exact test was used to compare the data from Hospital B and Hospital A as this data was binary and readmissions were uncommon. In addition, 95% confidence intervals and risk ratio were calculated for both sites.

Readmission classification

Readmissions can either be preventable (e.g. patient not taking their regular medicines as they are unable to obtain them) or non-preventable (e.g. patient had a new diagnosis of depression).

The preventable readmission can be modifiable (e.g. arrange repeat dispensing and delivery of medicines through pharmacy intervention) or unmodifiable (e.g. patient is homeless). While the IMMS team can contribute to reducing a preventable medicines-related readmission through pharmacy interventions, other readmissions can only be influenced where there is a medicines-related aspect to that readmission.

Readmissions can be classified according to clinical, medicines-related or social reasons. Clinical reasons may include patients who are readmitted due to an exacerbation of a long term medical condition such as Parkinson's disease, diabetes, heart failure, asthma and chronic obstructive pulmonary disease, as well as chronic alcohol use and recurrent falls. Social readmission relates to, for example, patients who have no fixed abode or GP, show signs of self-neglect, social isolation, housebound and patients unable to manage tasks of daily living independently. These patients may require support with daily tasks through carers (informal or formal. Medicines-related reasons include patients who have poor adherence and those prescribed a high risk medication but due to a physical or cognitive impairment may not be able to take their medication safely. There are many medicines that can increase the risk of a readmission if not taken as prescribed; examples include insulin, warfarin, antiplatelets, diuretics, oral hypoglycaemics, antihypertensives and opiates. Poor communication on medicine changes between care settings may also lead to a readmission.

Preventable medicines-related readmission data from Hospital A and Hospital B

- Patient was readmitted one day following discharge with diarrhoea secondary to laxatives use that were not reviewed on the previous admission (Hospital B).
- Patient was readmitted with unresolved vomiting secondary to use of anti-tuberculosis medication (Hospital B).
- Patient with dementia readmitted with seizures secondary to non-compliance with anti-epileptic medication as patient had carers but they would not support with medication unless in a compliance aid (Hospital B).
- Patient on warfarin for deep vein thrombosis (DVT), insulin and oral anti-diabetic medicines for diabetes was readmitted with reduced mobility and treatment of DVT. On his readmission it was noted that he was non-compliant with medication due to longstanding cognitive impairment, therefore his warfarin was stopped and arrangements were made to start LMWH for treatment and for support with his other medicines, including district nurses to administer insulin (Hospital B).
- Patient medication changes were not actioned by GP on discharge and patient readmitted as ran out of medication following discharge (Hospital A).
- Patient was started on dexamethasone prior to admission for a tumour. However, the patient was intentionally non-compliant due to fear of adverse effects from steroid therapy. Readmitted due to exacerbation of clinical condition that could have been prevented with dexamethasone. Potential for prevention of readmission if the patient's health beliefs had been explored more during admission (Hospital A).

Box 2: Readmission classification examples and details for preventable medicines-related readmissions
92 patients identified at risk of preventable medicines-related readmission at Hospital B (One in ten patients were peer reviewed)

17 patients readmitted within 30 days of discharge
NB: patients may have had more than one reason for readmission

Note: Some patients have more than one reason for readmission so total readmission reasons exceed total readmission. The majority of all cause readmissions identified were non-preventable.
Governance

The study was assessed by the Trust Governance Committee and was deemed to be a service improvement and did not need ethical approval.

Results

Readmissions

The IMM team saw 744 patients for which data was available in the pilot study period of whom 119 (16%) were re-admitted to Hospital A within 30 days of discharge, with two (0.3%) of the readmissions being identified as a PMRR (Chart 1).

92 patients were identified at Hospital B of which 17 (18%) were re-admitted within 30 days of discharge, with four (4.4%) of these patients were re-admitted for a PMRR (Chart 2).

The difference between PMRR rates at the two sites was statistically significant (P<0.002, Fisher’s exact test) with a risk ratio of 16.2 and 95% confidence intervals of 3.0, 87.1.

