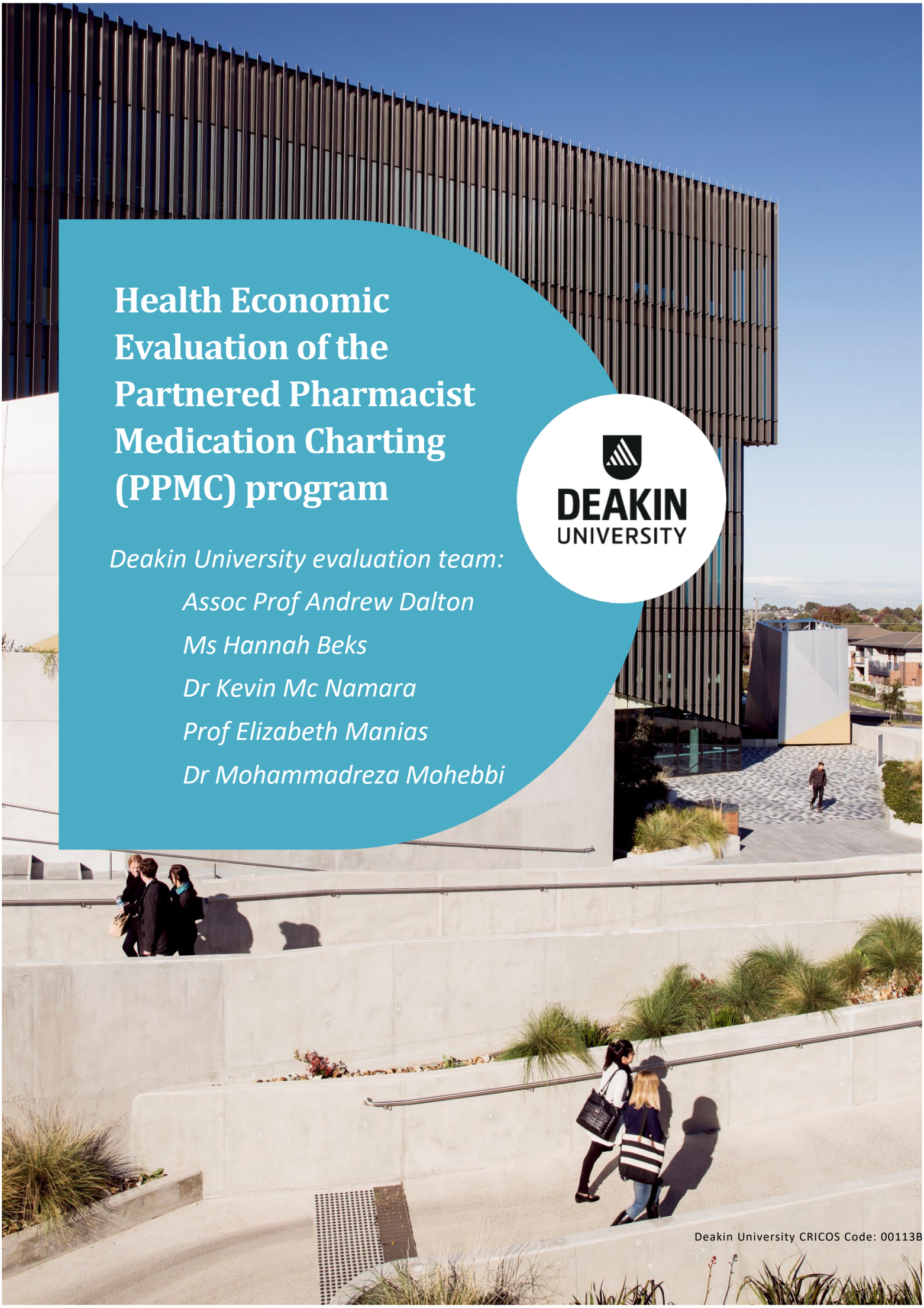


Health Economic Evaluation of the Partnered Pharmacist Medication Charting (PPMC) program

Deakin University evaluation team:

Assoc Prof Andrew Dalton

Ms Hannah Beks

Dr Kevin Mc Namara

Prof Elizabeth Manias

Dr Mohammadreza Mohebbi

DEAKIN UNIVERSITY

CONTENTS

EXECUTIVE SUMMARY

Medication incidents have been reported to be the second most common cause of clinical incidents in public hospitals (after falls), accounting for about 25% of reported incidents[1].

The Partnered Pharmacist Medication Charting (PPMC) model was developed to reduce the incidence of medication errors in an acute setting. The model requires a pharmacist who has completed the PPMC competency package training (credentialing) to chart pre-admission medication and venous thromboembolism (VTE) prophylaxis in collaboration with the admitting medical officer for patients admitted to either an emergency short stay unit or a general medicine unit. A second check is performed by a pharmacist within 24 hours. The collaboration between medical officer and pharmacist — a key feature of the PPMC model — allows for better integration of the skills and expertise of pharmacists and other clinicians, reduced duplication of effort, and consequently reduced medication errors.

This evaluation by Deakin University explored the impacts of the PPMC model upon patients presenting to emergency departments and being admitted to a general medicine ward in seven Victorian hospitals (5 metropolitan and 2 regional). A total of 8,648 patients were enrolled in the study which compared the traditional approach of medication charting (standard care) of 5,612 patients admitted over the period June – September 2016 to the PPMC approach of charting 3,036 patients admitted over the period September 2016 to July 2017 (final cost data became available in June 2018). The evaluation itself comprises three parts: a large qualitative survey involving interviews and focus groups with 125 hospital staff which captured the experiences and attitudes of pharmacists, doctors, nurses and key informants involved in the implementation of the PPMC; an online survey of health professionals to validate qualitative analysis; and an economic evaluation. These three parts of the evaluation should be interpreted conjointly. Together, they not only report the economic value or cost-effectiveness of the PPMC model, but also an understanding of the probable 'causal pathway' for this intervention. That is, how the constituent elements of the PPMC model combined to produce a change in quality of care and subsequently the desired clinical and health economic outcomes. Through these insights, plausibility is added to the economic findings.

The qualitative data and survey data suggest an overwhelmingly positive experience of the PPMC model. In addition to perceived improvements in patient safety and quality of care, it enhanced inter-professional relationships and professional satisfaction, which in turn facilitated

engagement in the collaborative care process. Three themes were developed from the qualitative interviews and focus groups conducted late in the implementation of PPMC:

- improved quality and safety of care;
- workforce integration and satisfaction;
- implementing, disseminating and sustaining practice changes.

A summary of the qualitative survey data collected during these interviews is provided in Table ES1.

