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Impact of a pharmacist-prepared interim residential care medication administration chart on continuity of medication management after discharge from hospital to residential care: a prospective pre- and post-intervention study (MedGap Study)

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TITLE PAGE

Title: Impact of a pharmacist-prepared interim residential care medication administration chart on continuity of medication management after discharge from hospital to residential care: a prospective pre- and post-intervention study (MedGap Study)

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ARTICLE SUMMARY

1) Article Focus

- Medication administration errors are common when patients are discharged from hospital to a residential care facility (RCF). In Australia a contributing factor is the need for the patient's primary care doctor to attend the RCF at short notice to write a medication administration chart; when the doctor cannot attend, doses may be missed or delayed and a locum doctor may be called to write a medication chart.
- The objective of this study was to test the impact of a hospital pharmacist-prepared interim residential care medication administration chart (IRCMAC) on medication administration errors and use of locum medical services after discharge from hospital.

2) Key Messages

- Provision of a hospital pharmacist-prepared IRCMAC resulted in significant reductions in missed or delayed medication doses and use of locum medical services after discharge from hospital.
- RCF staff reported that the IRCMAC improved continuity of care, and primary care doctors reported that it reduced pressure on them to attend RCFs at short notice.

3) Strengths and Limitations.

- This is the first study to evaluate the impact of a hospital-provided IRCMAC on medication errors or use of locum medical services. Strengths were that the two study groups were well matched in terms of demographics, ward-type, number of medications, and number of RCFs (>90 in each group).
- The main limitations were the use of a pre- and post-intervention study design and data collection via RCF staff telephone interview. However quantitative data on medication errors and use of locum services were validated by strongly positive feedback from RCF staff and doctors and widespread uptake of the IRCMAC.

ABSTRACT

Objectives: To test the impact of a hospital pharmacist-prepared interim residential care medication administration chart (IRCMAC) on medication administration errors and use of locum medical services after discharge from hospital to residential care.

Design: Prospective pre- and post-intervention study.

Setting: One major acute care hospital and one subacute aged-care hospital; more than 90 residential care facilities (RCF) in Victoria, Australia.

Participants: 428 patients (median age 84 years, inter-quartile range 79-88) discharged to a RCF from an inpatient ward over two 12 week periods.

Intervention: Seven-day IRCMAC, auto-populated with patient and medication data from the hospitals' pharmacy dispensing software, completed and signed by a hospital pharmacist and sent with the patient to the RCF.

Primary and secondary outcome measures: Primary endpoints were the proportion of patients with one or more missed or significantly delayed (>50% of prescribed dose interval) medication doses, and the proportion of patients whose RCF medication chart was written by a locum doctor, in the 24 hours after discharge. Secondary endpoints included RCF staff and GPs' opinions about the IRCMAC.

Results: The number of patients who experienced one or more missed or delayed doses fell from 37/202 (18.3%) to 6/226 (2.7%) (difference in percentages 15.6%, 95%CI 9.5-21.9%, p<0.001). The number of patients whose RCF medication chart was written by a locum doctor fell from 66/202 (32.7%) to 25/226 (11.1%) (difference in percentages 21.6%, 95%CI 13.5-29.7%, p<0.001). For 189/226 (83.6%) discharges, RCF staff reported that the IRCMAC improved continuity of care; 31/35 (88.6%) GPs said the IRCMAC reduced the urgency for them to attend the RCF, and 35/35 (100%) said that IRCMACs should be provided for all patients discharged to a RCF.

Conclusions: A hospital pharmacist-prepared IRCMAC significantly reduced medication errors and use of locum medical services after discharge from hospital to residential care.

MAIN TEXT

INTRODUCTION

Continuity of medication management is often compromised when patients are discharged from hospitals to residential care facilities (RCF) such as 'nursing homes' and 'care homes'.[1-8] Missed, delayed or incorrect medication administration is common.

Patients discharged to RCFs have complex and intensive medication needs.[1] An Australian study reported that patients discharged to RCFs were prescribed an average of 11 medications, of which seven were new or had been modified during hospitalisation.[2] The median time between arrival at the RCF and the first scheduled medication dose was three hours, and 'when required' (*prn*) medications were sometimes needed sooner.[2]

In a study conducted in the USA, most patients transferred to a RCF had one or more medication doses missed; on average, 3.4 medications per patient were omitted or delayed for an average of 12.5 hours.[5] In another US study, medication discrepancies related to transfers to and from hospitals and RCFs resulted in adverse drug events in 20% patients.[7] In an analysis of medication incidents that resulted in patient harm in Canadian long-term care facilities, patient transfer was identified as a common factor.[8]

Australian studies report that up to 23% of patients experience delays or errors in medication administration after discharge from hospital to a RCF.[2, 3, 9] A key reason is difficulty accessing primary care doctors (general practitioners [GPs]) at short notice to write or update RCF medication charts.[2, 3, 10]

Delays in obtaining an up-to-date medication chart can range from a few hours up to several days.[2, 10, 11] In the absence of an up-to-date medication chart, RCF staff may withhold medications, administer them without a current medication chart, or revert to pre-hospitalisation medication regimens.[2, 11] The clinical significance of delays or errors in medication administration depends on the clinical status of the patient, the nature of the medications involved and the length of the delay. In some cases no adverse event occurs. However, delays in access to medications for symptom control (e.g. analgesics and medications for terminal care) can adversely impact on quality of life, and delays or errors with regularly scheduled medications (e.g. anti-epileptics and antibiotics) may have serious consequences.[11] Unplanned hospital re-admissions have been reported as a result of failure to receive prescribed medications after transfer to a RCF.[11] When the patient's GP is unable to attend, a locum medical service may be called to write RCF medication chart, however this does not eliminate missed doses and errors, and it adds significantly to the cost of care.[2]

When GPs (or locums) write RCF medication charts, they often do not have access to accurate discharge medication information.[2, 3, 9, 12] Medication changes made in hospital are frequently not explained in medical discharge summaries, and discrepancies between discharge summaries and discharge prescriptions occur in up to 80% of cases.[2, 9, 12-15]

Some Australian hospitals have attempted to improve continuity of medication management by providing 5- or 7-day interim residential care medication administration charts (IRCMACs) on discharge. These charts enable medications to be safely administered upon arrival at the RCF, without the need for urgent GP or locum attendance. They enable the GP to attend the RCF and review the patient at a clinically appropriate time, a few days after discharge, rather than on the day of hospital discharge., Use of IRCMACs is not widespread,

and where they have been used there has been no evaluation of their impact on medication administration or use of locum medical services. Most Australian hospitals do not use electronic prescribing systems and, based on anecdotal experience, expecting hospital doctors to prepare handwritten interim medication charts at the point of discharge is neither a reliable, safe nor sustainable method for providing IRCMACs. This is because it relies on hospital doctors remembering to write the chart, it introduces risk of discrepancies between the IRCMAC and the discharge prescription(s), and it adds to hospital doctors' workload.

For this study, a novel method for preparing IRCMACs was developed. IRCMACs were generated via hospital pharmacy dispensing software during the processing of discharge prescriptions, with auto-population of the chart with patient, prescriber and medication data (name, strength and directions). This occurred after the discharge prescription had been reviewed by a pharmacist (including reconciliation with pre-admission medications and inpatient medication charts) and errors corrected. This method was chosen to avoid the need for manual transcription, minimise additional workload, and ensure the IRCMAC and discharge medications were concordant. An additional novel aspect, designed to address gaps in provision of discharge medication information, was inclusion of the 'change status' for each medication (unchanged, new, or dose-changed, with date and reason for change if known to the pharmacist), a list of medications ceased (with the date and reason, if known), and time of last dose given in hospital for each medication. These details were manually added by the pharmacist.

The aim of this study was to evaluate the impact of the hospital pharmacist-prepared IRCMAC on continuity of medication administration and use of locum medical services following discharge to RCFs.

METHODS

A prospective pre- and post-intervention study was undertaken at a 400-bed acute care hospital and an 80-bed subacute aged care (geriatric assessment and rehabilitation) hospital within a major metropolitan public health service in Melbourne, Australia over two 12-week periods (January-April and September-November 2009). A detailed analysis of the baseline (pre-intervention) data has been previously published;[2] this paper compares post-implementation data with that baseline data. The study was approved by the Austin Health and Monash University Human Research Ethics Committees.

Patients were eligible for inclusion if they were discharged to a RCF following an overnight stay on an inpatient ward. Exclusion criteria were: discharge under the Transition Care Program (a hospital managed short-term residential care program) or no medication changes made in hospital.

During the pre-intervention (control) period, no IRCMAC was provided. The hospitals' discharge policy included supplying all prescribed medications for patients discharged to a new RCF, or new and changed medications for patients returning to a RCF, dispensed in original packaging. A photocopy of the discharge prescription(s) was provided in the bag of medications.

During the post-intervention period, a 7-day IRCMAC was prepared by a hospital pharmacist. The IRCMAC and a photocopy of the discharge prescription(s) were placed in a transparent red plastic sleeve along with instructions for using the IRCMAC. The red sleeve was placed in a clear plastic bag with the discharge medications and transported with the patient. The

pharmacist telephoned the RCF prior to discharge to notify them that an IRCMAC would be provided. No other discharge procedures were changed.

Prior to implementation of the IRCMAC, stake-holders including hospital and RCF staff, GPs and regulatory, professional and accreditation organisations were consulted (Appendix). They provided input into the design of the IRCMAC and procedures for its preparation and use. All pharmacists involved in hospital discharge management received training in IRCMAC preparation. A standard operating procedure for use of the IRCMAC at RCFs was mailed to all RCFs that accepted patients from the health service during the pre-intervention study period.

Data collection

Data collection methods have been described in detail previously.[2] Briefly, a structured telephone interview was conducted with a RCF staff member responsible for managing the patient's medications using a pre-piloted questionnaire. Interviews were conducted approximately 24 hours after discharge. In the post-intervention period, for logistical reasons, interviews were not conducted on weekends, therefore interviews for Friday and Saturday discharges occurred 48-72 hours after discharge. Data collected included: time of arrival at the RCF, whether the RCF medication chart had been written/updated in time for the first dose of regularly scheduled medication, who wrote/updated the chart (if written), whether any doses had been missed or delayed since the resident arrived (and if so, the medication name and length of delay). In the post-intervention period, additional questions were asked, including: whether an IRCMAC was received, whether it was used to record medication administration, and whether the RCF staff member felt that the IRCMAC improved the medication transfer process. Also in the post-intervention period, a second structured

telephone interview was performed on day 8 post-discharge if the patient had not had their RCF medication chart written/updated at the time of the initial interview (to determine who wrote/updated the RCF medication chart, and whether the IRCMAC avoided or merely delayed locum doctor attendance).

To assess GP satisfaction with the IRCMAC, a 4 item questionnaire was mailed to the GPs of patients who had been provided with an IRCMAC during the last 4 weeks of the post-intervention period, along with a pre-addressed reply-paid envelope. There was no follow-up of non-responders.

Primary endpoints were the proportion of patients who experienced one or more missed or significantly delayed medication doses, and the proportion of patients whose RCF medication chart was written/updated by a locum doctor, in the 24 hours after discharge. Missed or significantly delayed doses were defined as: regularly scheduled medication dose completely omitted; regularly scheduled medication dose delayed by more than 50% of the prescribed dose-interval; or 'when required' (*prn*) medication delayed by any length of time if it was required by the patient.

Secondary endpoints were the proportion of patients for whom a 'workaround' was used by RCF staff to avoid a delayed or missed dose when an updated medication chart was not available, and RCF staff and GP satisfaction. A 'workaround' was defined as any action taken by RCF staff that was not usual practice for medication administration at the RCF (eg. using a copy of a hospital inpatient medication chart or administering medications without a medication chart).

The minimum sample size required was 112 patients per group, based on a predicted reduction in the incidence of missed or delayed doses from 25% to 10% (power 80%, level of significance 0.05, 2-sided). Statistical analysis was performed using SPSS Version 19.0 (IBM SPSS Statistics, USA). The chi square test was used to compare categorical data, and Mann-Whitney U for all other (non-parametric) data.

RESULTS

Of 593 patients discharged to a RCF, 428 met the inclusion criteria and had a post-discharge interview completed (Figure 1).

There were no significant differences between the pre- and post-intervention groups in terms of age, gender, length of hospital stay, number of medications, level of residential care, or time from discharge to first scheduled dose (Table 1).

In the pre-intervention period, 75 medications for 37 (18.3%) patients had one or more doses missed or significantly delayed within 24 hours of discharge from hospital. Following implementation of the IRCMAC, 9 medications for 6 (2.7%) patients were missed or delayed (difference in percentages 15.6%, 95% CI 9.5-21.9%, $p < 0.001$). Missed doses accounted for most medication administration errors: 70 (93%) pre-intervention and 9 (100%) post-intervention.

The number of RCF medication charts written or updated by a locum medical service within 24 hours of discharge declined following implementation of the IRCMAC, from 66 (32.7%) to 25 (11.1%) (difference in percentages 21.6%, 95% CI 13.5-29.7%, $p < 0.001$). Day 8

telephone interviews identified only 1 additional patient whose RCF medication chart was subsequently written/updated by a locum medical service.

One hundred and seventy-five (77.4%) patients in the post-intervention period did not have their RCF long-term medication chart written/updated by a GP or locum service in time for their first scheduled medication dose. In 147 (84%) of these cases, the RCF received and used the IRCMAC, 20 (11%) received but did not use the IRCMAC, and 8 (5%) did not receive the IRCMAC. The number of patients for whom a 'workaround' was used to avoid a missed or delayed dose fell following implementation of the IRCMAC, from 90 (44.6%) to 22 (9.7%) ($p < 0.001$).

For 189 (83.6%) discharges, the interviewed RCF staff member reported that the IRCMAC improved continuity of medication management, and in 139 (61.5%) cases the information about medication changes was useful. Examples of comments from RCF staff are provided in Table 2, categorised by theme. Questionnaires were sent to 84 GPs. Four were returned as the GP was no longer managing the resident's care, and 35 were completed (response rate 43.8%). GPs were highly satisfied with the IRCMAC and wanted it to become standard practice for all discharges to RCFs (Table 3).

DISCUSSION

This is the first study to evaluate a hospital-provided IRCMAC for patients discharged to residential care. It demonstrated that an IRCMAC prepared by hospital pharmacists (linked with review and processing of discharge prescriptions) improved continuity of medication administration, reduced pressure on the GP workforce, and reduced the need for locum

medical services to write RCF medication charts. It also led to a reduction in potentially unsafe medication administration 'workarounds' used by RCF staff.