Referrals

At Hospital A, the most common reason for referral to the service was to assess the need for commencing a compliance aid. At Hospital B, however, the main reason for referral was cognitive impairment, non-adherence to medication and risk from specific medicines followed by compliance aid support (Chart 3).

Interventions

Most interventions identified ongoing medication problems for patients, interventions made during the inpatient stay and follow-up recommendations post discharge (including community pharmacist). Specifically, more than three quarters of interventions (84%) involved patient consultations. Half (50%) included discussion with the patient’s community pharmacist and one third (32%) with their GP surgery (Chart 4).

Cost

An IMMS patient episode was estimated at 4 hours per patient during the pilot. This equates to 1 WTE (given 46 weeks/year with 6 weeks leave) reviewing 460 patients each year. Data from this pilot suggests

![Chart 1: Bar Chart showing the reasons for readmission within 30 days of discharge for 119 patients at the Hospital A site.](chart1.png)

Note: There may have been more than one reason for readmission. The majority of all cause readmissions identified were non-preventable.
that, if 460 patients are seen, only one patient would be re-admitted with a PMRR compared to 20 when the service was not provided. This suggests that 19 PMMRs per year per pharmacist per site could be avoided if the service had been provided in Hospital B. Provision of the service at Hospital A cost £49,974 per annum.

With over 95% of patients seen by IMM pharmacists being older people, the length of stay was estimated from Care of Older People wards. This is nineteen days at a cost of £444 per day (non-elective emergency admission) and the estimate of cost for one PMRR is £444 x 19 days = £8436 which, for 19 patients, is £160,284. With a pharmacist cost of £49,794, there is an opportunity cost of £10,490. Our pilot suggests this equates to a saving of over £3 for every £1 spent on pharmacist or an return on investment (ROI) of >2.

**Discussion**

With approximately 10% of hospital admissions being medicines-related and half being considered to be preventable, our study showed that at Hospital A had less readmissions than expected. From local readmission data we would expect 6.3% of patients to be readmitted within 30 days. For the number of patients seen in the study, this means 47 patients would be readmitted with a PMRR at Hospital A. By providing IMMS, this number was reduced to 2. In comparison to Hospital B, where 4 of 92 (4.4%) patients were readmitted, there were only 2 of 744 (0.3%) readmissions, the difference being statistically significant (p<0.002).

Scullin et al demonstrated that one readmission was prevented for every 12 patients receiving an IMMS. Similar services in other countries have demonstrated benefits. The pilot study data from Hospital A alone have been published and the full data given here concurs with findings from other centres.

While it is recognised that the data presented here are pilot results, these data suggest that provision of the service could benefit the health care economy with a return of over £3 per £1 invested.

![Chart 2: Bar Chart showing the reasons for readmission within 30 days of discharge for 17 patients at the Hospital B site.](chart2)

Note: There may have been more than one reason for readmission. The majority of all cause readmissions identified were non-preventable.
Chart 3: A bar chart to compare the reason for referrals via the PREVENT® checklist to the IMMS team between Hospital A and Hospital B site.

Reasons for referral

Note: some patients had more than one reason for referral.

Chart 4: Interventions by IMMS pharmacy staff at Hospital A.

Reasons for referral:
- Social
- Physical
- Cognitive impairment
- Medicines compliance aid
- Adherence issues
- Specific medicines risk
- New condition/worsening
- Medication compliance aid
- Medicines reminder chart
- Post disch discussion carer
- Post disch call to pt.
- Sign Posting
- Discharge note annotated

Note: some patients had more than one reason for referral.
This finding is in line, but with a lower ROI, with data reported from other IMMS sites where savings calculated including opportunity costs suggested a return of between £5 and £8 per every £1 spent on service provision. Reasons may be that other studies included costs associated with admission and outside hospital costs rather than cost of staff alone and assessing readmissions over a longer time frame.