The medication error rate reduced substantially from 19.2% of charted medications to 0.5%. The average length-of-stay (LOS) reduced by 0.77 days, and each admission under the PPMC model had an average saving of $726. While analysis of the admission costs of all patients enrolled found an average cost saving of $1,002 (rounded) per admission ($8,802 for PPMC compared with $9,803 for standard care), the result was adjusted to $726 per admission after excluding estimated savings occurring in any event from the state's underlying trend of reducing LOS, where appropriate, due to funding policy incentives to improve efficiency. The total savings from the 2,840 admissions where the PPMC model was used (excluding Echuca for which cost data were not available) for medication charting was therefore approximately $1.95M. The economic evaluation found strong evidence for the cost savings being driven more by reduced complications and increased safety than productivity. Importantly, it would also follow that health outcomes of patients are improved commensurately.

Cost modelling of the number of general medical patients admitted that could be expected to benefit from statewide roll-out of the PPMC model operating during business hours suggests potential savings on inpatient costs of $202M per annum could be achieved[1]. As the optimum staffing rosters and approach to PPMC at the 7 hospitals participating in the PPMC study is still evolving, the cost of roll-out is difficult to estimate at this time but is unlikely to exceed $13M (including establishing a pharmacist credentialing training centre /support service suggesting an attractive cost-benefit ratio of approximately 1:15. Although there may be a case for assistance

[1] From published data for the public hospitals admissions for Victoria (Victorian Health Services Performance), it was estimated that approx. 40% of patients admitted through emergency departments were admitted to a medical ward, and that 58% (278,492) of these occurred during the hours of 8am to 6pm. The gross savings estimate of $202M was estimated from multiplying the number of relevant admissions by the estimated savings per admission of $726.

with establishment costs, the estimated savings are such that hospitals should not require any recurrent funding allowance for the adoption of PPMC.

The model of care was viewed to be widely transferable to other clinical contexts. It should be noted though that the availability of pharmacists for employment in Victoria, particularly in regional areas, may limit the ability to roll-out PPMC statewide. This may even apply to a roll-out of PPMC for general medicine admissions only and requires further investigation before any funding for the adoption of PPMC is allocated.

The most commonly cited limitation of the PPMC model was the restriction to business hours of operation which failed to capture the large proportion of eligible patients being admitted after hours. This restriction reflected trial funding but also difficulties in rostering staff to after-hours. From an economic perspective, whilst the missed patients represent a missed opportunity to realise the efficiencies offered by the PPMC model, the fact remains that significant savings, and its corollary of health benefits, can be realised during business hours. These should not be forgone because larger savings cannot be captured after-hours.

It is reasonable to conclude from the evidence reviewed for this evaluation that the PPMC model could save lives by reducing the rate of medication errors that may be categorized as extreme. Attention must be paid towards exploring the possibility of wider dissemination and sustainability of the model.

Table ES1. Themes and subthemes developed from late phase data collection.

Theme	Subthemes	Description	Economic impact
Improving quality and safety of care	*Optimising the role of pharmacists*	• More efficient use of pharmacist skills resulting in improvements to medication safety and quality of care	• Average LOS reduced by 0.77 days. • Average cost per admission reduced by $1,002 per admission compared to standard care. Allowing for underlying trends in LOS still produces a saving of $726 per admission. • Any benefits for the approach to charting for non-PPMC patients would be additional to these benefits reported in this evaluation.
	Improving the management of complex patients	• Time savings and benefits were perceived to be greater for those with complex medication regimens and other high-risk patient groups	
	Disseminating safe medication practice	• A greater visibility of pharmacists in emergency departments resulted in more clinicians engaging with pharmacists and benefits for non-PPMC patients	
	Limiting factors	• For example, hours of model	• Each admission under the PPMC model will realise an average saving of $726. Therefore, even limited hours of operation will still offer economic gains.
Workforce integration and satisfaction	*A greater involvement of pharmacists*	• A distinct cultural shift towards engagement of PPMC pharmacists by doctors and nurses, improving the integration of care	• These benefits cannot be quantified on the data available at this time. It would be expected though continued learning through increased engagement will further improve results as the model matures.
	Increased workforce satisfaction	• Professional benefits from the model extended to nurses and doctors in addition to PPMC and non-PPMC pharmacists	
	Harnessing existing capacity for integrated care	• Various intervention, individual and organisational attributes mediated seamlessness of intervention delivery by clinicians	• Not applicable to the evaluation in this paper.

Theme	Subthemes	Description	Economic impact
Implementing, disseminating and sustaining practice changes	*Implementing the PPMC model*	• Perceive inputs and outputs of the model at an organisational level	• The economic consequences, both costs and savings, that lead to the conclusion of estimated savings of $726 per admission are described in Main report section of this paper.
	Reliance on pharmacy resources	• Sustainability is dependent on having sufficient PPMC-accredited pharmacists consistently available to deliver the service	• The current proposal is that a central credentialing and support service be established. The advice of Alfred Health is that a single senior pharmacist would be sufficient to provide and maintain this service (re-credentialing and support). A budget of approximately $150,000 has been allowed for this service. Although this may be an underestimate, the cost-benefit ratio reported in the conclusion to this evaluation of approximately 1:15 allows considerable contingency without affecting conclusions. • The availability of pharmacists in the workforce of Victoria may be a constraining issue and is one that requires further investigation.
	Meeting credentialing requirements	• Limited capacity to credential pharmacists during the trial phase proved challenging for larger hospitals	
	Expanding the scope of the model	• A desire to extend the hours when PPMC was available	
	Need for ongoing leadership	• Importance of leadership to initiate and maintain the model	
	Developing an adaptable model	• Need for flexibility to adapt to a rapidly changing healthcare environment to ensure sustainability	
	Transferring the model to other settings	• Implications for applying the PPMC model in other clinical contexts and health services	

MAIN REPORT

This paper reports the methods and findings of the 'Health Economic Evaluation of the Partnered Pharmacist Medication Charting Program' conducted by Deakin University. The evaluation itself comprised two related streams of a qualitative evaluation and a quantitative, or economic, evaluation. This paper addresses both components.

Background

Correct recording of a patient's medication history at the time of admission to hospital is critical in ensuring that the patient is not re-exposed to medicines that have previously caused them harm, and to maintaining current and proposed therapeutic regimens. This information must be available from the medication chart (or electronic medication system) at the point of care. Traditionally, medical practitioners have undertaken medication charting in both the emergency department (ED) setting and in general wards. However, this process has been shown to be subject to failure with medication histories often found to be missing, or incorrectly recording important information with medication incidents accounting for about 25% of reported incidents.[1] Medical practitioners often have competing responsibilities in addressing clinical priorities, and in consulting guidelines for practice, complexities and conflicting information can arise, thereby affecting the quality of medication charting. These observations contribute to medication incidents being reported to be the second most common cause of clinical incidents in public hospitals (after falls), accounting for about 25% of reported incidents (AIHW, 2014)[2].