Clinical outcomes were not assessed, but case reports and anecdotal evidence indicate that 'workarounds' and missed doses sometimes result in adverse outcomes.[7, 8, 11, 16] Of the 75 missed and delayed medications in the pre-intervention period, a moderate or high risk of adverse outcome was considered by a multidisciplinary expert panel to be likely in 49 (65.3%) cases.[2]

Reduced reliance on locum doctors to write medication charts after hospital discharge also has potential to improve patient safety, because the locum would be unfamiliar with the patient and may not be the most appropriate person to write the long-term care medication chart (which can be used for up to 6 months). The IRCMAC enables the GP to review the patient (and write the long-term care medication chart) at a clinically appropriate time, a few days after discharge, rather than on the day of hospital discharge.

Reduced reliance on locum medical services also reduces healthcare costs. If the results of this study were replicated across all hospitals in Australia (based on 2001-2 discharge data,[17] and the minimum Medicare Australia locum medical consultation rebate in 2010 [AUD126]), savings to the Australian Government in excess of AUD2.1 million annually could be realised. Avoidance of adverse medication events may lead to further cost-savings. The IRCMAC could also lead to efficiency gains within the RCF and GP workforce; telephone interviews and satisfaction surveys suggested that the IRCMAC resulted in considerable (though unquantified) time savings for RCF staff and GPs. Countering these savings would be costs incurred by hospitals to deliver the IRCMAC (software, pharmacy

labour and consumables), but in our experience these would be significantly less than the likely savings.

Although RCF medication charts are traditionally written by medical practitioners, the IRCMAC used in this study was able to be legally prepared and signed by the pharmacist because in the RCF setting the chart was an administration record, not a prescription, and therefore did not need the signature of a medical practitioner. Preparing the IRCMAC in this way provided a number of advantages. It ensured that IRCMAC production occurred after the discharge prescription had been reviewed and reconciled by a pharmacist, and errors corrected, and it enabled auto-population of the chart from the pharmacy dispensing software. This ensured a high level of concordance between the IRCMAC and the discharge prescription. An audit of a random selection of 76 IRCMACs prepared during this study revealed a medication discrepancy rate of 9/870 (1.0%).[18] Although there are no studies that have assessed accuracy of hand-written IRCMACs, medication transcription error rates on hand-written inpatient orders and discharge summaries range from 12% to 56%.[14, 19-21]

There were some limitations with our methodology. Data on missed and delayed doses was obtained by telephone interview, introducing risk of under-reporting and recall bias. However, as described elsewhere,[2] we piloted several methods of data collection, and telephone interview 24 hours after discharge was judged to be the most reliable and practical. Any under-reporting and recall bias is likely to have been similar during the pre- and post-intervention periods. Whilst transfer-related medication administration errors may continue for several days after discharge,[4, 9] our methodology did not enable us to assess what proportion of errors persisted beyond 24 hours after discharge. Use of a pre- and post-

intervention study design meant that the interviewer could not be blinded to group allocation, and that factors other than the IRCMAC could have contributed to the reduction in medication administration errors and LMS attendances over time. However the strongly positive feedback from GPs and RCF staff regarding the impact of the IRCMAC suggests that it was the primary cause of the observed improvements. Furthermore, the participating hospitals have continued to provide IRCMACs since this study finished, and (unsolicited) positive feedback continues to be received. Several RCFs have indicated that they are now happy to accept patients on weekends or after hours, provided they receive the IRCMAC, whereas previously they would not. A major locum medication service in the area has indicated that since the IRCMAC was introduced they infrequently receive calls to write medication charts following hospital discharge. Data was collected from RCFs within approximately 24 hours for all discharges in the pre-intervention period, but up to 48-72 hours in the post-intervention period for Friday and Saturday discharges (24 hours for all others). It is possible that the longer time between discharge and interview in the post-intervention period may have increased the risk of recall bias. However Saturday discharges were rare (5/226), and it was our experience that delaying interviews for Friday discharges until Monday was advantageous, because the interview was more likely to involve a RCF staff member who was present on Friday, when the patient arrived. Therefore, this minor difference in methodology was unlikely to have resulted in under-estimation of error prevalence.

In conclusion, implementation of a hospital pharmacist-prepared IRCMAC led to significant improvements in continuity of medication administration and reduced reliance on locum medical services to write medication charts after discharge from hospital to RCFs. As a result of this study, hospital pharmacist-prepared IRCMACs are being implemented in many Australian hospitals, and national guidelines addressing continuity of medication management

on transfer from hospital to RCF are planned. Although health systems vary between countries, problems with continuity of medication management on discharge from hospital to residential care have been reported internationally,[2, 5, 8] so the findings of this study may be widely applicable.

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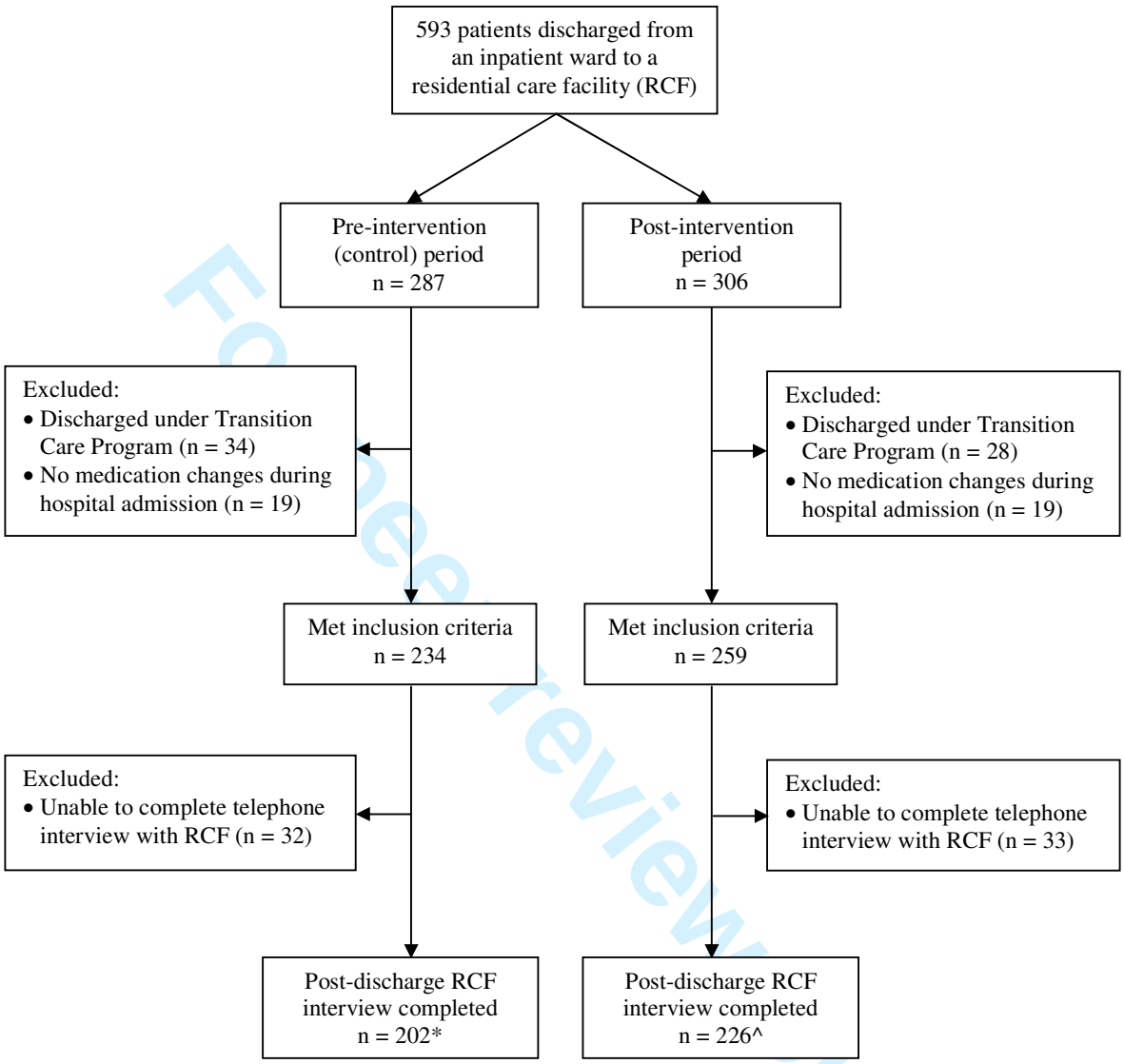
Figure 1. Patient flow diagram



* discharged to 90 RCFs; ^ discharged to 91 RCFs

RCF: Residential care facility

Table 1. Patient demographics

	Pre-intervention n = 202	Post-intervention n = 226	p-value
Age (years) [median (IQR)]	84 (79-88)	84 (79-88)	0.73
Gender [number (%) female]	119 (58.9)	142 (62.8)	0.43
Length of stay in hospital (days) [median (IQR)]	11.5 (6.0-33)	11.0 (5.8-33)	0.63
Number of medications prescribed on discharge from hospital [median (IQR)]			
Regular	9.0 (6.5-12)	9.0 (7.0-12)	0.41
When required (*prn*)	1.0 (0-2.0)	1.0 (0-2.0)	0.15
Total	11.0 (7.0-13.5)	10.0 (8.0-14)	0.60
New admission to RCF [Number (%)]	76 (37.6)	79 (35.0)	0.62
Level of care at RCF [Number (%)]			
High*	97 (48.0)	126 (55.7)	0.21
Low†	92 (45.5)	89 (39.4)	
Other‡	13 (6.4)	11 (4.9)	
Time between arrival at RCF and first scheduled dose due [median (IQR), minutes]	180 (60-360)	180 (60-330)	0.17

RCF: Residential care facility

* Australian Government-approved and subsidised residential aged care place for a person who needs a high level of assistance with activities of daily living and 24-hour nursing care.

† Australian Government-approved and subsidised residential aged care place for a person who needs a lower level of personal and nursing care.

‡ Residential care facility providing non-government subsidised personal and/or nursing care (e.g. Supported Residential Service).

Table 2. Examples of comments from residential care staff about the interim residential care medication administration chart (IRCMAC)

Theme	Comments
Reduction in need for urgent medical practitioner attendance	"Avoided us needing to call locum" "Beautiful, perfect, gives time to organise doctor" "So good. Saves getting locum, saves getting a phone order" "Very good, can't get doctor always. Could accept patients (from hospital) later now. Normally only before 1pm"
Clarity of information	"Brilliant, able to read, very easy to read" "More legible, easier for the doctor. Really good"
Usefulness of information	"Change status alerted nurse of new medications" "Did not need to check when last dose was given"
Reduction in medication administration errors	"Wouldn't have been able to administer medications (without it)" "…Usually cannot administer from script so this allowed for signing"
Lack of familiarity with IRCMAC (RCF staff who received but didn't use the IRCMAC)	"…. didn't realise it could be used til the day after" "Unfamiliar with the chart though fantastic idea" "Would have been helpful if staff familiar"

IRCMAC = Interim Residential Care Medication Administration Chart

Table 3. General practitioner (GP) questionnaire

Survey question	Yes [Number (%)]	No or Not sure [Number (%)]
Did the provision of an IRCMAC reduce the urgency for you to attend the RCF to review this patient after discharge from hospital?	31/35	4/35
Were you comfortable with a hospital-provided IRCMAC being used at the residential care facility (for up to 7 days) until you or another GP were able to review the patient and write the long-term residential care medication chart?	35/35	0
Were the "Change status" and "Medications ceased" sections on the IRCMAC helpful for informing you about medication changes made in hospital?	34/35	1/35
Do you think provision of an IRCMAC should be standard practice for all patients discharged from hospital to a residential care facility?	35/35	0

Examples of comments from GPs about the IRCMAC:

- "This is a great help in arranging an easy move from hospital to residential care facility and helps take the pressure off the first few days – thank you."
- "Less stress on (RCF) staff chasing the GP's or locum service to write the medication chart."
- "The typed nature of these charts helps a lot – some hand written discharge medication lists in the past have been illegible."
- "Interim chart is very useful. Would be useful if done for every patient discharged to residential facilities on a regular basis."
- "(I) think this is the best idea ever."

GP = General practitioner

IRCMAC = Interim Residential Care Medication Administration Chart

APPENDIX. Stakeholders consulted during development of the interim residential care medication administration chart

Australian government and professional bodies:

- Aged Care Standards & Accreditation Agency
- Australian Nursing Federation
- North East Valley Division of General Practice
- Northern Division of General Practice
- Nurses Board of Victoria
- Pharmacy Board of Australia
- Victorian Department of Health – Aged Care Branch
- Victorian Department of Health – Ambulatory & Continuing Care Programs Branch
- Victorian Department of Health – Drugs and Poisons Unit
- Victorian Department of Health – Quality Use of Medicines Program

Individual health professionals and aged care staff:

- Community pharmacists (n = 4)
- Hospital pharmacists (n = 6)
- Hospital doctors (n = 3)
- Hospital aged care liaison nurse (n = 1)
- RCF staff (directors of nursing, care coordinators, division 1 & 2 registered nurses, personal care assistants) (n = 34)
- General practitioners (n = 6)

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COMPETING INTERESTS:

None

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Gaps in continuity of medication management during the transition from hospital to residential care: an observational study.

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Abstract

Objective: To assess continuity of medication management during transition from hospital to residential care facilities (RCF).

Method: Telephone interviews with RCF staff were performed 24hours after patient transfer to determine proportion of patients with: missed or significantly delayed doses; RCF medication chart not written/updated in time for the first dose; suitably packed medications not available for the first dose; and RCF medication chart written/updated by a locum doctor. Retrospective audit was used to identify discharge summary discrepancies.

Results: Seventy-five doses for 37/202 (18.3%) patients were missed or significantly delayed in the 24 hours after discharge. 125 (61.9%) patients did not have their medication chart written/updated and 77 (38.1%) did not have suitably packed medications available for the first dose. Locum doctors wrote RCF medication charts for 66 (32.7%) patients. 197/392 (50.3%) changes to regularly scheduled medications were communicated.

Conclusions: Strategies are needed to address gaps in continuity of medication management.

Introduction

Almost 9% of hospital discharges involving patients aged 65 and over are to residential care facilities (RCF).[1] Current medication management arrangements for these patients in the immediate post-discharge period are complex and associated with significant risks.[2-5] General practitioners (GP), or locum medical services, are called at short notice to write medication charts, often without access to comprehensive discharge medication information.[3,6] Community pharmacists are called at short notice to supply or pack medications into dose administration aids.[3,5] RCF staff may be required to act beyond their normal duties to facilitate timely medication administration.[3,4] These processes can lead to medication administration errors and adverse patient outcomes.[7-9]

Quality Use of Medicines (QUM) is one of the central objectives of Australia's National Medicines Policy. QUM means using medications judiciously, appropriately, safely, and effectively. There has been considerable investment in Australia over the last 15 years aimed at improving QUM for older people residing in RCFs, including development of medication management guidelines and standards and implementation of medication advisory committees and medication reviews.[10] Guidelines have also been developed to address continuity of medication management. However, none of these policies, guidelines or strategies has addressed medication management during the transition from hospital to RCFs.[10,11]

Although gaps in continuity of medication management during transitions from hospital to residential care have been recognised,[2-7] there is little quantitative data to inform development, or enable evaluation, of potential solutions.[7] The purpose of this study was to describe and quantify medication management problems in the 24 hours after discharge from hospital to residential care.