Other benefits suggested by this pilot include support for medicines optimisation, including reducing inappropriate polypharmacy and improving transfer of care, which have been highlighted nationally. The IMMS team at Hospital A provided patient-centred consultations using a coaching approach and following NICE recommendations prior to discharge, and at discharge, documented medication changes to improve safety at transfer of care as part of medicines optimisation. This included discussion of perceptual and practical issues around medicine taking as well as education of patient and/or carer regarding indications, adverse effects, follow-up and ongoing monitoring.

Many of the interventions included facilitating information transfer between the patient, community pharmacist and GP. Studies have shown that risk around medicines can be minimised with good communication and referral to community pharmacists can reduce length of stay by 50%. The IMM service commonly liaised with social care as patients needing help with activities of daily living may also require assistance with medicines.

It is interesting to note that 36% of patients had medication compliance aids (MCAs) initiated at Hospital A whereas Hospital B does not provide a hospital-based compliance aid filling service for new patients. This is likely to account for the difference in interventions in this category. However, interventions including MCAs at Hospital A often resulted in alternative medicines support being put into place. This has been described recently in a study of a hospital and primary care service published by Lai et al who identify that patients referred for compliance aids often need individualised medicines support.

In terms of cross-sector working, there are a number of published studies which describe post discharge follow-up and its contribution to improving care through patient satisfaction as well as reducing hospital utilisation and admission. In a review of drug-related problems in older people after hospital discharge, the most effective interventions in reducing drug-related problems were considered as including both discharge planning and home follow-up.
follow-up. The IMM team worked across the interface, undertaking agreed post discharge telephone calls to patients/carers to support post discharge medicines management integrated with the multidisciplinary health and social care team. Studies have shown that post discharge follow-up helps promote patient satisfaction\textsuperscript{24,26} and reduce admission and hospital utilisation.\textsuperscript{27-30} In this study the community pharmacist was contacted to support adherence and provide community pharmacy medication services as appropriate.

As stated, studies suggest that causes of readmission are multi-factorial and that multidisciplinary team working supports reducing overall readmissions to hospital. A number of IMM services similar to this pilot have also demonstrated benefits of this type of support,\textsuperscript{14,15,16,24,25} which begs the question regarding rollout of IMM services. In order to do this, a collection of prospective data will be needed, preferably including a number of sites in primary and secondary care. An exploration of other measurable outcomes, which could include patient satisfaction, will also be needed.

Bias and limitations

This study is a pilot to explore what is possible in terms of data collection within a hospital Trust. Several limitations to this study are acknowledged including:

- lack of published data to guide the study around methods of reducing PMMRs
- discontinuous data collection from Hospital A
- convenience sampling over a different time period in Hospital B

The following is in progress:

- The service on all three sites is in the process of being merged, with staff in place on each site to undertake identification and management of patients in the risk group in secondary care and, on one site, primary care too.
- The data collection tool is being updated to improve robustness of data gathering and to add exclusion criteria for the service to PREVENT\textsuperscript{©} to ensure that services are being appropriately prioritised.
- PICS was launched on 6th June 2017.

Conclusion

Some medicines-related admissions and readmissions to hospital are avoidable. Reducing readmissions is better for patients and for the health system. This pilot study focussed on the provision of an IMMS to deliver holistic pharmaceutical care, identifying and managing high-risk patients to reduce preventable medicines-related readmissions. Results of this work suggest that an IMMS team is a cost-effective method to reduce PMMR. Further work, such as a case control prospective study, is required to confirm or refute these findings.

Declaration of interests

The authors have nothing to disclose.

Acknowledgements

We would like thank Dr Joseph Devine for peer reviewing the cases, Mr Paul Bassett for statistical analysis and Professor Michael Scott for his comments on the paper.

“\ldots an IMMS team is a cost-effective method to reduce preventable medicines-related readmissions.”
REFERENCES


22. Personal communication, Rachel Howard. Isle of Wight Medicines optimisation in vulnerable patients project, Jan 2015.


87

Journal of Pharmacy Management Volume 33 Issue 3 July 2017