Common areas where medication incidents take place include interfaces or transitions of care as patients move from one environment to another, and communication failures in informing health professionals about changes to medication regimens. Depending on the severity of medication incidents, patients may experience poor health outcomes, with increased costs from treatment of adverse clinical consequences.[2]

The 'Partnered Pharmacist Medication Charting' (PPMC) model was developed to explore the potential for this workforce model to reduce the incidence of medication incidents in an acute

[2] Australian Institute of Health and Welfare 2016. Admitted patient care 2014–15: Australian hospital statistics. Health services series no. 68. Cat. no. HSE 172. Canberra: AIHW

setting. The model requires a credentialed pharmacist (that is, one who has completed the PPMC competency package training) to chart pre-admission medication and venous thromboembolism (VTE) prophylaxis in collaboration with the admitting medical officer for patients admitted to either an emergency short stay unit (SSU) or a general medicine unit. A second check is performed by a pharmacist within 24 hours. The collaboration between medical officer and pharmacist — a key feature of the PPMC model — allows for better integration of the skills and expertise of pharmacists and clinicians, reduced duplication of effort, and consequently reduced medication errors.

From March to July 2015, Alfred Health conducted an unblinded, cluster randomised controlled trial of the PPMC model to explore its ability to reduce the incidence of medication incidents in general medical units and SSUs. The Alfred Health pilot study compared the PPMC model to the standard medical charting model at admission and this was associated with a significant reduction in medication errors from 35.3% to 0.5. One high- or extreme-risk error was prevented for every 2.7 patients treated.

The PPMC study; 2016-18

The cost-effectiveness of the PPMC model was not examined during the Alfred Health pilot of the PPMC model and therefore remained unknown, as did the generalisability of the result to the broader hospital system in Victoria. The Department of Health and Human Services (the department) funded a further replication of the PPMC (refer to Table 1) in five Victorian health services (seven hospitals). Participating hospitals included three metropolitan and two regional hospitals; Eastern Health (Box Hill and Maroondah campuses), Monash Health (Clayton and Dandenong campuses), Melbourne Health (Royal Melbourne), Barwon Health and Echuca Regional Health. Alfred Health were nominated as the lead health service working cooperatively with the five participating health services to train and assess pharmacists undertaking the PPMC. Credentialing training was provided by Alfred Health.

Table 1: PPMC core replication requirements

PPMC Core replication requirements 2016-17		
Service	**Workforce**	**Model**
• Unit based pharmacy service (not ward based) • Routine pharmacist attendance on daily medical ward rounds • Pharmacist to patient ratio 1:20 (excluding non-clinical time) • Pharmacy leadership in general practice • 6-12 month rotation of pharmacists	• Minimum Grade 2 pharmacist • Minimum 2 years hospital experience • Minimum 6 months general medicine experience	• In operation Monday-Friday during pharmacy working hours • Face-to-face discussion between medical officer and pharmacist at admission

The study design nominated the primary outcome as length of stay (LOS) in hospital per admission and commenced mid-2016.

The department sought an external evaluation of the PPMC study which it referred to as the 'Health Economic Evaluation of the Partnered Pharmacist Medication Charting Program' and appointed Deakin University to undertake this evaluation. The evaluation commenced in June 2016 with final data becoming available in June 2018. The terms of reference for the evaluation required undertaking two sub-studies or components, namely:

- A **qualitative** evaluation of PPMC, and;
- A **quantitative**, or **economic**, evaluation of PPMC.

The terms of reference also specifically requested the overall evaluation provide consideration of whether the PPMC model is:

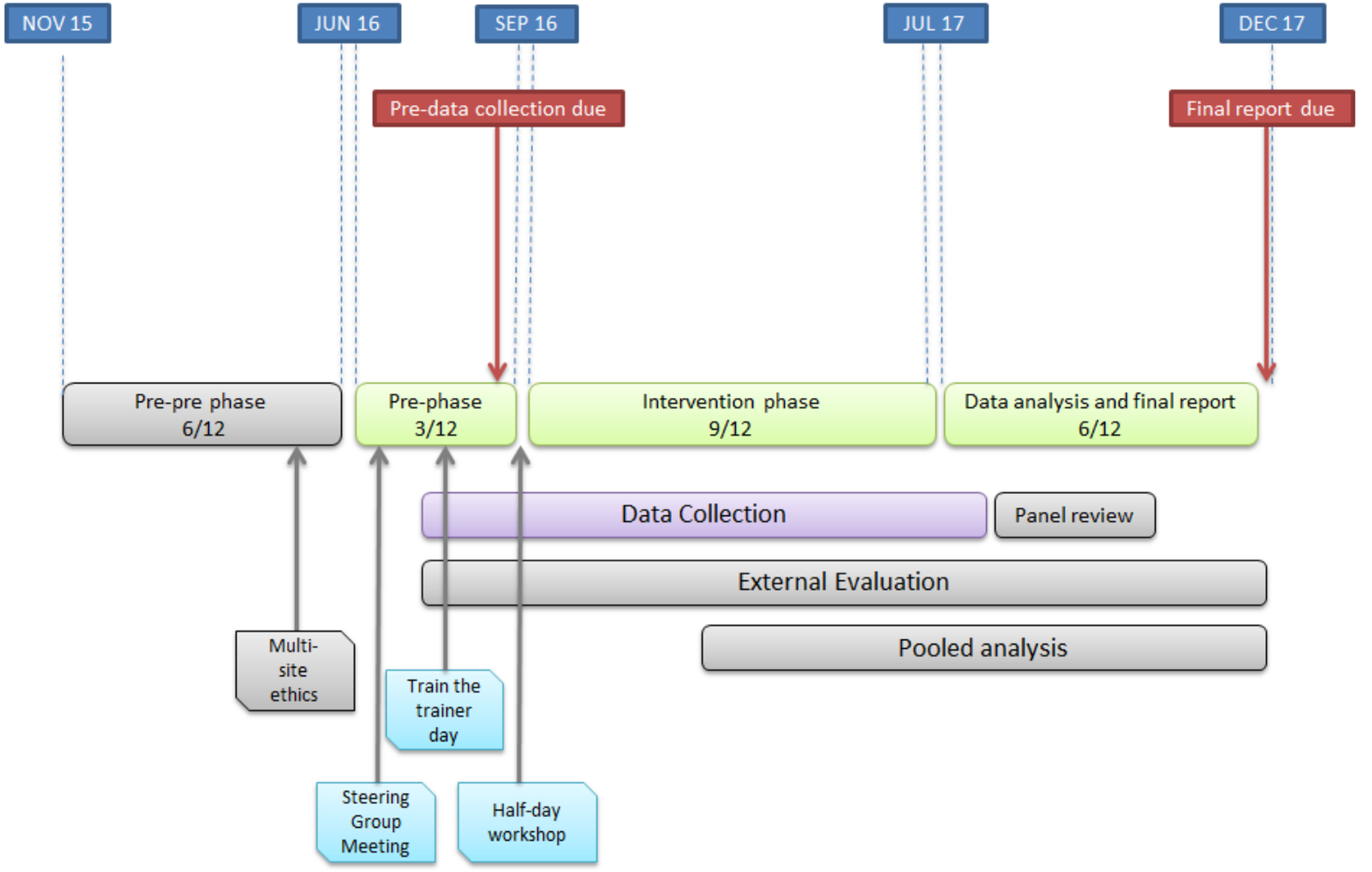
- **Cost-efficient:** that is, utilising existing resources efficiently to produce a better service, and not just adding extra steps and/or an added cost.
- **Effective:** that is, providing high quality and safe services that are responsive and accessible to patient needs and have greater value through better health outcomes for patients and enhanced job satisfaction for the healthcare workforce.