Methods

An observational study of medication management following discharge from a 400 bed acute care hospital and an 80 bed subacute aged care hospital within a major metropolitan public health service was undertaken over 12 weeks (January to April 2009). Patients were eligible for inclusion if they were discharged to a RCF following an overnight stay on an inpatient ward. Exclusion criteria were: discharge under the Transition Care Program (a hospital-managed short-term residential care program), no medication changes made in hospital, or RCF staff unable to complete a telephone interview.

The hospitals' discharge policy included supplying all prescribed medications for patients discharged to a new RCF, or new and changed medications for patients returning to a RCF, dispensed in original packaging. A hospital pharmacist contacted the RCF's community pharmacy prior to discharge and provided a facsimile of the discharge prescription(s) and a summary of medication changes made in hospital. A medical discharge summary with a free-text section about medication management was prepared by a hospital doctor and faxed to the patient's GP.

Patients' pre-admission medication lists and discharge prescriptions were obtained from the medical record to determine changes to the medication regimen in hospital and when the first dose of medication was due after hospital discharge. Pre-admission medication lists were recorded by clinical pharmacists (routine care), using standardised medication reconciliation procedures.[12]

Approximately 24 hours after discharge, a structured telephone interview was conducted with a RCF staff member directly responsible for managing the patient's medications (where possible, a registered nurse, but at RCFs without such staff, an enrolled nurse or patient care assistant). Data collected included: time of arrival at the RCF, whether the RCF medication chart had been written/updated in time for the first dose of regularly scheduled medication, who wrote/updated the chart (if written), whether the resident's medications were available in the RCF's usual format (dose administration aid or original packaging) for the first dose, whether any doses had been missed or delayed since the resident arrived (and if so, the medication name and length of delay), and how medications were administered and recorded if an updated medication chart or medications in the RCF's usual format were not available when the first dose was due and no missed/delayed doses were reported.

The interview questionnaire was developed with input from a multidisciplinary reference group that included RCF nurses, GPs and pharmacists to ensure content validity. It was piloted and refined with approximately 10 discharges before the study commenced. Other data collection methods were piloted, but were found to be less reliable than telephone interview and were therefore not utilised (see Discussion section).

Medication information included in medical discharge summaries was assessed by an experienced clinical pharmacist for a random sample of approximately 1 in 3 patients. The accuracy of medication lists was determined by comparing the summary with patients' discharge prescriptions (which had been reconciled by a hospital pharmacist against the patient's pre-admission medication list and inpatient medication chart to resolve unintended discrepancies). Medication changes were identified by comparing discharge prescriptions with pre-admission medication lists, and changes were considered to have been

communicated if the change and its rationale were mentioned in the discharge summary, or the change was mentioned and the rationale could be deduced (e.g. bisphosphonate commenced after a hip fracture).

Re-presentations to hospital within seven days of discharge were identified via the health service's patient administration system. Medical records were reviewed by an independent geriatrician and clinical pharmacist to determine whether re-presentations were potentially related to a medication administration error in the 24 hours after hospital discharge.

The primary endpoint was the proportion of patients who experienced one or more missed or significantly delayed doses in the 24 hours after discharge, defined as: regularly scheduled medication dose completely omitted; regularly scheduled medication dose delayed by more than 50% of the prescribed dose-interval; or 'when required' (*prn*) medication delayed by any length of time if it was required by the patient.

Missed and delayed doses were classified into three levels of risk according to the likelihood and severity of a potential adverse outcome, using a classification system developed through a Delphi process[13] involving nine experienced aged care professionals (3 geriatricians, 2 GPs, 2 clinical pharmacists, and 2 registered nurses).

Secondary endpoints were the proportion of patients with: RCF medication chart written/updated by a locum doctor within 24 hours of transfer; updated RCF medication administration chart not available for the first dose of regularly scheduled medication; medications in RCF's preferred packaging not available for the first dose; one or more

medication discrepancies in the medical discharge summary; re-presentation to hospital within 7 days of discharge due to a medication administration error.

Statistical analysis was performed using SPSS Version 17.0 (SPSS Inc. Chicago). Characteristics of patients who had a missed or significantly delayed dose were compared with those who did not. Mann-Whitney U test was used for age, length of stay and number of medications, and chi square test for categorical data.

We estimated that 25% of patients would have doses missed or delayed after discharge to a RCF, and if an intervention aimed to reduce this to 10% (power 80%, level of significance 0.05, 2-sided) at least 112 patients would be required in this study and subsequent intervention studies.

The study was approved by the Austin Health and Monash University Human Research Ethics Committees.

Results

287 patients were discharged to a RCF during the study period. Eighty five patients were excluded: discharged under the Transition Care Program (n=34), unable to complete a telephone interview with RCF (n=32), no changes to pre-admission medication regimen (n=19). Therefore, 202 patients were included (Table 1). They were discharged to 90 RCFs; 199 (98.5%) discharges occurred on weekdays.

On discharge, medications were supplied by the hospital for 177 (88%) patients and by the RCF's community pharmacy for 25 (12%) patients. The median time from patient arrival at

the RCF to when the first dose of regularly scheduled medication was due was 180 (IQR 60-360) minutes.

Seventy-five medication doses for 37 (18.3%) patients were missed or significantly delayed in the 24 hours after discharge. Seventy (93.3%) were doses of regularly scheduled medications that were completely missed, one (1.3%) was a regularly scheduled medication that was significantly delayed, and four (5.3%) were *prn* medications not administered when needed (oxycodone in 3 cases and salbutamol in one case). Nine (12.0%) missed or delayed doses were classified as high risk, 40 (53.3%) as moderate risk, and 26 (34.7%) as low risk (Table 2).

One hundred and twenty-five (61.9%) patients did not have their RCF medication chart written or updated and 77 (38.1%) did not have medications available in the RCF's preferred format in time for the first dose of regularly scheduled medication. Missed or delayed doses were more common when an up-to-date medication chart was not available than when medications weren't available in the RCF's usual format (Figure 1).

Locum doctors wrote or updated the RCF medication chart in the 24 hours after hospital discharge for 66 (32.7%) patients; 43 (65.2%) of these were not written in time for the first dose.

Patients with missed or delayed doses required their first scheduled dose of medication sooner after discharge than those who did not. They were also more likely to have had their medication chart written by a locum doctor (Table 3).

RCF staff reported using one or more 'workarounds' (procedures that weren't usual practice) to avoid missed or delayed doses for 116 (57.4%) patients when an updated medication chart or medications in the RCF's usual format were not available (Table 4).

Of 71 reviewed medical discharge summaries, 59 (83.1%) included a discharge medication list, of which 47 (79.7%) contained one or more medication or dose discrepancies compared to the patients' discharge prescriptions (median 2 discrepancies per patient, range 0-16). A median of 7 medication changes per patient were made in hospital (5 involving regularly scheduled medications, 2 involving *prn* medications). 197/392 (50.3%) changes to regularly scheduled medications and 36/150 (24.0%) changes to *prn* medications were communicated in the discharge summary.

When describing how and when medication charts were written and medications were administered, RCF staff described six additional medication errors affecting four patients as a result of 'workarounds' or poor communication of medication changes. These were: administration of medication that had been ceased in hospital (aspirin, controlled release oxycodone and prochlorperazine); administration of pre-hospital dose of medication (gabapentin had been reduced during admission from three times to once daily); and wrong medication administered (an antidepressant instead of nitrazepam, and an incorrect antibiotic). Overall, medication administration errors were identified in 41 (20.3%) patients.

Sixteen (7.9%) patients re-presented to hospital within 7 days of discharge. These patients were more likely to have experienced a missed or delayed dose than patients who did not re-present (8/16 [50.0%] vs 29/186 [15.6%], $p < 0.0001$), but medical record review found no

evidence that any re-presentation was directly related to a medication administration error in the 24 hours after discharge.

Discussion

For RCF staff to administer medications after discharge from hospital, they require an up-to-date medication administration chart that reflects changes made in hospital, and medications in a format that can be used by the RCF (usually packed in a dose administration aid). We found that a majority of patients did not have an up-to-date medication chart in time for their first scheduled medication dose, and more than one third did not have medications in the RCF's usual format. This is not surprising given that the median time from arrival at the RCF to when the first dose of regularly scheduled medication was due was three hours, and *prn* medications were sometimes required earlier than that.

These delays resulted in RCF staff using 'workarounds', including practicing outside of recommended industry standards and guidelines, to avoid missed doses. Some of these workarounds may be associated with increased risk of medication errors. For example, we identified several cases where use of an old (pre-hospital) RCF medication chart, pre-hospital medications, or medications borrowed from another resident, was associated with errors. Using a copy of a hospital inpatient medication chart was a common workaround, and sometimes resulted in confusion and errors because the inpatient chart is often different to the intended discharge medication regimen.

Approximately 1 in 5 patients experienced a medication administration error within 24 hours of discharge. Most errors were missed doses, and almost two thirds were high or moderate risk errors. Although we did not identify any cases where a medication administration error

within 24 hours of discharge resulted in hospital readmission, anecdotal evidence, case reports and a US study suggest that adverse outcomes do occur due to gaps in continuity of medication management during transition from hospital to residential care.[2,3,7,8,14] These include poorly controlled pain, suboptimal terminal care, recurrence of medical problems that led to the original hospital admission, and unplanned hospital readmission.

Our data suggest that not having an up-to-date medication administration chart is a greater barrier to continuity of medication administration than not having medications packed in the RCF's usual format. When medications were supplied by the hospital in original packaging they were often able to be administered, provided there was an up-to-date medication chart.

Our findings are consistent with an Australian study that examined 59 admissions to rural RCFs, including 37 from hospital.[4] Medication delays were reported for 23% of residents, and RCF staff reported that they sometimes had to 'act beyond their normal duties' to ensure timely medication delivery. The most commonly reported problem was absence of an up-to-date medication administration chart. Medications being unavailable at the RCF was a less frequent, but important, problem.[4] Similar problems following discharge from hospital to long-term care have been reported in North America.[14,15]

The need for a medical practitioner to attend the RCF and write a medication chart on the day of discharge from hospital, often within 3 hours of the resident's arrival, creates challenges for the GP workforce. It is also not the optimal time for patients to receive a medical review following discharge from hospital. Use of locums to write medication charts for one third of residents highlights the difficulties experienced by RCFs in accessing residents' GPs at short notice, and because locums are unable to attend until after-hours (to be eligible for Medicare

Benefits Scheme funding), usually the medication chart was not written/updated in time. Use of locums to write medication charts is also a poor use of health funding, and poses potential patient safety risks since this task should ideally be performed by the patient's regular GP, who may have a better understanding of their medical and medication history. Difficulties accessing a GP to write the medication chart (and accessing packed medications), also results in RCFs often declining to accept transfers from hospital after-hours and at weekends; in this study only 1.5% of transfers occurred on weekends.

We did not assess how often GPs and RCFs received a medical discharge summary on the day of discharge. However, consistent with other studies,[6,16-19] we found that medication changes were often not communicated in discharge summaries, and medication regimens listed in discharge summaries were frequently inconsistent with the intended discharge regimen. On at least one occasion this led to a medication error (incorrect antibiotic prescribed and administered).

Our methodology had some limitations, but these would be more likely to underestimate error prevalence rather than overestimate. In most cases the RCF staff member who was interviewed was involved in the patient's care when they arrived at the RCF the previous day, so had first-hand knowledge about whether doses were missed or delayed and whether a locum doctor was called, but there remains a risk of recall bias and deliberate under-reporting. In a minority of cases the interviewee wasn't involved in the patient's care and/or could not confirm whether there were missed or delayed doses; in these cases no missed/delayed dose was recorded. Because interviews were completed approximately 24 hours after discharge (to minimise recall bias), some missed or delayed doses could not be detected. This occurred when once-daily, morning, doses had not been administered by the time of the telephone

interview, but the delay had not yet exceeded 50% of the prescribed dose-interval (12 hours). We excluded emergency department discharges (for logistical reasons), but in our experience these patients are at high risk of post-discharge medication errors because of the short notice of discharge and the fact that a pharmacist is often not involved in the transfer, particularly after hours. Whilst transfer-related medication administration errors may continue for several days after discharge,[2,13] our methodology did not enable us to assess what proportion of errors persisted beyond 24 hours after discharge.

Alternative data collection methods were considered, but were either not feasible or were found to be less reliable than telephone interview. Sending a researcher to RCFs to observe medication administration was not feasible because of the number of discharges each day, usually at short notice, and the number of different RCFs (90 RCFs received the 202 patients in this study). This method may also have been more likely to have a Hawthorn effect. We piloted a fax-back form, sent to RCFs with each patient, to be completed prospectively by RCF staff. However response rate was poor and again there was risk of a Hawthorn effect. Two methods for validating telephone interview data were piloted, but turned out to be unreliable and prone to over-estimation of the rate of missed/delayed doses. The first involved asking RCF staff to fax a copy of the RCF medication chart once it was written. Response rate was poor, and due to the large number of workarounds used by RCF staff to administer and/or record medications when the chart wasn't written in time for the first dose, the faxed chart could not always confirm whether doses were given (eg. the chart indicated no dose was given, but the phone interview indicated it was given, for example without signing a drug chart, or by getting a family member to administer it). The second method involved a researcher visiting RCFs several days after discharge to retrospectively collect data, but again

this was unable to confirm whether doses were administered, due to variable documentation and workarounds.

In conclusion, there are significant gaps in continuity of medication management across the hospital-residential care interface. Strategies to improve continuity of care are urgently needed. One potential method to reduce the risk of missed doses and pressure on the GP workforce is a hospital-provided 7-day interim residential care medication administration chart (IRCMAC) which can be used by RCF staff to administer and record medications until the patient's GP prepares a new medication chart. Such interim charts have been implemented on a limited basis at some Australian hospitals, however their effectiveness and safety has not been evaluated. A potential method to ensure timely availability of appropriately packed medications is a hospital-provided interim residential care multi-dose medication pack; however there are a number of barriers to this approach, such as variability in packing preferences amongst RCFs, and hospital discharge medication funding arrangements. Further work is needed to identify and evaluate strategies to address these problems.