- **Sustainable:** that is, the feasibility of implementing the revised workforce model long term warrants the cost.

These criteria reflect the Victorian Innovation and Reform Impact Assessment Framework (VIRIAF).

The planned project schedule (Figure 1) provided for a comparison of 'standard care', being the existing approach to medication charting at admission, during the pre-pre-phase to the 'intervention' phase (the operation of the PPMC model). The intervening phase (the pre-phase) was proposed to allow for a period of transition. The appropriate comparison would then be the pre-pre-phase to the intervention phase; that is, a comparison of current practice compared to PPMC. However, at the conclusion of the pre-pre-phase, the data collected by the hospitals for this phase was found to be insufficient and not fit-for-purpose. Coincidentally, slow uptake of PPMC by the 5 health services (7 campuses) meant that this phase took the form of the pre-pre-phase. The pre-phase data were therefore used to represent standard care, rather than a period of transition. The possible consequences of this change in approach are reviewed briefly in the Discussion section of this paper, but are not considered to undermine the validity of the overall results.

Figure 1: Planned PPMC study schedule



Source: Adapted from Alfred Health

Methods

Participant selection and recruitment

Qualitative study methods and data collection:

The qualitative data collection was conducted at two intervals during the implementation period; an early implementation (after credentialing and initiation of the intervention) and a late implementation of the PPMC model (around the time of data completion) survey of experiences and attitudes of doctors and pharmacists from the participating hospitals. As a result, a detailed analysis of requirements for initial adoption of the PPMC model in different settings was provided by the respondents, whilst the late implementation data collection explored the perspectives of pharmacists, nurses, doctors and key informants (i.e. managers) in relation to the perceived impact of the PPMC model, with a particular focus on sustainability, dissemination and transferability of the model to other settings.

In the early implementation survey, pharmacists and medical officers who delivered or who were involved in the early implementation phase of the PPMC program at one of the five health services (seven hospitals), were invited to participate in an interview or focus group session. All invitations to participate were disseminated by a member of each hospital's pharmacy staff. Informed consent was obtained in writing by a researcher prior to participation.

Similar recruitment processes were undertaken for the late implementation survey, but with an expansion of the target group. Nurses were also invited to participate in either profession-specific focus groups or interviews, or mixed-profession focus groups, at each of the five health services. Mixed focus groups were used to explore whether the multidisciplinary environment elicited new perspectives, particularly with respect to inter-professional collaboration. A minimum of three key informants were also interviewed at each hospital – the Director of Pharmacy, the Director of the relevant admitting unit involved with PPMC (i.e. general medicine), and one other key informant who had direct involvement with the PPMC program (e.g. Nurse Unit Manager, hospital clinical management). A total of 24 interviews and 22 focus groups were recorded over the two phases, involving 125 participants.

For data collection in the early phase, semi-structured interviews (n=5) and focus groups (n= 11) were conducted using an interview guide based on the *Victorian Innovation and Reform Impact*

Assessment Framework [4] (VIRIAF, Appendix 1). Individual interviews were conducted over the telephone and focus group sessions occurred within the hospital environment with two researchers, one of whom acted as a moderator (KM, EM). A short demographic survey was used to collect information regarding the qualifications and work experience of participants. Sessions were audio-recorded and transcribed verbatim by a researcher (HB). Transcripts were reviewed by another researcher as a means of face validity (KM).

Early phase PPMC interviews and focus groups explored issues around implementation, initial PPMC experiences, the quality of support and local roll-out. The same VIRIAF-focused interview schedule was used for the 19 late phase interviews and 11 focus groups. However, the emphasis of interviews and focus group sessions shifted towards the long-term viability of the model. This shift involved identifying local needs for the ongoing sustainability of the model, exploring options regarding further expansion of the model, and transferring the PPMC to other Victorian hospitals.

Interview and focus group transcripts were imported into NVivo™, a data management software platform, for analysis. An initial reading of the transcripts was undertaken by researchers in order to ensure data familiarisation (KM, EM and HB) [5]. Three researchers then each coded several transcripts independently (KM, EM and HB). Approaches to coding were compared and discussed in order to develop a uniformed approach to coding. A combination of inductive (seeking facts from analysis of cases to support an existing theory), deductive (applying a theory to analysis of cases) and abductive reasoning (seeking a theory from analysis of cases) within the domains of the Victorian Innovation and Reform Impact Assessment Framework (VIRIAF)[4] was used. Analysing data within the VIRIAF ensured that the evaluation focused on outcomes relevant to key stakeholders (i.e. the department). Themes were developed as a result of an iterative process of coding, discussion among the researchers, re-reading of the transcripts and engagement with the relevant academic literature[6]. The three researchers (KM, EM and HB) met several times to discuss the coding and themes generated.

A subsequent anonymous online survey was developed based on the findings of the qualitative data analysis. This was distributed by the project officer at each hospital to all pharmacists, and doctors and nurses in relevant units at participating hospitals. The purpose of this survey was to validate the interview/focus group findings to ensure that factors such as recruitment bias and social desirability bias did not influence findings.

Economic study methods and data collection

Credentialed pharmacists at each of the seven campuses participating in the study were required to recruit consenting patients to the study. Patients were enrolled in the study from amongst those admitted through the hospitals' ED. The target recruitment was 5,000 patients in the pre-pre-phase (later amended to the pre-phase) over the period November 2015 – June 2016 and 5,000 in the intervention phase. Recruitment to the intervention phase was intended to be completed by March 2017, however, due to slower than expected recruitment rates across all sites, recruitment was extended to July 2017 and the target reduced to 3,000 patients (statistical power retained for 10% difference). Recruitment criteria were not provided to the health services and the patients enrolled therefore represent a 'convenience sample' of patients presenting to EDs and admitted to general medical wards.

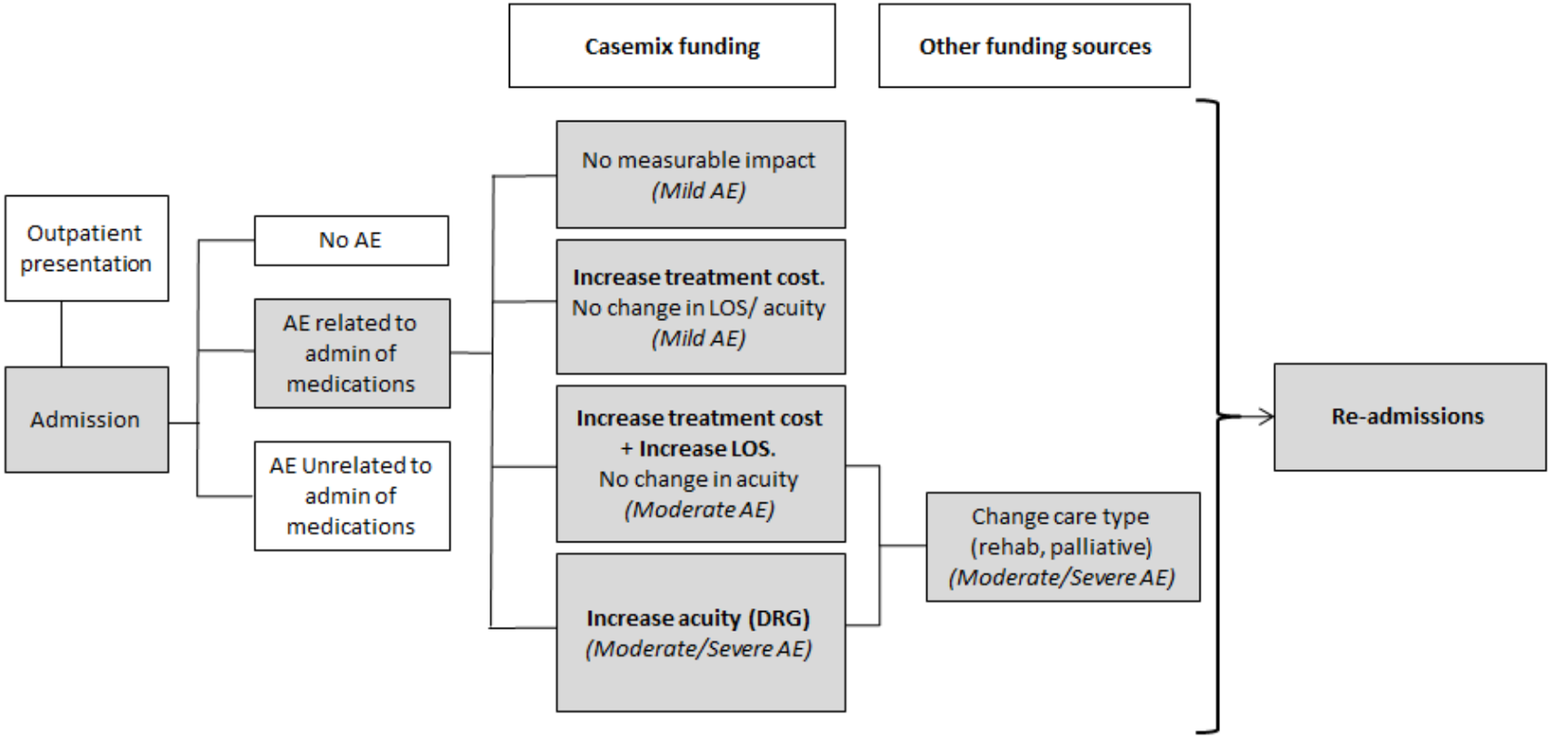
Data for the primary outcome of LOS became available for analysis shortly after the conclusion of the study itself in July 2017. The analysis then compared:

- LOS of standard care patients recruited over the period November 2015-June 2016,
- LOS of PPMC patients recruited over the period August 2016 to July 2017.

However, any reduction in LOS does not necessarily mean that there was a reduction in costs, or if there was a reduction in costs that the reduction was proportional. Figure 2 provides a schematic overview of the adverse event experiences and cost implications for patients admitted through EDs. From an understanding of the possible impacts of PPMC, the shaded boxes represent data identified a priori for collection.

Figure 2 highlights that some of the cost impacts anticipated will result in increased costs without increased severity of the condition (acuity) and therefore upcoding of the diagnosis related group (DRG). The magnitude of any such costs could only then be estimated by collecting actual individual patient costs per admission.

Figure 2: Predicted cost impacts of the PPMC model upon costs†



† Shaded boxes represent data captured.

Therefore, a post-hoc analysis was proposed by Deakin which sought access to the actual cost data for the study (including readmissions) for patients enrolled in the study. The data fields requested for the two cohorts appear in Appendix I. As the identification of patients required linking of patient data from the Victorian Admitted Episodes Dataset (VAED) to the Victoria Cost Data Collection (VCDC), the request was made through the Centre for Victorian Data Linkage (CVDL). Ethics approval was obtained and de-identified data provided. As these data were not available until the completion of the state's entire cost data collection for 2016-2017, the complete data set for the PPMC study was not available until June 2018.

Data were entered by each campus into the software program REDCap and collected by Alfred Health. Analyses by Deakin were performed in Microsoft Excel/IBM SPSS®. The data fields available are listed in Appendix III.

The study recorded the frequency and type of medication errors, but not the severity of the implications which requires subjective judgement. An independent clinical panel comprising a senior medical registrar, consultant physician and senior clinical pharmacist was therefore given the task of reviewing a random sample of 10% of the medication errors in order to categorise their clinical importance to one of the following categories:

- Insignificant
- Low
- Moderate
- High
- Extreme

The criteria for these judgements were not supplied to Deakin but would in any event rely heavily upon the judgement of the clinical experts.

Given the lapse of up to 12 months from the time of recruitment of patients to standard care and recruitment of patients to PPMC, it is expected that on-going efforts to improve efficiency in the hospital sector, together with improvements in clinical practice, may have affected the LOS averages over this period in any event. Therefore, the possibility of an underlying trend in LOS for patients admitted to general medicine wards needed to be controlled for. This was done by trend analysis of the average LOS (ALOS) for general medicine admissions to Victorian public hospitals for the 5 year period from 2012-13 to 2016-17.

Qualitative Study Results

Findings from early phase interviews and focus groups

Demographic information for participants involved in early phase interviews and focus groups are provided in Table 1.

Table 2. Overview of demographic information of participants involved in early phase interviews and focus groups

	Pharmacy (n=32)	Medicine (n=13)
Female/Male ratio	27:5	8:5
Age range (years)	23-60	26-45
Years in profession (range) **Number < 5 years**	1-39 9	2-20 3
Years working in the Australian hospital system	1-39	2-11
Number of consultant physicians		3

The key themes derived from early phase interviews and focus groups were:

- improved quality and safety of care;
- optimisation of pharmacists' skills and competencies;
- satisfaction with the new model as a result of more multidisciplinary approaches to care, and ;
- transferability and sustainability of the model. These themes are outlined in more detail in the next sections. Participants focused on issues related to the effectiveness and the impact of the model.

These four themes are detailed below.