Table 1. Patient characteristics

	Subacute ward discharges (n = 63)	**Acute ward discharges** (n = 139)	**All patients** (n = 202)
Age (years) [median (IQR)]	85 (81-89)	84 (81-89)	84 (79-88)
Gender [number (%) female]	39 (62%)	80 (58%)	119 (59%)
Length of stay in hospital (days) [median (IQR)]	40 (30-63)	7 (5-13)*	11.5 (6-33)
Number of medications prescribed on discharge [median (IQR)]			
Regular	9.0 (6.0-12.0)	9.0 (6.0-12.0)	9.0 (6.5-12.0)
When required (*prn*)	2.0 (1.0-3.0)	1.0 (0-2.0)*	1.0 (0-2.0)
Total	11.0 (9.0-13.0)	10.5 (7.0-14.3)	11.0 (7.0-13.5)
Discharged to a new RCF [Number (%)]	44 (70%)	32 (23%)*	76 (37%)
Level of care at RCF [Number (%)]			
High	35 (56%)	62 (45%)	97 (48%)
Low	25 (39%)	67 (48%)	92 (45%)
Supported Residential Service	3 (5%)	10 (7%)	13 (7%)
One or more missed or significantly delayed doses within 24 hours of discharge [Number (%)]	11 (17.5%)	26 (18.7%)	37 (18.3%)

* $p < 0.05$ (acute versus subacute)

Table 2: Medications missed or significantly delayed within 24 hours of discharge from hospital.

Risk[†]	Medication	Number of occurrences
High	Strong analgesics: oxycodone immediate release (OxyNorm), oxycodone slow release (OxyContin)	4
	Anticoagulants: enoxaparin, warfarin	3
	Antiparkinsonian medications: levodopa/carbidopa	1
	Bronchodilators: salbutamol	1
Moderate	Anti-infectives: amoxycillin, amoxycillin/clavulanic acid, cephalexin, doxycycline, flucloxacillin, metronidazole	11
	Cardiovascular medications: atenolol, captopril, frusemide, metoprolol, prazosin, propranolol	8
	Milder analgesics: paracetamol	7
	Glaucoma medications: bimatoprost, brimonidine, pilocarpine, timolol	4
	Anticonvulsants: carbamazepine, sodium valproate	3
	Antiemetics: domperidone, metoclopramide	3
	Antipsychotics: olanzapine, quetiapine	2
	Antidiarrhoeals: diphenoxylate/atropine	1
	Colchicine	1
Low	Laxatives: docusate/senna, lactulose, polyethylene glycol oral solution	8
	Lipid-lowering medications: atorvastatin, pravastatin, simvastatin	7
	Mineral & vitamin supplements : potassium, calcium, cholecalciferol	4
	Antiplatelet medications: aspirin/dipyridamole	2
	Cholinesterase inhibitors: donepezil	1

Acid suppressing medications / antacids: Gastrogel	1
Antidepressants: mirtazapine	1
Lubricant eye drops: Polytears	1
Topical medications: nystatin oral drops	1

† Risk based on 'average' residential care patient (84 years of age, multiple morbidities, 11 medications). High risk defined as "Moderate to high likelihood of a high-severity adverse consequence"; Moderate risk defined as "Moderate to high likelihood of a medium-severity adverse consequence OR low likelihood of a high-severity adverse consequence"; Low risk defined as "Any likelihood of a low-severity adverse consequence OR low likelihood of a medium-severity adverse consequence". 'High severity adverse consequence' defined as any adverse consequence that could cause major patient discomfort or harm, medical practitioner attendance or readmission to hospital; 'Medium-severity adverse consequence' defined as any adverse consequence that could cause mild to moderate patient discomfort or harm or that may require telephone consultation with a medical practitioner; 'Low-severity adverse consequence' defined as any situation other than the above.

Table 3. Comparison of patients who did and did not experience a missed or significantly delayed dose in the 24 hours after discharge from hospital

	Missed or delayed medication (n = 37)	No missed or delayed medication (n = 165)	p-value
Age [median (IQR)]	84 (79-89)	84 (80-88)	NS
Gender [number (%) female]	25 (68%)	94 (57%)	NS
Hospital ward-type			
- Acute	26 (70%)	113 (68%)	NS
- Subacute	11 (30%)	52 (32%)	
Length of hospital stay [median (IQR), days]	12 (6-36.5)	11 (6-33)	NS
Discharge time			
- am	21 (57%)	79 (48%)	NS
- pm	16 (43%)	86 (52%)	
RCF admission-type			
- New admission to RCF	18 (49%)	58 (35%)	NS
- Returning to RCF	19 (51%)	107 (65%)	
RCF level of care			
- High	18 (49%)	78 (47%)	NS
- Low or SRS	19 (51%)	87 (53%)	
Number of medications [median (IQR)]	10.0 (7.0-14.0)	11.0 (7.0-13.75)	NS
Medications supplied by the hospital on discharge			
- Yes	33 (89%)	144 (87%)	NS
- No	4 (11%)	21 (13%)	
Time between arrival at RCF and first scheduled dose due [median (IQR), minutes]	120 (30-225)	180 (90-360)	P = 0.03

Medication chart not written or updated in time for first dose [number (%)]	34 (92%)	90 (53%)	P < 0.0001
Medications not available in RCF's preferred format in time for first dose [number (%)]	20 (54%)	57 (35%)	P = 0.02
Locum doctor wrote/updated RCF medication chart [number (%)]	24 (65%)	42 (25%)	P < 0.0001

IQR = interquartile range; RCF = residential care facility; SRS = special residential service

Table 4. Workarounds[†] used by residential care staff to avoid medication delays and missed doses

a) Due to absence on an updated medication administration chart

Type of 'workaround'	Number[‡]
Documented on a medication list obtained from the hospital (e.g. in the margin of a copy of the patient's discharge prescription or hospital inpatient medication chart)	44
Obtained a telephone or facsimile medication administration order from a doctor	19
Community pharmacy provided a medication signing sheet	4
Documented in 'Nurse-Initiated Medication' section of a RCF medication administration chart	4
Documented against RCF chart used prior to hospital admission (e.g. when the only change made in hospital was cessation of one or more medications, or when the pre-admission medication regimen was [incorrectly] continued while waiting for a new medication chart to be written and/or medications to be re-packed in a DAA)	4
Administration of medication(s) not documented	4
Documented administration in the patient's RCF file/progress notes	3
Medication chart transcribed by RCF nurse	3
Retrospectively documented after medication chart updated/written	3
Not specified (RCF staff unable to explain how medication was administered and recorded)	3
Total	**91**

b) Due to medications being unavailable in the RCF's preferred format

Type of 'workaround'	Number[†]
Medications administered from original packaging supplied by hospital while waiting for medications to be re-packed in a DAA by a community pharmacy.	49

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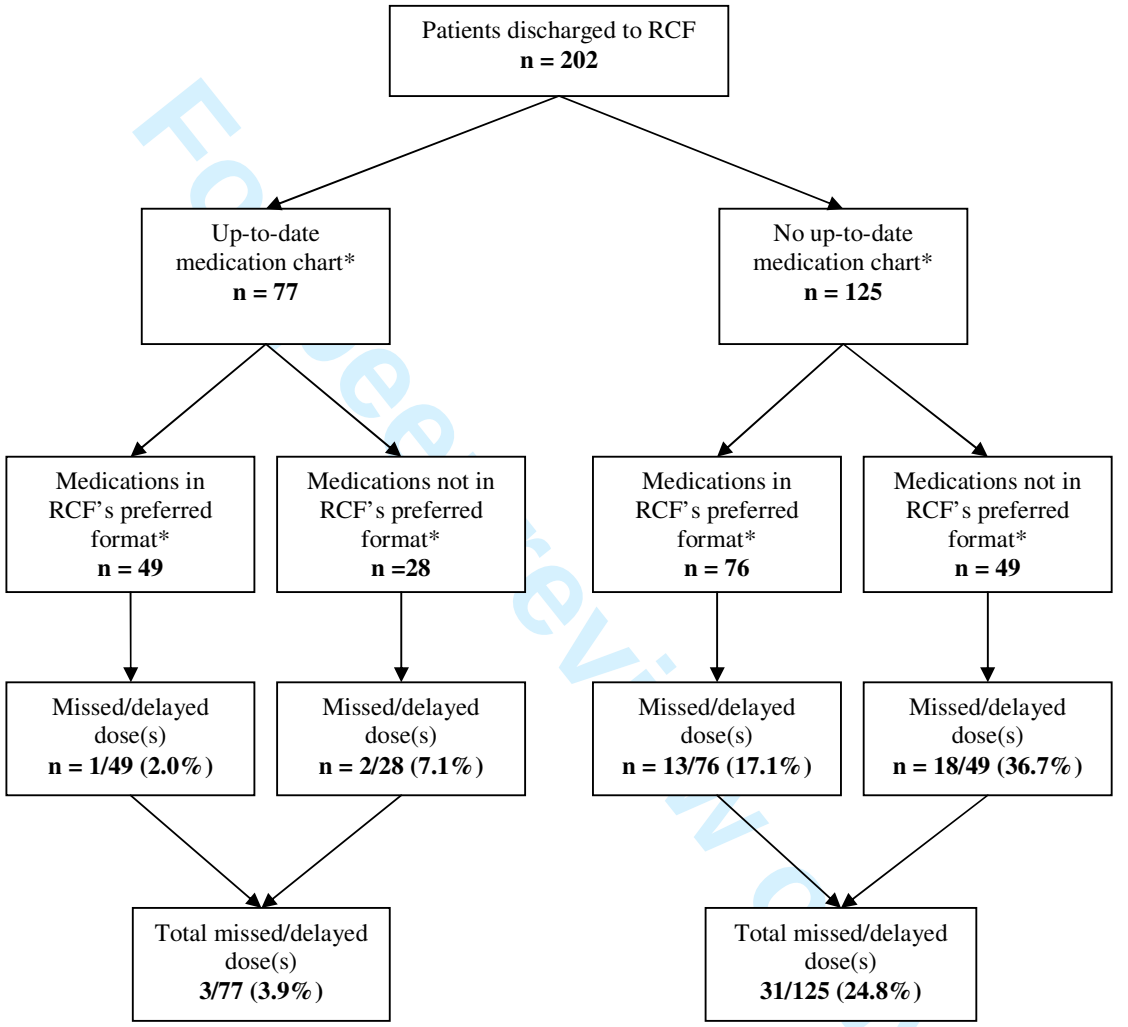
Pre-admission medications (packed in a DAA) used while waiting for new and/or changed medications to be re-packed in a DAA by a community pharmacy	7
RCF registered nurse filled DAA for personal care assistants to administer medications from	3
Borrowed medication from another resident	2
RCF staff asked patient's family to administer medications	1
Not specified (RCF staff unable to explain how medication was administered)	1
Total	**63**

DAA: dose administration aid (e.g. Webster Pak)

† 'Workarounds' defined as procedures that weren't usual practice for medication administration at the RCF

‡ More than one 'workaround' used for some patients

Figure 1. Relationship between having an up-to-date medication chart and experiencing a missed or significantly delayed dose within 24 hours of discharge from hospital



RCF = residential care facility
* Available at RCF in time for first dose of regularly scheduled medication

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Impact of a pharmacist-prepared interim residential care medication administration chart on gaps in continuity of medication management after discharge from hospital to residential care: a prospective pre- and post-intervention study (MedGap Study)

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TITLE PAGE

Title: Impact of a pharmacist-prepared interim residential care medication administration chart on gaps in continuity of medication management after discharge from hospital to residential care: a prospective pre- and post-intervention study (MedGap Study)

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ARTICLE SUMMARY

1) Article Focus

- Medication administration errors are common when patients are discharged from hospital to a residential care facility (RCF). In Australia a contributing factor is the need for the patient's primary care doctor to attend the RCF at short notice to write a medication administration chart; when the doctor cannot attend, doses may be missed or delayed and a locum doctor may be called to write a medication chart.
- The objective of this study was to test the impact of a hospital pharmacist-prepared interim residential care medication administration chart (IRCMAC) on medication administration errors and use of locum medical services after discharge from hospital.

2) Key Messages

- Provision of a hospital pharmacist-prepared IRCMAC resulted in significant reductions in missed or delayed medication doses and use of locum medical services after discharge from hospital.
- RCF staff reported that the IRCMAC improved continuity of care, and primary care doctors reported that it reduced pressure on them to attend RCFs at short notice.

3) Strengths and Limitations.

- This is the first study to evaluate the impact of a hospital-provided IRCMAC on medication errors or use of locum medical services. Strengths were that the two study groups were well matched in terms of demographics, ward-type, number of medications, and number of RCFs.
- The main limitations were the use of a pre- and post-intervention study design and data collection via RCF staff telephone interview. However quantitative data on medication errors and use of locum services were validated by strongly positive feedback from RCF staff and doctors and widespread uptake and ongoing use of the IRCMAC.

ABSTRACT

Objectives: To test the impact of a hospital pharmacist-prepared interim residential care medication administration chart (IRCMAC) on medication administration errors and use of locum medical services after discharge from hospital to residential care.

Design: Prospective pre- and post-intervention study.

Setting: One major acute care hospital and one subacute aged-care hospital; 128 residential care facilities (RCF) in Victoria, Australia.

Participants: 428 patients (median age 84 years, inter-quartile range 79-88) discharged to a RCF from an inpatient ward over two 12 week periods.

Intervention: Seven-day IRCMAC, auto-populated with patient and medication data from the hospitals' pharmacy dispensing software, completed and signed by a hospital pharmacist and sent with the patient to the RCF.

Primary and secondary outcome measures: Primary endpoints were the proportion of patients with one or more missed or significantly delayed (>50% of prescribed dose interval) medication doses, and the proportion of patients whose RCF medication chart was written by a locum doctor, in the 24 hours after discharge. Secondary endpoints included RCF staff and GPs' opinions about the IRCMAC.

Results: The number of patients who experienced one or more missed or delayed doses fell from 37/202 (18.3%) to 6/226 (2.7%) (difference in percentages 15.6%, 95%CI 9.5-21.9%, p<0.001). The number of patients whose RCF medication chart was written by a locum doctor fell from 66/202 (32.7%) to 25/226 (11.1%) (difference in percentages 21.6%, 95%CI 13.5-29.7%, p<0.001). For 189/226 (83.6%) discharges, RCF staff reported that the IRCMAC improved continuity of care; 31/35 (88.6%) GPs said the IRCMAC reduced the urgency for them to attend the RCF, and 35/35 (100%) said that IRCMACs should be provided for all patients discharged to a RCF.