1. Improved quality and safety of care

The PPMC model was perceived to have a range of direct and indirect benefits with regard to quality and safety of care. Compared with prior to implementation of the PPMC model, it was agreed by both doctors and pharmacists that the new model of care was safer. It resulted in an earlier medicines reconciliation, provided a more comprehensive and accurate list of medicines, had fewer errors, and allowed for quicker resolution of medication issues with doctors. The general view was that more accurate reconciliation via the PPMC model resulted from pharmacists having more time than doctors in ED to ensure rigour and accuracy about medication issues, and being more likely in ED at the point of admission to have access to a carer and the patient's own medicines (as opposed to conducting reconciliation on a ward).

There was also a common perception among pharmacists and some doctors that pharmacists were more suitably skilled to the task and they placed greater priority in medicines reconciliation, particularly compared with junior doctors who often might otherwise perform the reconciliation. The perceived flow-on effects were more accurate and timely administration of required medicines, fewer errors, better continuity of care between ED and the ward, and potentially more timely patient discharge.

'It does make the admission process quicker for us but also we have that added clarification of the medication so we're not trying to find through other means what their usual medications are, so I think that was actually really helpful.'

Doctor (focus group)

'…we do two minimum (sources of medicines information to confirm medicines)… But I probably end up doing three. So I will probably look at our medical records, talk to the patient, either do own meds or pharmacy and if they are really rubbish and can't tell me anything, I probably do even four.'

Pharmacist (focus group)

'…before when we did admit a patient, we did the medications, we'd either have to try and go through old admissions if they had any or chase up with GP, whereas now, we get an immediate medication, medication reconciliation which is …more accurate … So there's less errors involved there and we get more advice about, you know, certain interacting medications, things that may need to be withheld…also allergies that we might of [sic] missed..'.

Doctor (focus group)

'… the (PPMC-credentialed) pharmacist has charted and I've been reconciling to see against the drug chart… there's no errors that I've found so far in reconciling compared to when doctors chart.'

Ward pharmacist (focus group)

Indirect benefits were observed by most participants, relating to a reduction in workload for both the admitting medical officers and ward pharmacists. Medical officers were reported to spend less time on charting and ward pharmacists had to follow up fewer issues when reviewing medications charted in ED. Time saved allowed health professionals to focus on other important clinical tasks, such as reviewing other patients and attending ward rounds.

'I feel like from the patient that I've just seen and called the pharmacist to review because of an admission, because I knew they were there taking a detailed history, corroborating it with their own, other sources, I kind of felt that everything that I was doing was being double checked by them and in the meantime I was seeing another acutely unwell patient and that was really, that was really helpful.'

Doctor (focus group)

The most commonly cited limitation of the PPMC model was the business hours of operation, which failed to capture the large proportion of eligible patients being admitted after hours. Some identified the potential for complacency around the clinical conversation between the doctor and pharmacist or missing errors if the PPMC model became standard practice. Individuals raising this possibility did not appear concerned for their own hospital in this regard – they felt that the professionalism of the pharmacists and doctors, and anticipated continuation of performance monitoring, would suffice to minimise this risk.

2. Optimisation of pharmacists' skills and competencies

Pharmacists and doctors held positive views regarding the impact of the PPMC model in terms of harnessing the skills and competencies of pharmacists. In addition to having the more appropriate training, it was felt that pharmacists tended to have personal attributes that emphasise rigorous medication review and documentation. Credentialed pharmacists reported

that the PPMC project enabled them to reflect on their competency gaps, undertake significant upskilling, and take greater responsibility for medication management. Doctors and pharmacists reported increased collaboration and clinical interactions between the professions as a result of the project, which had benefits for patients receiving both the PPMC and usual care. This ability to collaborate was particularly the case where pharmacists had not previously been embedded within the clinical team.

'…and as the pharmacists keep telling me they are extremely OCD [obsessive compulsive disorder] about these things [laughs] so they're much, much better, yes, much less likely to make an error I think than a busy registrar and human error is always there in charting, but I don't see the pharmacists as more likely to make an error than doctors at all.'

Doctor (focus group)

'I guess it (PPMC) gives the pharmacist more responsibility… they were still doing the same amount of work (previously), it's just that, I guess in a way, the work they were doing was not been utilised. It was not being taken advantage of as much as it could have been and now we are actually taking advantage of it.'

Pharmacist (focus group)

'… since the project has been introduced, I think there's more of a willingness and an openness to actually discuss other things, just, other than that, just the patient's medications as well. So, I find often, personally I feel more comfortable actually calling pharmacy and asking them advice in regards to appropriate antibiotic prescribing and you know, if they can maybe check the renal function for this, so that, you know, that communication has opened up quite well.'

Doctor (focus group)

Several pharmacists alluded to the emerging contexts for their delivery of PPMC, which underscored the importance of skills development. Issues raised included new challenges such as deciding which patients to prioritise for care (particularly if pharmacists were also undertaking ward and ED duties concurrently), extending the scope of their clinical interviews with patients, the need for experienced pharmacists to deliver PPMC, and the need to make proactive clinical recommendations that are often reliant on clinical judgement.

3. Satisfaction with more multidisciplinary approaches from the PPMC model.

Participants from pharmacy and medical professions were consistently satisfied with the new model of care and preferred this approach over previous models in place at their hospitals. From the perspective of PPMC-credentialled pharmacists, the upskilling, greater accountability and involvement in clinical decision-making led to considerable job satisfaction and a sense of being valued within the team. By comparison, doctors and ward pharmacists appreciated the positive impact of improved clinical information available, and how the PPMC process freed them up to do other important work. Medical staff who experienced the program had little or no concerns about turf encroachment or the loss of learning opportunities for junior doctors because of having pharmacists engaged with charting, and medical staff often felt it was beneficial from a professional development perspective.

'If I walk into ED, the doctors, they go 'brilliant, yes the pharmacist is here!'. And the ward pharmacist if I tell them about an ED patient, they go 'brilliant, the work is already part way done and it is quicker for me to do my follow on with the patient', so it means they've got more time to do other patients as well who haven't been through the program. And it means we've got a clear idea of the issues going in because I've had time to sort of follow through that patient what the issues might have been with medication and what the intention was in ED.'

Pharmacist (focus group)

'For me, I get an enormous amount of satisfaction from it. I feel like I'm able to have better clinical discussions with the doctors. Because we actually sit down and have the in-depth conversation with them… we've got the diagnosis happening there, which makes it easier for me to mine out which medication is likely to be contributing and it's easier for the doctors to go 'ok, well these are things we need to change from a medication point of view, then review in twenty four hours on the acute ward'.

Pharmacist (focus group)

'It has been a process that's been embraced by our network from the highest level to medical staff to our director of pharmacy, our pharmacy team, our pharmacists on the floor. It's been very well received so I think it's a really positive step overall.'

Pharmacist (interview)

'I would actually argue that having a good clinical conversation with a pharmacist in writing up that initial drug chart provides more of a teaching opportunity than copying down a list of medications, so for me I, I don't think it's a valid concern...'

Doctor (focus group)

The background context to overall satisfaction was a general appreciation that better patient care was achieved through the PPMC model.

4. Transferability and sustainability of the model

As the interview and focus group sessions were conducted during the initial phase of PPMC implementation, there was little consideration placed on transferability and sustainability compared with issues around effectiveness as described in the previous sections. However, some themes began to emerge including resource implications of sustaining or upscaling current delivery, adaptation required to training and implementation if rolled out to other hospitals or clinical units, and general matters to consider with a future rollout. The benefits of this model were considered widely applicable, more so for surgical units where medication charting was perceived as less of a priority. It was equally acknowledged that a different workflow, and consideration of priorities and culture in surgical units may necessitate adaptation of the model for success.

Resource implications for a future rollout varied between sites and depended on the existing pharmacist full time equivalent (FTE) to bed ratio. Rolling out this program was not thought to impact significantly on the workload of medical staff.

'Well things would be very helpful for all aspects of the hospital to have lists of medications that been verified by pharmacists on admission, that would be very helpful for surgical residents etc. But I do feel that we need broader cover to have that service, the busiest times in the hospital is mornings and evenings or afternoons and evenings so I think the impact of the study will be very limited if it's just restricted from eight till four.'

Doctor (focus group).

Several views were expressed regarding the ease of potentially rolling this model out to other hospitals, particularly the enablers and barriers for smaller and more rural hospitals. It was felt that staff engagement and program coordination would be easier in a smaller hospital, but that there were potential challenges for some in having adequately experienced pharmacists in

appropriate numbers. Rural practitioners interviewed reported considerable enthusiasm and feasibility at their site. Conversely, the logistical challenges of training up large numbers of pharmacists at large metropolitan hospitals were also noted.

Yep, I think that it would probably be easier in smaller sites, smaller networks for now. We do have a really high turnover of patients and probably, maybe a higher acuity so in comparison to our network it should work well. Again like, smaller networks might not have a lot of staffing, that's an issue. But I think uptake across the hospital would be really good with appropriate criteria for the pharmacist's skills and appropriate credentialing.

Metropolitan pharmacist (interview)

Participants also identified a range of inputs that contributed to successful project implementation at a local level, and both clinical and non-clinical outputs and outcomes.

Findings from late phase interviews and focus groups

Demographic information for late phase interviews and focus groups are provided in Table 3. Themes that were derived from late phase data collection included;

(1) Improving quality and safety of care

(2) Workforce integration and satisfaction

(3) Implementing, disseminating and sustaining practice changes

As a result of additional data collection and an exploration of themes developed from early phase data collection, a more comprehensive analysis of data within the VIRIAF was conducted resulting in numerous sub-themes, described in Table 3. For example, it was confirmed that improved quality and safety observed, were closely linked with optimising the use of pharmacists, so these initial themes were synthesised. However, a separate theme was developed around integration of care and interdisciplinary teamwork. Issues around PPMC model implementation, sustainability and dissemination were also identified as a strong theme.

Table 3. Overview of participants involved in baseline interviews and focus groups

	Pharmacy (n=32)	Medicine (n=20)	Nursing (n=13)	Key informant interviews (n=14)	Overall (n=79)
Female/Male ratio	23:8 (1 unknown)	11:8 (1 unknown)	9:4	6:8	49:29 (2 unknown)
Age range (years)	24-54	26-54	24-64	32-68	24-68 (4 unknown)
Years in profession (range) **Number < 5 years**	1.5 – 30	2 – 33	4 – 47	7 – 40	1.5 – 47 (2 unknown)
Years working in the Australian hospital system	1.5-30	2-33	4-47	3-40	1.5 – 47 (2 unknown)
Number of consultant physicians		3 consultant physicians	-	5 medical consultants, 5 Directors of Pharmacy	8

1. Improving quality and safety of care

Late phase interviewees and focus group participants provided strong support for the perceived ongoing positive impact of the PPMC model on quality and safety of care. A greater involvement of pharmacists as the medication experts in the care of patients, was identified as a key component to this theme. Some specific examples included the impact of meticulous pharmacist documentation regarding decision-making in ED, on improving medication decision making on the ward. These views were also shared by nurses and key informants. As a result, four sub-themes were developed under this theme:

(i) optimising the role of pharmacists;

(ii) improving the management of complex patients;

(iii) disseminating safe medication practice; and;

(iv) limiting factors of the model.

i. Optimising the role of pharmacists

A broad perception that the safety of patients was generally enhanced through the introduction of the new PPMC model was communicated by participants from all health professional groups. Pharmacists were considered, both by themselves and by nurses and doctors, to be neater and more accurate in their documentation of individual medicines, as well as providing a more comprehensive list of medicines through the use of multiple sources.

'…when the pharmacist does the reconciliation when the patient is actually in ED and you end up with a full list of medications right at the start of admission. Whereas when we chart their medications on admission, sometimes if the patient doesn't have them or if things have changed recently, there might be things that are missed that then don't get charted for a few days…'

Doctor (Focus Group)

There was a general view that this high-quality review stemmed both from pharmacists' innate medication expertise, delivering the review in a structured manner, and from pharmacists having more time to conduct the review than doctors. Some felt that pharmacists needed a certain level of experience before they could undertake the PPMC role, while others spoke of a preference for making it a core competency for all undergraduate pharmacists.

'I think in general pharmacists have some inherent trait that it has to be perfect and it has to be right.'

Pharmacist (focus group)

The review and clinical conversation were seen as a valuable double-checking of issues, particularly for less experienced junior doctors and admitting doctors who were often managing multiple clinical demands. Despite occasional reservations prior to implementation, none of the interviewed doctors indicated outstanding concerns regarding the PPMC model. Rather they felt that doctors retained a high level of oversight and that the clinical interview with pharmacists provided a great opportunity for reflecting on medications prescribed in a more structured manner.

'…the liaison between the pharmacist and the medical person in completing the chart has meant that there was more discussion around medications… should this drug be withheld? Should it be charted?'

Doctor (interview)

As in early phase interviews, an earlier medication review was considered to deliver a more comprehensive medication reconciliation by having the review conducted in the ED or the SSU. Compared with a ward-based review, family members were more likely to be available for the pharmacist interview in ED, and the patient's own medications were more likely to be available for confirmation about medication-taking behaviours. One interviewee also proffered that the patient was less likely to be suffering from interview fatigue, which can occur on wards as a result of prior discussions about their medications.

'…seeing patients a lot earlier in ED, we get an idea of what medicines patients are on pre-admission and then with partnering up with the doctor, we are able to get all the regular medications charted straight in ED and it's correct from the get go as opposed to…the next day having to chase up the doctors, they've already had a few maybe incorrect doses, incorrect medications. It saves us time, it's safer for the patients.'