Conclusions: A hospital pharmacist-prepared IRCMAC significantly reduced medication errors and use of locum medical services after discharge from hospital to residential care.

MAIN TEXT

INTRODUCTION

Continuity of medication management is often compromised when patients are discharged from hospitals to residential care facilities (RCF) such as 'nursing homes' and 'care homes'.[1-8] Missed, delayed or incorrect medication administration is common.

Patients discharged to RCFs have complex and intensive medication needs.[1] An Australian study reported that patients discharged to RCFs were prescribed an average of 11 medications, of which seven were new or had been modified during hospitalisation.[2] The median time between arrival at the RCF and the first scheduled medication dose was three hours, and 'when required' (*prn*) medications were sometimes needed sooner.[2]

In a study conducted in the USA, most patients transferred to a RCF had one or more medication doses missed; on average, 3.4 medications per patient were omitted or delayed for an average of 12.5 hours.[5] In another US study, medication discrepancies related to transfers to and from hospitals and RCFs resulted in adverse drug events in 20% patients.[7] In an analysis of medication incidents that resulted in patient harm in Canadian long-term care facilities, patient transfer was identified as a common factor.[8]

Australian studies report that up to 23% of patients experience delays or errors in medication administration after discharge from hospital to a RCF.[2, 3, 9] A key reason is difficulty accessing primary care doctors (general practitioners [GPs]) at short notice to write or update RCF medication charts.[2, 3, 10]

Delays in obtaining an up-to-date medication chart can range from a few hours up to several days.[2, 10, 11] In the absence of an up-to-date medication chart, RCF staff may withhold medications, administer them without a current medication chart, or revert to pre-hospitalisation medication regimens.[2, 11] The clinical significance of delays or errors in medication administration depends on the clinical status of the patient, the nature of the medications involved and the length of the delay. In some cases no adverse event occurs. However, delays in access to medications for symptom control (e.g. analgesics and medications for terminal care) can adversely impact on quality of life, and delays or errors with regularly scheduled medications (e.g. anti-epileptics and antibiotics) may have serious consequences.[11] Unplanned hospital re-admissions have been reported as a result of failure to receive prescribed medications after transfer to a RCF.[11] When the patient's GP is unable to attend, a locum medical service may be called to write the RCF medication chart, however this does not eliminate missed doses and errors, and it adds significantly to the cost of care.[2]

When GPs (or locums) write RCF medication charts, they often do not have access to accurate discharge medication information.[2, 3, 9, 12] Medication changes made in hospital are frequently not explained in medical discharge summaries, and discrepancies between discharge summaries and discharge prescriptions occur in up to 80% of cases.[2, 9, 12-15]

Some Australian hospitals have attempted to improve continuity of medication management by providing 5- or 7-day interim residential care medication administration charts (IRCMACs) on discharge. These charts enable medications to be safely administered upon arrival at the RCF, without the need for urgent GP or locum attendance. They enable the GP to attend the RCF and review the patient at a clinically appropriate time, a few days after discharge, rather than on the day of hospital discharge., Use of IRCMACs is not widespread,

and where they have been used there has been no evaluation of their impact on medication administration or use of locum medical services. Most Australian hospitals do not use electronic prescribing systems and, based on anecdotal experience, expecting hospital doctors to prepare handwritten interim medication charts at the point of discharge is neither a reliable, safe nor sustainable method for providing IRCMACs. This is because it relies on hospital doctors remembering to write the chart, it introduces risk of discrepancies between the IRCMAC and the discharge prescription(s), and it adds to hospital doctors' workload.

For this study, a novel method for preparing IRCMACs was developed. IRCMACs were generated via hospital pharmacy dispensing software during the processing of discharge prescriptions, with auto-population of the chart with patient, prescriber and medication data (name, strength and directions). This occurred after the discharge prescription had been reviewed by a pharmacist (including reconciliation with pre-admission medications and inpatient medication charts) and errors corrected. This method was chosen to avoid the need for manual transcription, minimise additional workload, and ensure the IRCMAC and discharge medications were concordant. An additional novel aspect, designed to address gaps in provision of discharge medication information, was inclusion of the 'change status' for each medication (unchanged, new, or dose-changed, with date and reason for change if known to the pharmacist), a list of medications ceased (with the date and reason, if known), and time of last dose given in hospital for each medication. These details were manually added by the pharmacist.

The aim of this study was to evaluate the impact of the hospital pharmacist-prepared IRCMAC on continuity of medication administration and use of locum medical services following discharge to RCFs.

METHODS

A prospective pre- and post-intervention study was undertaken at a 400-bed acute care hospital and an 80-bed subacute aged care (geriatric assessment and rehabilitation) hospital within a major metropolitan public health service in Melbourne, Australia over two 12-week periods (January-April and September-November 2009). A detailed analysis of the baseline (pre-intervention) data has been previously published;[2] this paper compares post-implementation data with that baseline data. The study was approved by the Austin Health and Monash University Human Research Ethics Committees.

Patients were eligible for inclusion if they were discharged to a RCF following an overnight stay on an inpatient ward. Exclusion criteria were: discharge under the Transition Care Program (a hospital managed short-term residential care program) or returning to an RCF with no medication changes made in hospital.

During the pre-intervention (control) period, no IRCMAC was provided. The hospitals' discharge policy included provision of at least seven days supply of all prescribed medications for patients discharged to a new RCF, or new and changed medications for patients returning to a RCF, dispensed in original packaging. A photocopy of the discharge prescription(s) was provided in the bag of medications.

During the post-intervention period, a 7-day IRCMAC was prepared by a hospital pharmacist. The IRCMAC and a photocopy of the discharge prescription(s) were placed in a transparent red plastic sleeve along with instructions for using the IRCMAC. The red sleeve was placed in a clear plastic bag with the discharge medications and transported with the patient. The

pharmacist telephoned the RCF prior to discharge to notify them that an IRCMAC would be provided. No other discharge procedures were changed.

Prior to implementation of the IRCMAC, stake-holders including hospital and RCF staff, GPs and regulatory, professional and accreditation organisations were consulted (Appendix). They provided input into the design of the IRCMAC and procedures for its preparation and use. All pharmacists involved in hospital discharge management received training in IRCMAC preparation. A standard operating procedure for use of the IRCMAC at RCFs was mailed to all RCFs that accepted patients from the health service during the pre-intervention study period.

Data collection

Data collection methods have been described in detail previously.[2] Briefly, a structured telephone interview was conducted with a RCF staff member responsible for managing the patient's medications using a pre-piloted questionnaire. Interviews were conducted approximately 24 hours after discharge. In the post-intervention period, for logistical reasons, interviews were not conducted on weekends, therefore interviews for Friday and Saturday discharges occurred 48-72 hours after discharge. Data collected included: time of arrival at the RCF, whether the RCF medication chart had been written/updated in time for the first dose of regularly scheduled medication, who wrote/updated the chart (if written), whether any doses had been missed or delayed since the resident arrived (and if so, the medication name and length of delay). In the post-intervention period, additional questions were asked, including: whether an IRCMAC was received, whether it was used to record medication administration, and whether the RCF staff member felt that the IRCMAC improved the medication transfer process. Also in the post-intervention period, a second structured

telephone interview was performed on day 8 post-discharge if the patient had not had their RCF medication chart written/updated at the time of the initial interview (to determine who wrote/updated the RCF medication chart, and whether the IRCMAC avoided or merely delayed locum doctor attendance).

To assess GP satisfaction with the IRCMAC, a 4 item questionnaire was mailed to the GPs of patients who had been provided with an IRCMAC during the last 4 weeks of the post-intervention period, along with a pre-addressed reply-paid envelope. There was no follow-up of non-responders.

Primary endpoints were the proportion of patients who experienced one or more missed or significantly delayed medication doses, and the proportion of patients whose RCF medication chart was written/updated by a locum doctor, in the 24 hours after discharge. Missed or significantly delayed doses were defined as: regularly scheduled medication dose completely omitted; regularly scheduled medication dose delayed by more than 50% of the prescribed dose-interval; or 'when required' (*prn*) medication delayed by any length of time if it was required by the patient.

Secondary endpoints were the proportion of patients for whom a 'workaround' was used by RCF staff to avoid a delayed or missed dose when an updated medication chart was not available, and RCF staff and GP satisfaction. A 'workaround' was defined as any action taken by RCF staff that was not usual practice for medication administration at the RCF (eg. using a copy of a hospital inpatient medication chart or administering medications without a medication chart).

The minimum sample size required was 112 patients per group, based on a predicted reduction in the incidence of missed or delayed doses from 25% to 10% (power 80%, level of significance 0.05, 2-sided). Statistical analysis was performed using SPSS Version 19.0 (IBM SPSS Statistics, USA). The chi square test was used to compare categorical data, and Mann-Whitney U for all other (non-parametric) data.

RESULTS

Of 593 patients discharged to a RCF, 428 met the inclusion criteria and had a post-discharge RCF staff interview completed (Figure 1).

There were no significant differences between the pre- and post-intervention groups in terms of age, gender, length of hospital stay, number of medications, level of residential care, or time from discharge to first scheduled dose (Table 1). The distribution of patients across RCFs was similar in the two study periods, with a median of two patients discharged to each RCF in both periods (Figure 1).

In the pre-intervention period, 75 medications for 37 (18.3%) patients had one or more doses missed or significantly delayed within 24 hours of discharge from hospital. Following implementation of the IRCMAC, 9 medications for 6 (2.7%) patients were missed or delayed (difference in percentages 15.6%, 95% CI 9.5-21.9%, $p < 0.001$). Missed doses accounted for most medication administration errors: 70 (93%) pre-intervention and 9 (100%) post-intervention.

The number of RCF medication charts written or updated by a locum medical service within 24 hours of discharge declined following implementation of the IRCMAC, from 66 (32.7%)

to 25 (11.1%) (difference in percentages 21.6%, 95% CI 13.5-29.7%, p < 0.001). Day 8 telephone interviews identified only 1 additional patient whose RCF medication chart was subsequently written/updated by a locum medical service.

One hundred and seventy-five (77.4%) patients in the post-intervention period did not have their RCF long-term medication chart written/updated by a GP or locum service in time for their first scheduled medication dose. In 147 (84%) of these cases, the RCF received and used the IRCMAC, 20 (11%) received but did not use the IRCMAC, and 8 (5%) did not receive the IRCMAC. The number of patients for whom a 'workaround' was used to avoid a missed or delayed dose fell following implementation of the IRCMAC, from 90 (44.6%) to 22 (9.7%) (p < 0.001).

For 189 (83.6%) discharges, the interviewed RCF staff member reported that the IRCMAC improved continuity of medication management, and in 139 (61.5%) cases the information about medication changes was useful. Questionnaires were sent to 84 GPs. Four were returned as the GP was no longer managing the resident's care, and 35 were completed (response rate 43.8%). Thirty-one (88.6%) GPs reported that provision of an IRCMAC reduced urgency to attend the RCF after patients were discharge from hospital, 35 (100%) said they were comfortable with a hospital-provided IRCMAC being used at the RCF for up to 7 days until they reviewed the patient, 34 (97.1%) reported that 'Change status' and 'Medications ceased' sections on the IRCMAC were helpful, and 35 (100%) agreed that provision of an IRCMAC should be standard practice for all patients discharged from hospital to a RCF. Examples of comments from RCF staff and GPs are provided in Table 2, categorised by theme.

DISCUSSION

This is the first study to evaluate a hospital-provided IRCMAC for patients discharged to residential care. It demonstrated that a 7-day IRCMAC prepared by hospital pharmacists (linked with review and processing of discharge prescriptions) improved continuity of medication administration, reduced pressure on the GP workforce, and reduced the need for locum medical services to write RCF medication charts. It also led to a reduction in potentially unsafe medication administration 'workarounds' used by RCF staff.

Clinical outcomes were not assessed, but case reports and anecdotal evidence indicate that 'workarounds' and missed doses sometimes result in adverse outcomes.[7, 8, 11, 16] Of the 75 missed and delayed medications in the pre-intervention period, a moderate or high risk of adverse outcome was considered by a multidisciplinary expert panel to be likely in 49 (65.3%) cases.[2]

Reduced reliance on locum doctors to write medication charts after hospital discharge also has potential to improve patient safety, because the locum would be unfamiliar with the patient and may not be the most appropriate person to write the long-term care medication chart (which may be used for up to 6 months). The IRCMAC enabled GPs to review their patients (and write long-term care medication charts) at a clinically appropriate time, a few days after discharge, rather than on the day of hospital discharge (when the patient should not require a clinical review).

The duration of the IRCMAC was limited to 7 days to ensure that post-discharge medical review could not be excessively delayed, whilst also providing flexibility for GPs in the scheduling of their visit to the RCF (during stakeholder consultation some GPs reported that they usually attend the RCF for routine patient care activities on a set day each week). If the

patient is stable and the GP's usual day of attendance is 7 days away, a 7 day chart avoids the need for the GP to make an extra visit, and/or the need for locum attendance. If the patient is clinically unstable the GP can attend sooner.

We did not assess whether there was a change in the time from hospital discharge to first GP visit. Anecdotally we noted that the chart was usually used for less than 7 days. Whilst there is a potential risk that the IRMCAC may delay GP review of an unstable patient, the risk may be smaller with the IRCMAC than without the IRCMAC. This is because without the IRCMAC a locum medical service is often called to write a long-term care medication chart on the day of discharge,[2] and this chart will last for up to 6 months; therefore the patient's GP can delay their attendance for much longer than 7 days.

Another benefit of reducing reliance on locum medical services is that is reduces healthcare costs. If the results of this study were replicated across all hospitals in Australia (based on 2001-2 discharge data,[17] and the minimum Medicare Australia locum medical consultation rebate in 2010 [126 Australian dollars]), savings to the Australian Government in excess of AUD2.1 million annually could be realised. Avoidance of adverse medication events may lead to further cost-savings. The IRCMAC could also lead to efficiency gains within the RCF and GP workforce; telephone interviews and satisfaction surveys suggested that the IRCMAC resulted in considerable (though unquantified) time savings for RCF staff and GPs. Countering these savings would be costs incurred by hospitals to deliver the IRCMAC, but in our experience these are significantly less than the likely savings (approximately 10 Australian dollars per IRCMAC for labour and consumables, excluding software and set-up costs, in a setting in which pharmacists were already conducting admission and discharge medication reconciliation and entering discharge medication data into dispensing software;

greater labour costs for IRCMAC provision would be incurred if these tasks needed to be introduced).

Although RCF medication charts are traditionally written by medical practitioners, the IRCMAC used in this study was able to be legally prepared and signed by the pharmacist because in the RCF setting the chart was an administration record, not a prescription, and therefore did not need the signature of a medical practitioner. Preparing the IRCMAC in this way provided a number of advantages. It ensured that IRCMAC production occurred after the discharge prescription had been reviewed and reconciled by a pharmacist, and errors corrected, and it enabled auto-population of the chart from the pharmacy dispensing software. This ensured a high level of concordance between the IRCMAC and the discharge prescription. An audit of a random selection of 76 IRCMACs prepared during this study revealed a medication discrepancy rate of 9/870 (1.0%).[18] Although there are no studies that have assessed accuracy of hand-written IRCMACs, medication transcription error rates on hand-written inpatient orders and discharge summaries range from 12% to 56%.[14, 19-21]

For 11% of patients the RCF received an IRCMAC but did not use it. In some cases this was because a doctor attended in time to write a new RCF medication chart. In other cases it was because the RCF had a policy requiring all admissions to be reviewed/admitted by a medical practitioner or stating that all medication administration charts must be written by a medical practitioner. Sometimes RCF staff did not use the chart because they were unfamiliar with it (Table 2).

In our study, the hospital supplied medications on discharge along with the IRCMAC. In settings in which the hospital does not supply discharge medications the IRCMAC may be less effective, but would still be expected to provide some benefits. It may reduce pressure on the GP workforce and use of locum medical services. And because the IRCMAC provides RCF staff with clarity as to what the intended discharge regimen is, if pre-admission medications are available at the RCF, with an IRCMAC they can be given correctly, without delay. For new or changed medications, whether the IRCMAC would be effective will depend on how the medications are supplied - if delays in medication supply and/or delivery occur then missed doses may still occur until the medications become available, but if the medications are supplied on time (within 1 to 6 hours of discharge) the IRCMAC could facilitate timely and accurate administration.

There were some limitations with our study methodology. Data on missed and delayed doses was obtained by telephone interview, introducing risk of under-reporting and recall bias. However, as described elsewhere,[2] we piloted several methods of data collection, and telephone interview 24 hours after discharge was judged to be the most reliable and practical. Any under-reporting and recall bias is likely to have been similar during the pre- and post-intervention periods. Whilst transfer-related medication administration errors may continue for several days after discharge,[4, 9] our methodology did not enable us to assess what proportion of errors persisted beyond 24 hours after discharge. Use of a pre- and post-intervention study design meant that the interviewer could not be blinded to group allocation, and that factors other than the IRCMAC could have contributed to the reduction in medication administration errors and locum medical service attendances over time. However the strongly positive feedback from GPs and RCF staff regarding the impact of the IRCMAC suggests that it was the primary cause of observed improvements, and because the problems addressed by

the IRCMAC have been long-standing, it is unlikely that over the space of a few months they would decline significantly without specific intervention. Furthermore, the participating hospitals have continued to provide IRCMACs since this study finished, and (unsolicited) positive feedback continues to be received. Several RCFs have indicated that they are now happy to accept patients on weekends or after hours, provided they receive the IRCMAC, whereas previously they would not. A major locum medication service in the area has indicated that since the IRCMAC was introduced they infrequently receive calls to write medication charts following hospital discharge. Data was collected from RCFs within approximately 24 hours for all discharges in the pre-intervention period, but up to 48-72 hours in the post-intervention period for Friday and Saturday discharges (24 hours for all others). It is possible that the longer time between discharge and interview in the post-intervention period may have increased the risk of recall bias. However Saturday discharges were rare (5/226), and it was our experience that delaying interviews for Friday discharges until Monday was advantageous, because the interview was more likely to involve a RCF staff member who was present on Friday, when the patient arrived. Therefore, this minor difference in methodology was unlikely to have resulted in under-estimation of error prevalence.

In conclusion, implementation of a hospital pharmacist-prepared IRCMAC led to significant improvements in continuity of medication administration and reduced reliance on locum medical services to write medication charts after discharge from hospital to RCFs. As a result of this study, hospital pharmacist-prepared IRCMACs have been implemented in several Australian hospitals, and a national IRCMAC and guidelines addressing continuity of medication management on transfer from hospital to RCF are planned. Although health systems vary between countries, problems with continuity of medication management on

discharge from hospital to residential care have been reported internationally,[2, 5, 8] so the findings of this study may be widely applicable.

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Table 1. Patient demographics

	Pre-intervention n = 202	Post-intervention n = 226	p-value
Age (years) [median (IQR)]	84 (79-88)	84 (79-88)	0.73
Gender [number (%) female]	119 (58.9)	142 (62.8)	0.43
Length of stay in hospital (days) [median (IQR)]	11.5 (6.0-33)	11.0 (5.8-33)	0.63
Number of medications prescribed on discharge from hospital [median (IQR)]			
Regular	9.0 (6.5-12)	9.0 (7.0-12)	0.41
When required (*prn*)	1.0 (0-2.0)	1.0 (0-2.0)	0.15
Total	11.0 (7.0-13.5)	10.0 (8.0-14)	0.60
New admission to RCF [Number (%)]	76 (37.6)	79 (35.0)	0.62
Level of care at RCF [Number (%)]			
High*	97 (48.0)	126 (55.7)	0.21
Low†	92 (45.5)	89 (39.4)	
Other‡	13 (6.4)	11 (4.9)	
Time between arrival at RCF and first scheduled dose due [median (IQR), minutes]	180 (60-360)	180 (60-330)	0.17

RCF: Residential care facility

* Australian Government-approved and subsidised residential aged care place for a person who needs a high level of assistance with activities of daily living and 24-hour nursing care.

† Australian Government-approved and subsidised residential aged care place for a person who needs a lower level of personal and nursing care.

‡ Residential care facility providing non-government subsidised personal and/or nursing care (e.g. Supported Residential Service).

Table 2. Examples of comments from residential care staff and general practitioners about the interim residential care medication administration chart (IRCMAC)

Theme	Comments
Reduction in need for urgent medical practitioner attendance	"Avoided us needing to call locum" [Nurse] "Beautiful, perfect, gives time to organise doctor" [Nurse] "So good. Saves getting locum, saves getting a phone order" [Nurse] "Very good, can't get doctor always. Could accept patients (from hospital) later now. Normally only before 1pm" [Nurse Manager] "This is a great help in arranging an easy move from hospital to residential care facility and helps take the pressure off the first few days – thank you" [GP]
Clarity of information	"Brilliant, able to read, very easy to read" [Nurse] "The typed nature of these charts helps a lot – some hand written discharge medication lists in the past have been illegible" [GP]
Usefulness of information	"Change status alerted nurse of new medications" [Nurse] "Did not need to check when last dose was given" [Nurse]
Reduction in medication administration errors	"Wouldn't have been able to administer medications (without it)" [Nurse] "…Usually cannot administer from script so this allowed for signing" [Nurse]
Lack of familiarity with IRCMAC (RCF staff who received but didn't use the IRCMAC)	"…. didn't realise it could be used til the day after" [Nurse] "Unfamiliar with the chart though fantastic idea" [Nurse] "Would have been helpful if staff familiar" [Nurse]
Other	"Interim chart is very useful. Would be useful if done for every patient discharged to residential facilities on a regular basis"

	[GP]
	"(I think this is the best idea ever" [GP]

GP = General practitioner

IRCMAC = Interim Residential Care Medication Administration Chart

APPENDIX. Stakeholders consulted during development of the interim residential care medication administration chart

Australian government and professional bodies:

- Aged Care Standards & Accreditation Agency
- Australian Nursing Federation
- North East Valley Division of General Practice
- Northern Division of General Practice
- Nurses Board of Victoria
- Pharmacy Board of Australia
- Victorian Department of Health – Aged Care Branch
- Victorian Department of Health – Ambulatory & Continuing Care Programs Branch
- Victorian Department of Health – Drugs and Poisons Unit
- Victorian Department of Health – Quality Use of Medicines Program

Individual health professionals and aged care staff:

- Community pharmacists (n = 4)
- Hospital pharmacists (n = 6)
- Hospital doctors (n = 3)
- Hospital aged care liaison nurse (n = 1)
- RCF staff (directors of nursing, care coordinators, division 1 & 2 registered nurses, personal care assistants) (n = 34)
- General practitioners (n = 6)

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COMPETING INTERESTS:

None

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TITLE PAGE

Title: Impact of a pharmacist-prepared interim residential care medication administration chart on gaps in continuity of medication management after discharge from hospital to residential care: a prospective pre- and post-intervention study (MedGap Study)

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ARTICLE SUMMARY

1) Article Focus

- Medication administration errors are common when patients are discharged from hospital to a residential care facility (RCF). In Australia a contributing factor is the need for the patient's primary care doctor to attend the RCF at short notice to write a medication administration chart; when the doctor cannot attend, doses may be missed or delayed and a locum doctor may be called to write a medication chart.
- The objective of this study was to test the impact of a hospital pharmacist-prepared interim residential care medication administration chart (IRCMAC) on medication administration errors and use of locum medical services after discharge from hospital.

2) Key Messages

- Provision of a hospital pharmacist-prepared IRCMAC resulted in significant reductions in missed or delayed medication doses and use of locum medical services after discharge from hospital.
- RCF staff reported that the IRCMAC improved continuity of care, and primary care doctors reported that it reduced pressure on them to attend RCFs at short notice.

3) Strengths and Limitations.

- This is the first study to evaluate the impact of a hospital-provided IRCMAC on medication errors or use of locum medical services. Strengths were that the two study groups were well matched in terms of demographics, ward-type, number of medications, and number of RCFs.
- The main limitations were the use of a pre- and post-intervention study design and data collection via RCF staff telephone interview. However quantitative data on medication errors and use of locum services were validated by strongly positive feedback from RCF staff and doctors and widespread uptake and ongoing use of the IRCMAC.

ABSTRACT

Objectives: To test the impact of a hospital pharmacist-prepared interim residential care medication administration chart (IRCMAC) on medication administration errors and use of locum medical services after discharge from hospital to residential care.

Design: Prospective pre- and post-intervention study.

Setting: One major acute care hospital and one subacute aged-care hospital; 128 residential care facilities (RCF) in Victoria, Australia.

Participants: 428 patients (median age 84 years, inter-quartile range 79-88) discharged to a RCF from an inpatient ward over two 12 week periods.

Intervention: Seven-day IRCMAC, auto-populated with patient and medication data from the hospitals' pharmacy dispensing software, completed and signed by a hospital pharmacist and sent with the patient to the RCF.

Primary and secondary outcome measures: Primary endpoints were the proportion of patients with one or more missed or significantly delayed (>50% of prescribed dose interval) medication doses, and the proportion of patients whose RCF medication chart was written by a locum doctor, in the 24 hours after discharge. Secondary endpoints included RCF staff and GPs' opinions about the IRCMAC.

Results: The number of patients who experienced one or more missed or delayed doses fell from 37/202 (18.3%) to 6/226 (2.7%) (difference in percentages 15.6%, 95%CI 9.5-21.9%, p<0.001). The number of patients whose RCF medication chart was written by a locum doctor fell from 66/202 (32.7%) to 25/226 (11.1%) (difference in percentages 21.6%, 95%CI 13.5-29.7%, p<0.001). For 189/226 (83.6%) discharges, RCF staff reported that the IRCMAC improved continuity of care; 31/35 (88.6%) GPs said the IRCMAC reduced the urgency for them to attend the RCF, and 35/35 (100%) said that IRCMACs should be provided for all patients discharged to a RCF.

Conclusions: A hospital pharmacist-prepared IRCMAC significantly reduced medication errors and use of locum medical services after discharge from hospital to residential care.

MAIN TEXT

INTRODUCTION

Continuity of medication management is often compromised when patients are discharged from hospitals to residential care facilities (RCF) such as 'nursing homes' and 'care homes'.[1-8] Missed, delayed or incorrect medication administration is common.

Patients discharged to RCFs have complex and intensive medication needs.[1] An Australian study reported that patients discharged to RCFs were prescribed an average of 11 medications, of which seven were new or had been modified during hospitalisation.[2] The median time between arrival at the RCF and the first scheduled medication dose was three hours, and 'when required' (*prn*) medications were sometimes needed sooner.[2]

In a study conducted in the USA, most patients transferred to a RCF had one or more medication doses missed; on average, 3.4 medications per patient were omitted or delayed for an average of 12.5 hours.[5] In another US study, medication discrepancies related to transfers to and from hospitals and RCFs resulted in adverse drug events in 20% patients.[7] In an analysis of medication incidents that resulted in patient harm in Canadian long-term care facilities, patient transfer was identified as a common factor.[8]

Australian studies report that up to 23% of patients experience delays or errors in medication administration after discharge from hospital to a RCF.[2, 3, 9] A key reason is difficulty accessing primary care doctors (general practitioners [GPs]) at short notice to write or update RCF medication charts.[2, 3, 10]

Delays in obtaining an up-to-date medication chart can range from a few hours up to several days.[2, 10, 11] In the absence of an up-to-date medication chart, RCF staff may withhold medications, administer them without a current medication chart, or revert to pre-hospitalisation medication regimens.[2, 11] The clinical significance of delays or errors in medication administration depends on the clinical status of the patient, the nature of the medications involved and the length of the delay. In some cases no adverse event occurs. However, delays in access to medications for symptom control (e.g. analgesics and medications for terminal care) can adversely impact on quality of life, and delays or errors with regularly scheduled medications (e.g. anti-epileptics and antibiotics) may have serious consequences.[11] Unplanned hospital re-admissions have been reported as a result of failure to receive prescribed medications after transfer to a RCF.[11] When the patient's GP is unable to attend, a locum medical service may be called to write the RCF medication chart, however this does not eliminate missed doses and errors, and it adds significantly to the cost of care.[2]

When GPs (or locums) write RCF medication charts, they often do not have access to accurate discharge medication information.[2, 3, 9, 12] Medication changes made in hospital are frequently not explained in medical discharge summaries, and discrepancies between discharge summaries and discharge prescriptions occur in up to 80% of cases.[2, 9, 12-15]

Some Australian hospitals have attempted to improve continuity of medication management by providing 5- or 7-day interim residential care medication administration charts (IRCMACs) on discharge. These charts enable medications to be safely administered upon arrival at the RCF, without the need for urgent GP or locum attendance. They enable the GP to attend the RCF and review the patient at a clinically appropriate time, a few days after discharge, rather than on the day of hospital discharge., Use of IRCMACs is not widespread,

and where they have been used there has been no evaluation of their impact on medication administration or use of locum medical services. Most Australian hospitals do not use electronic prescribing systems and, based on anecdotal experience, expecting hospital doctors to prepare handwritten interim medication charts at the point of discharge is neither a reliable, safe nor sustainable method for providing IRCMACs. This is because it relies on hospital doctors remembering to write the chart, it introduces risk of discrepancies between the IRCMAC and the discharge prescription(s), and it adds to hospital doctors' workload.

For this study, a novel method for preparing IRCMACs was developed. IRCMACs were generated via hospital pharmacy dispensing software during the processing of discharge prescriptions, with auto-population of the chart with patient, prescriber and medication data (name, strength and directions). This occurred after the discharge prescription had been reviewed by a pharmacist (including reconciliation with pre-admission medications and inpatient medication charts) and errors corrected. This method was chosen to avoid the need for manual transcription, minimise additional workload, and ensure the IRCMAC and discharge medications were concordant. An additional novel aspect, designed to address gaps in provision of discharge medication information, was inclusion of the 'change status' for each medication (unchanged, new, or dose-changed, with date and reason for change if known to the pharmacist), a list of medications ceased (with the date and reason, if known), and time of last dose given in hospital for each medication. These details were manually added by the pharmacist.

The aim of this study was to evaluate the impact of the hospital pharmacist-prepared IRCMAC on continuity of medication administration and use of locum medical services following discharge to RCFs.

METHODS

A prospective pre- and post-intervention study was undertaken at a 400-bed acute care hospital and an 80-bed subacute aged care (geriatric assessment and rehabilitation) hospital within a major metropolitan public health service in Melbourne, Australia over two 12-week periods (January-April and September-November 2009). A detailed analysis of the baseline (pre-intervention) data has been previously published;[2] this paper compares post-implementation data with that baseline data. The study was approved by the Austin Health and Monash University Human Research Ethics Committees.

Patients were eligible for inclusion if they were discharged to a RCF following an overnight stay on an inpatient ward. Exclusion criteria were: discharge under the Transition Care Program (a hospital managed short-term residential care program) or returning to an RCF with no medication changes made in hospital.

During the pre-intervention (control) period, no IRCMAC was provided. The hospitals' discharge policy included ~~supplying~~ provision of at least seven days supply of all prescribed medications for patients discharged to a new RCF, or new and changed medications for patients returning to a RCF, dispensed in original packaging. A photocopy of the discharge prescription(s) was provided in the bag of medications.

During the post-intervention period, a 7-day IRCMAC was prepared by a hospital pharmacist. The IRCMAC and a photocopy of the discharge prescription(s) were placed in a transparent red plastic sleeve along with instructions for using the IRCMAC. The red sleeve was placed in a clear plastic bag with the discharge medications and transported with the patient. The

pharmacist telephoned the RCF prior to discharge to notify them that an IRCMAC would be provided. No other discharge procedures were changed.

Prior to implementation of the IRCMAC, stake-holders including hospital and RCF staff, GPs and regulatory, professional and accreditation organisations were consulted (Appendix). They provided input into the design of the IRCMAC and procedures for its preparation and use. All pharmacists involved in hospital discharge management received training in IRCMAC preparation. A standard operating procedure for use of the IRCMAC at RCFs was mailed to all RCFs that accepted patients from the health service during the pre-intervention study period.

Data collection

Data collection methods have been described in detail previously.[2] Briefly, a structured telephone interview was conducted with a RCF staff member responsible for managing the patient's medications using a pre-piloted questionnaire. Interviews were conducted approximately 24 hours after discharge. In the post-intervention period, for logistical reasons, interviews were not conducted on weekends, therefore interviews for Friday and Saturday discharges occurred 48-72 hours after discharge. Data collected included: time of arrival at the RCF, whether the RCF medication chart had been written/updated in time for the first dose of regularly scheduled medication, who wrote/updated the chart (if written), whether any doses had been missed or delayed since the resident arrived (and if so, the medication name and length of delay). In the post-intervention period, additional questions were asked, including: whether an IRCMAC was received, whether it was used to record medication administration, and whether the RCF staff member felt that the IRCMAC improved the medication transfer process. Also in the post-intervention period, a second structured

telephone interview was performed on day 8 post-discharge if the patient had not had their RCF medication chart written/updated at the time of the initial interview (to determine who wrote/updated the RCF medication chart, and whether the IRCMAC avoided or merely delayed locum doctor attendance).

To assess GP satisfaction with the IRCMAC, a 4 item questionnaire was mailed to the GPs of patients who had been provided with an IRCMAC during the last 4 weeks of the post-intervention period, along with a pre-addressed reply-paid envelope. There was no follow-up of non-responders.

Primary endpoints were the proportion of patients who experienced one or more missed or significantly delayed medication doses, and the proportion of patients whose RCF medication chart was written/updated by a locum doctor, in the 24 hours after discharge. Missed or significantly delayed doses were defined as: regularly scheduled medication dose completely omitted; regularly scheduled medication dose delayed by more than 50% of the prescribed dose-interval; or 'when required' (*prn*) medication delayed by any length of time if it was required by the patient.

Secondary endpoints were the proportion of patients for whom a 'workaround' was used by RCF staff to avoid a delayed or missed dose when an updated medication chart was not available, and RCF staff and GP satisfaction. A 'workaround' was defined as any action taken by RCF staff that was not usual practice for medication administration at the RCF (eg. using a copy of a hospital inpatient medication chart or administering medications without a medication chart).

The minimum sample size required was 112 patients per group, based on a predicted reduction in the incidence of missed or delayed doses from 25% to 10% (power 80%, level of significance 0.05, 2-sided). Statistical analysis was performed using SPSS Version 19.0 (IBM SPSS Statistics, USA). The chi square test was used to compare categorical data, and Mann-Whitney U for all other (non-parametric) data.

RESULTS

Of 593 patients discharged to a RCF, 428 met the inclusion criteria and had a post-discharge RCF staff interview completed (Figure 1).

There were no significant differences between the pre- and post-intervention groups in terms of age, gender, length of hospital stay, number of medications, level of residential care, or time from discharge to first scheduled dose (Table 1). The distribution of patients across RCFs was similar in the two study periods, with a median of two patients discharged to each RCF in both periods (Figure 1).

In the pre-intervention period, 75 medications for 37 (18.3%) patients had one or more doses missed or significantly delayed within 24 hours of discharge from hospital. Following implementation of the IRCMAC, 9 medications for 6 (2.7%) patients were missed or delayed (difference in percentages 15.6%, 95% CI 9.5-21.9%, $p < 0.001$). Missed doses accounted for most medication administration errors: 70 (93%) pre-intervention and 9 (100%) post-intervention.

The number of RCF medication charts written or updated by a locum medical service within 24 hours of discharge declined following implementation of the IRCMAC, from 66 (32.7%)

to 25 (11.1%) (difference in percentages 21.6%, 95% CI 13.5-29.7%, p < 0.001). Day 8 telephone interviews identified only 1 additional patient whose RCF medication chart was subsequently written/updated by a locum medical service.

One hundred and seventy-five (77.4%) patients in the post-intervention period did not have their RCF long-term medication chart written/updated by a GP or locum service in time for their first scheduled medication dose. In 147 (84%) of these cases, the RCF received and used the IRCMAC, 20 (11%) received but did not use the IRCMAC, and 8 (5%) did not receive the IRCMAC. The number of patients for whom a 'workaround' was used to avoid a missed or delayed dose fell following implementation of the IRCMAC, from 90 (44.6%) to 22 (9.7%) (p < 0.001).

For 189 (83.6%) discharges, the interviewed RCF staff member reported that the IRCMAC improved continuity of medication management, and in 139 (61.5%) cases the information about medication changes was useful. ~~Examples of comments from RCF staff are provided in Table 2, categorised by theme.~~ Questionnaires were sent to 84 GPs. Four were returned as the GP was no longer managing the resident's care, and 35 were completed (response rate 43.8%). Thirty-one (88.6%) GPs reported that provision of an IRCMAC reduced urgency to attend the RCF after patients were discharge from hospital, 35 (100%) said they were comfortable with a hospital-provided IRCMAC being used at the RCF for up to 7 days until they reviewed the patient, 34 (97.1%) reported that 'Change status' and 'Medications ceased' sections on the IRCMAC were helpful, and 35 (100%) agreed that provision of an IRCMAC should be standard practice for all patients discharged from hospital to a RCF. ~~GPs were highly satisfied with the IRCMAC and wanted it to become standard practice for all discharges to RCFs (Table 3).~~Examples of comments from RCF staff and GPs are provided in Table 2, categorised by theme.

DISCUSSION

This is the first study to evaluate a hospital-provided IRCMAC for patients discharged to residential care. It demonstrated that a~~n~~ 7-day IRCMAC prepared by hospital pharmacists (linked with review and processing of discharge prescriptions) improved continuity of medication administration, reduced pressure on the GP workforce, and reduced the need for locum medical services to write RCF medication charts. It also led to a reduction in potentially unsafe medication administration 'workarounds' used by RCF staff.

Clinical outcomes were not assessed, but case reports and anecdotal evidence indicate that 'workarounds' and missed doses sometimes result in adverse outcomes.[7, 8, 11, 16] Of the 75 missed and delayed medications in the pre-intervention period, a moderate or high risk of adverse outcome was considered by a multidisciplinary expert panel to be likely in 49 (65.3%) cases.[2]

Reduced reliance on locum doctors to write medication charts after hospital discharge also has potential to improve patient safety, because the locum would be unfamiliar with the patient and may not be the most appropriate person to write the long-term care medication chart (which may be used for up to 6 months). The IRCMAC enable~~sd~~ ~~the~~ GP~~s~~ to review the~~ir~~ patient~~s~~ (and write ~~the~~ long-term care medication chart~~s~~) at a clinically appropriate time, a few days after discharge, rather than on the day of hospital discharge (when the patient should not require a clinical review).

The duration of the IRCMAC was limited to 7 days to ensure that post-discharge medical review could not be excessively delayed, whilst also providing flexibility for GPs in the scheduling of their visit to the RCF (during stakeholder consultation some GPs reported that

they usually attend the RCF for routine patient care activities on a set day each week). If the patient is stable and the GP's usual day of attendance is 7 days away, a 7 day chart avoids the need for the GP to make an extra visit, and/or the need for locum attendance. If the patient is clinically unstable the GP can attend sooner.

We did not assess whether there was a change in the time from hospital discharge to first GP visit. Anecdotally we noted that the chart was usually used for less than 7 days. Whilst there is a potential risk that the IRMCAC may delay GP review of an unstable patient, the risk may be smaller with the IRCMAC than without the IRCMAC. This is because without the IRCMAC a locum medical service is often called to write a long-term care medication chart on the day of discharge,[2] and this chart will last for up to 6 months; therefore the patient's GP can delay their attendance for much longer than 7 days.

~~Reduced~~ Another benefit of reducing reliance on locum medical services ~~also~~is that is reduces healthcare costs. If the results of this study were replicated across all hospitals in Australia (based on 2001-2 discharge data,[17] and the minimum Medicare Australia locum medical consultation rebate in 2010 [~~AUD~~126 Australian dollars]), savings to the Australian Government in excess of AUD2.1 million annually could be realised. Avoidance of adverse medication events may lead to further cost-savings. The IRCMAC could also lead to efficiency gains within the RCF and GP workforce; telephone interviews and satisfaction surveys suggested that the IRCMAC resulted in considerable (though unquantified) time savings for RCF staff and GPs. Countering these savings would be costs incurred by hospitals to deliver the IRCMAC ~~(software, pharmacy labour and consumables)~~, but in our experience these ~~would be~~are significantly less than the likely savings (approximately 10 Australian dollars per IRCMAC for labour and consumables, excluding software and set-up costs, in a

setting in which pharmacists were already conducting admission and discharge medication reconciliation and entering discharge medication data into dispensing software; greater labour costs for IRCMAC provision would be incurred if these tasks needed to be introduced).

Although RCF medication charts are traditionally written by medical practitioners, the IRCMAC used in this study was able to be legally prepared and signed by the pharmacist because in the RCF setting the chart was an administration record, not a prescription, and therefore did not need the signature of a medical practitioner. Preparing the IRCMAC in this way provided a number of advantages. It ensured that IRCMAC production occurred after the discharge prescription had been reviewed and reconciled by a pharmacist, and errors corrected, and it enabled auto-population of the chart from the pharmacy dispensing software. This ensured a high level of concordance between the IRCMAC and the discharge prescription. An audit of a random selection of 76 IRCMACs prepared during this study revealed a medication discrepancy rate of 9/870 (1.0%).[18] Although there are no studies that have assessed accuracy of hand-written IRCMACs, medication transcription error rates on hand-written inpatient orders and discharge summaries range from 12% to 56%.[14, 19-21]

For 11% of patients the RCF received an IRCMAC but did not use it. In some cases this was because a doctor attended in time to write a new RCF medication chart. In other cases it was because the RCF had a policy requiring all admissions to be reviewed/admitted by a medical practitioner or stating that all medication administration charts must be written by a medical practitioner. Sometimes RCF staff did not use the chart because they were unfamiliar with it (Table 2).

In our study, the hospital supplied medications on discharge along with the IRCMAC. In settings in which the hospital does not supply discharge medications the IRCMAC may be less effective, but would still be expected to provide some benefits. It may reduce pressure on the GP workforce and use of locum medical services. And because the IRCMAC provides RCF staff with clarity as to what the intended discharge regimen is, if pre-admission medications are available at the RCF, with an IRCMAC they can be given correctly, without delay. For new or changed medications, whether the IRCMAC would be effective will depend on how the medications are supplied - if delays in medication supply and/or delivery occur then missed doses may still occur until the medications become available, but if the medications are supplied on time (within 1 to 6 hours of discharge) the IRCMAC could facilitate timely and accurate administration.

There were some limitations with our study methodology. Data on missed and delayed doses was obtained by telephone interview, introducing risk of under-reporting and recall bias. However, as described elsewhere,[2] we piloted several methods of data collection, and telephone interview 24 hours after discharge was judged to be the most reliable and practical. Any under-reporting and recall bias is likely to have been similar during the pre- and post-intervention periods. Whilst transfer-related medication administration errors may continue for several days after discharge,[4, 9] our methodology did not enable us to assess what proportion of errors persisted beyond 24 hours after discharge. Use of a pre- and post-intervention study design meant that the interviewer could not be blinded to group allocation, and that factors other than the IRCMAC could have contributed to the reduction in medication administration errors and locum medical service ~~LMS~~ attendances over time. However the strongly positive feedback from GPs and RCF staff regarding the impact of the IRCMAC suggests that it was the primary cause of observed improvements,~~.~~ and because the problems

addressed by the IRCMAC have been long-standing, it is ~~highly improbable~~unlikely that over the space of a few months they would decline significantly without specific intervention. Furthermore, the participating hospitals have continued to provide IRCMACs since this study finished, and (unsolicited) positive feedback continues to be received. Several RCFs have indicated that they are now happy to accept patients on weekends or after hours, provided they receive the IRCMAC, whereas previously they would not. A major locum medication service in the area has indicated that since the IRCMAC was introduced they infrequently receive calls to write medication charts following hospital discharge. Data was collected from RCFs within approximately 24 hours for all discharges in the pre-intervention period, but up to 48-72 hours in the post-intervention period for Friday and Saturday discharges (24 hours for all others). It is possible that the longer time between discharge and interview in the post-intervention period may have increased the risk of recall bias. However Saturday discharges were rare (5/226), and it was our experience that delaying interviews for Friday discharges until Monday was advantageous, because the interview was more likely to involve a RCF staff member who was present on Friday, when the patient arrived. Therefore, this minor difference in methodology was unlikely to have resulted in under-estimation of error prevalence.

In conclusion, implementation of a hospital pharmacist-prepared IRCMAC led to significant improvements in continuity of medication administration and reduced reliance on locum medical services to write medication charts after discharge from hospital to RCFs. As a result of this study, hospital pharmacist-prepared IRCMACs have been implemented in several Australian hospitals, and a national IRCMAC and guidelines addressing continuity of medication management on transfer from hospital to RCF are planned. Although health systems vary between countries, problems with continuity of medication management on

discharge from hospital to residential care have been reported internationally,[2, 5, 8] so the findings of this study may be widely applicable.

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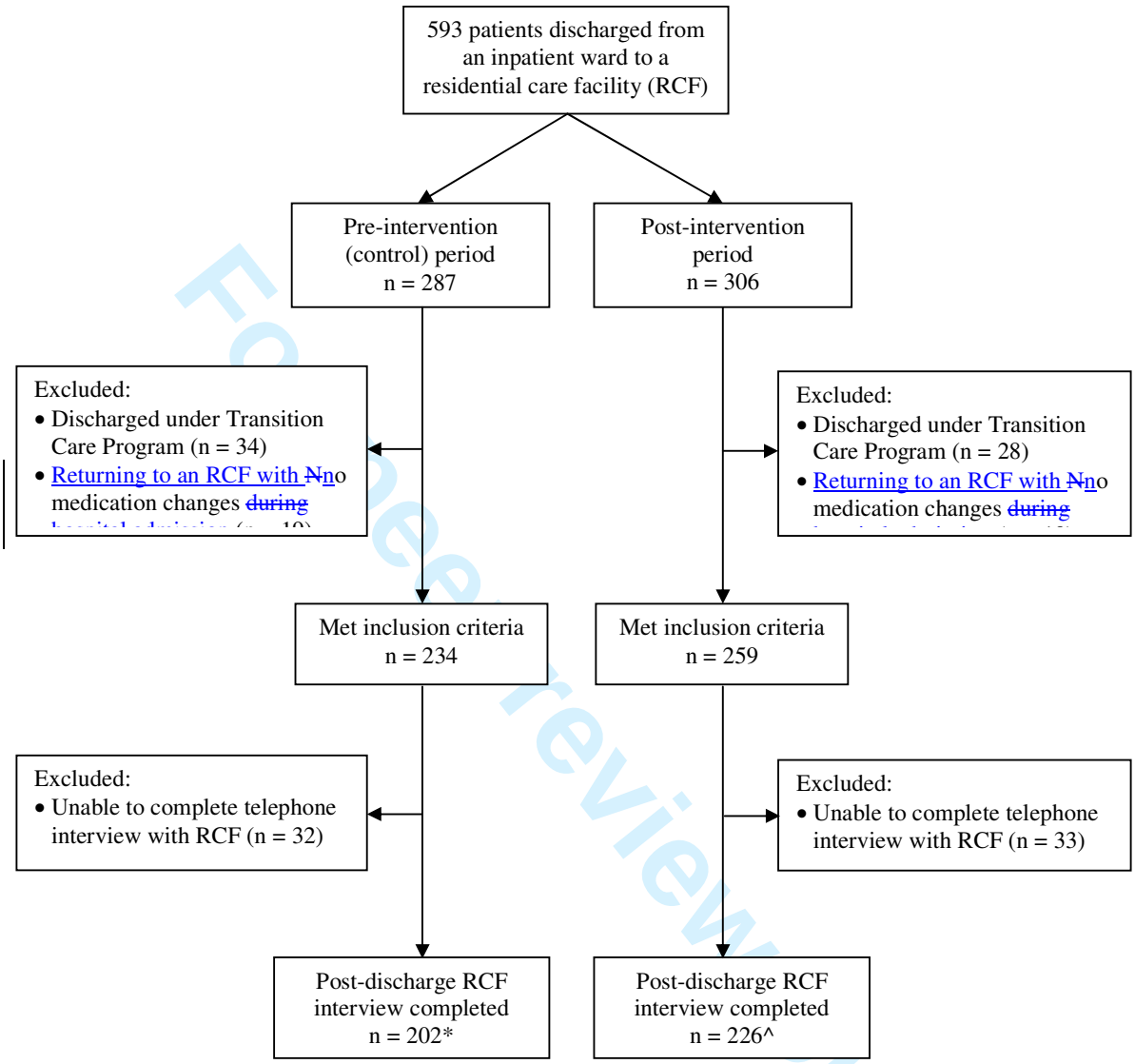
Figure 1. Patient flow diagram



* discharged to 90 RCFs (median 2 patient transfers per RCF, inter-quartile range 1-3, range 1-9);

^ discharged to 84 RCFs (median 2 patient transfers per RCF, inter-quartile range 1-3, range 1-14)

RCF: Residential care facility

Table 1. Patient demographics

	Pre-intervention n = 202	**Post-intervention** n = 226	**p-value**
Age (years) [median (IQR)]	84 (79-88)	84 (79-88)	0.73
Gender [number (%) female]	119 (58.9)	142 (62.8)	0.43
Length of stay in hospital (days) [median (IQR)]	11.5 (6.0-33)	11.0 (5.8-33)	0.63
Number of medications prescribed on discharge from hospital [median (IQR)]			
Regular	9.0 (6.5-12)	9.0 (7.0-12)	0.41
When required (*prn*)	1.0 (0-2.0)	1.0 (0-2.0)	0.15
Total	11.0 (7.0-13.5)	10.0 (8.0-14)	0.60
New admission to RCF [Number (%)]	76 (37.6)	79 (35.0)	0.62
Level of care at RCF [Number (%)]			
High*	97 (48.0)	126 (55.7)	0.21
Low†	92 (45.5)	89 (39.4)	
Other‡	13 (6.4)	11 (4.9)	
Time between arrival at RCF and first scheduled dose due [median (IQR), minutes]	180 (60-360)	180 (60-330)	0.17

RCF: Residential care facility

* Australian Government-approved and subsidised residential aged care place for a person who needs a high level of assistance with activities of daily living and 24-hour nursing care.

† Australian Government-approved and subsidised residential aged care place for a person who needs a lower level of personal and nursing care.

‡ Residential care facility providing non-government subsidised personal and/or nursing care (e.g. Supported Residential Service).

Table 2. Examples of comments from residential care staff and general practitioners about the interim residential care medication administration chart (IRCMAC)

Theme	Comments
Reduction in need for urgent medical practitioner attendance	"Avoided us needing to call locum" [Nurse] "Beautiful, perfect, gives time to organise doctor" [Nurse] "So good. Saves getting locum, saves getting a phone order" [Nurse] "Very good, can't get doctor always. Could accept patients (from hospital) later now. Normally only before 1pm" [Nurse Manager] "This is a great help in arranging an easy move from hospital to residential care facility and helps take the pressure off the first few days – thank you" [GP]
Clarity of information	"Brilliant, able to read, very easy to read" [Nurse] ~~"More legible, easier for the doctor. Really good"~~"The typed nature of these charts helps a lot – some hand written discharge medication lists in the past have been illegible" [GP]
Usefulness of information	"Change status alerted nurse of new medications" [Nurse] "Did not need to check when last dose was given" [Nurse]
Reduction in medication administration errors	"Wouldn't have been able to administer medications (without it)" [Nurse] "…Usually cannot administer from script so this allowed for signing" [Nurse]
Lack of familiarity with IRCMAC (RCF staff who received but didn't use the IRCMAC)	"…. didn't realise it could be used til the day after" [Nurse] "Unfamiliar with the chart though fantastic idea" [Nurse] "Would have been helpful if staff familiar" [Nurse]
Other	"Interim chart is very useful. Would be useful if done for every

	patient discharged to residential facilities on a regular basis" [GP] "(I) think this is the best idea ever" [GP]

GP = General practitioner

IRCMAC = Interim Residential Care Medication Administration Chart

Table 3. General practitioner (GP) questionnaire

Survey question	Yes [Number (%)]	No or Not sure [Number (%)]
Did the provision of an IRCMAC reduce the urgency for you to attend the RCF to review this patient after discharge from hospital?	31/35	4/35
Were you comfortable with a hospital provided IRCMAC being used at the residential care facility (for up to 7 days) until you or another GP were able to review the patient and write the long-term residential care medication chart?	35/35	0
Were the "Change status" and "Medications ceased" sections on the IRCMAC helpful for informing you about medication changes made in hospital?	34/35	1/35
Do you think provision of an IRCMAC should be standard practice for all patients discharged from hospital to a residential care facility?	35/35	0
Examples of comments from GPs about the IRCMAC:		
• "This is a great help in arranging an easy move from hospital to residential care facility and helps take the pressure off the first few days – thank you."		
• "Less stress on (RCF) staff chasing the GP's or locum service to write the medication chart."		
• "The typed nature of these charts helps a lot – some hand written discharge medication lists in the past have been illegible."		
• "Interim chart is very useful. Would be useful if done for every patient discharged to residential facilities on a regular basis."		
• "(I) think this is the best idea ever."		

GP = General practitioner

IRCMAC = Interim Residential Care Medication Administration Chart

APPENDIX. Stakeholders consulted during development of the interim residential care medication administration chart

Australian government and professional bodies:

- Aged Care Standards & Accreditation Agency
- Australian Nursing Federation
- North East Valley Division of General Practice
- Northern Division of General Practice
- Nurses Board of Victoria
- Pharmacy Board of Australia
- Victorian Department of Health – Aged Care Branch
- Victorian Department of Health – Ambulatory & Continuing Care Programs Branch
- Victorian Department of Health – Drugs and Poisons Unit
- Victorian Department of Health – Quality Use of Medicines Program

Individual health professionals and aged care staff:

- Community pharmacists (n = 4)
- Hospital pharmacists (n = 6)
- Hospital doctors (n = 3)
- Hospital aged care liaison nurse (n = 1)
- RCF staff (directors of nursing, care coordinators, division 1 & 2 registered nurses, personal care assistants) (n = 34)
- General practitioners (n = 6)

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COMPETING INTERESTS:

None

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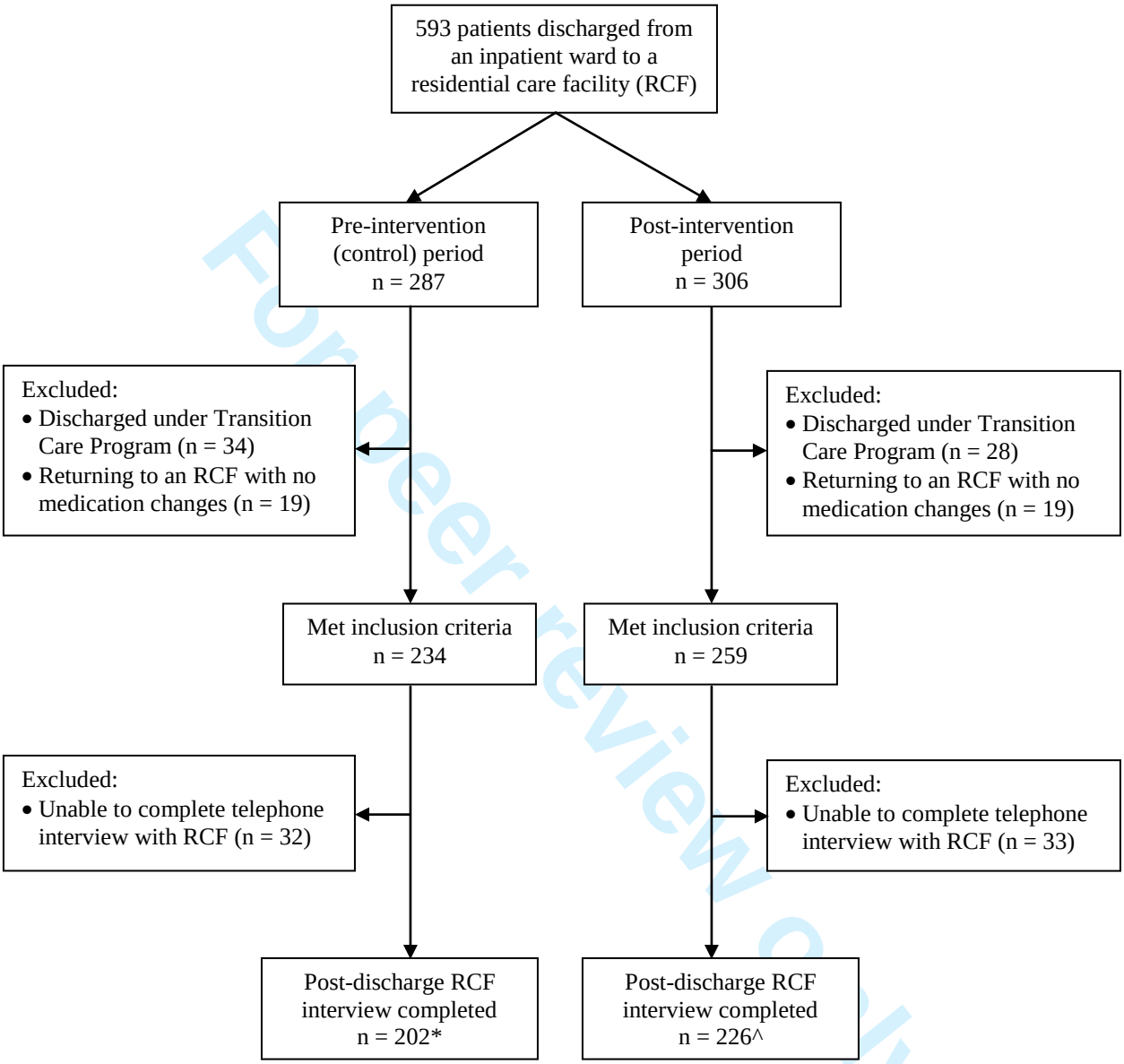
Figure 1. Patient flow diagram



* discharged to 90 RCFs (median 2 patient transfers per RCF, inter-quartile range 1-3, range 1-9);

^ discharged to 84 RCFs (median 2 patient transfers per RCF, inter-quartile range 1-3, range 1-14)

RCF: Residential care facility