Pharmacist (focus group)

ii. Improving the management of complex patients

Doctors and nurses appreciated the emphasis the PPMC intervention placed on high risk drug groups and high risk patient groups. Doctors cited examples of benefits among patient groups including those who had experienced falls, those with cardiac exacerbations being misdiagnosed, those prescribed anticoagulant medications, renal failure, transplant patients, those with polypharmacy, and those requiring antibiotic therapy and VTE prophylaxis.

From a workflow perspective, doctors felt that the greater benefit came from reviews of more complicated patients. Reviews of more complicated patients also resulted in greater time savings for doctors. In addition to the clinical interventions that pharmacists performed, it was also identified that many patients received their non-urgent therapies in a more timely fashion as a result of the earlier medicines reconciliation.

'…a lot of patients now, they've got polypharmacy, a lot of medications … and then charting them correctly takes a lot of time….if you start seeing the patient and the pharmacist gets information about the medications, it definitely speeds up the work quite a lot.'

Doctor (focus group)

iii. Disseminating safe medication practice

A number of medical and pharmacist interviewees indicated a flow on effect from the PPMC model to other patients who were not involved in the project. They claimed that greater multidisciplinary interaction and frequent learning opportunities also led to clinical benefits for non-PPMC patients. These effects were a consequence of clinicians being more empowered to contact pharmacists with queries. Previously, they may have been inhibited by a lack of familiarity with the pharmacist and their skills. Other learning opportunities were also established. For example, learning occurred from pharmacists about prescribing issues, which might previously not have been considered a priority (e.g. dosage adjustment in renal failure).

'It also meant if I was in there doing a PPMC patient and they were admitting someone who wasn't eligible for the project, with one of those shortlisted antimicrobials, I could sort of intercede.'

Pharmacist (interview)

Nurses also identified how the PPMC model improved the safety of medication practice beyond the scope of the project and identified how the model could continue to shape medication safety

if maintained. An example of this situation included how a greater involvement of pharmacists as a result of PPMC could ensure patients were discharged from hospital on the correct medications, which would have flow on effects to general practice clinics and community pharmacies.

iv. Limiting factors of the model

A major limitation frequently cited by participants, particularly doctors and key informants, during the late phase interviews and focus groups was the PPMC hours of operation. It was regularly felt that the limited hours of operation, typically from about 8am or 8.30am until 4.30pm or 5.30pm, resulted in only a fraction of eligible patients availing of and benefitting from the new process. When hospitals extended the availability of the service by just a few hours into the evening (e.g. until 8pm), participants reported an increase in the recruitment of eligible patients. However, doctors often felt that the expanded hours were not adequate to capture the majority of eligible patients admitted during the evening, with admissions typically slowing after 10pm or 11pm. The partial coverage of patients was also considered to have made the routinisation of referral by doctors more difficult, who would often initiate charting of medications themselves.

'… the only time I end up doing a drug chart for a patient is if it hasn't been done and they've been there for a while. So that's often the overnight patients who are still down waiting to go upstairs. They haven't been admitted yet by the inpatient unit, the pharmacist isn't there to do their drug chart and you get given the bag in the morning and you kind of almost have to. You can't say 'stop, this is a gen med patient, let's just wait until pharmacy get here'. If they need their medications then they need them...'

Doctor (focus group)

In at least one hospital, the introduction of electronic charting at around the same time as the PPMC project did appear to affect accuracy of pharmacist charting as they became familiar with the electronic formulary and product selection processes. There is no evidence that pharmacists were more likely to make errors than doctors with this new system, but it may have led to lower levels of improvement in errors relating to documentation. However, the availability of pharmacists due to the PPMC model, established additional teaching opportunities surrounding electronic charting.

1. Workforce integration and satisfaction

A noticeable positive impact on overall levels of interdisciplinary interaction and on the integration of care for patients was observed by participants. Several clinicians and key informants identified this change as the key benefit of the intervention alongside the improved safety and quality of care of patients. Increased integration of care manifested in a number of ways, and explored in the following subthemes: (i) a greater involvement of pharmacists; (ii) increased workforce satisfaction; and (iii) harnessing existing capacity for integrated care.

i. A greater involvement of pharmacists

Many spoke of a perceptible cultural shift in interprofessional communication between doctors, nurses and pharmacists because of greater involvement of pharmacists in patient care during the trial. As with the early phase findings, PPMC credentialled pharmacists reflected on how the project had enabled them to build on their clinical skills and competencies. However, in late phase data, additional insights described how PPMC pharmacists adapted their practice to meet the needs of the interdisciplinary team. For example, PPMC pharmacists assumed accountability for the accuracy of charts, whereas prior to the trial, it was felt that doctors often did not prioritise accuracy of charting, or take responsibility for following up on issues they had identified as needing further resolution.

'…this has really cemented their role within the team. From having them engaged from the very outset instead of you know, on the first weekday ward round, they're kind of involved now from the morning the patient presents to the emergency department…'

Doctor (interview)

Furthermore, both doctors and pharmacists alluded to stronger interprofessional relationships between the disciplines due to the program. As members of both professions highlighted, their role had shifted from policing errors and pharmacists asking doctors to 'fix things', to collaborating alongside the registrars in planning patient care, which created a more positive focus.

'…getting that med rec [medicines reconciliation] right at the point of admission, you're preventing omission of doses particularly critical medicines. So, all of those medicines that perhaps the patient might not get for a day or two days, you're getting that solved straight way

which, some patients have the anxiety that they're not getting their medicines and people actually need those medicines.'

Pharmacist (focus group)

Some pharmacists reported that doctors, with whom they had charted, were also more disposed to PPMC pharmacist recommendations outside the project, even when pharmacists were acting as a ward pharmacist. Both consultants and junior medical staff embraced the support for junior staff from pharmacists and identified flow on benefits for patients. Overall, doctors valued the interaction with pharmacists and typically felt that time was saved through the PPMC model.

ii. Increased workforce satisfaction

Satisfaction with the new model of care appeared to be unanimous amongst the participants. In addition to identifying benefits for patients, participants were also willing to engage in the PPMC program as they perceived that there were benefits to their professional role in relation to being part of an integrated team. For PPMC pharmacists, a greater level of their engagement by other professions made them feel valued and imparted a feeling of self-actualisation. The positive impact of the project on morale within the pharmacy department was noted both by PPMC and ward pharmacists. Even ward pharmacists who were not PPMC-credentialled appeared to identify PPMC as a great opportunity for their profession that they should support.

'… this is the gold standard of what we want… even though it takes a little bit longer, it's the first model I find getting in early, fixing errors, rationalising the medications, what we want to do for the patients.'

Pharmacist (focus group)

'From a satisfaction point of view, this project has been really good. I was actually a bit of cynic when I first came into it because you see it's a big-time commitment for us to put someone down here... But it's a hundred percent worth it, and is really, really, really good… Both for patient safety, interprofessional collaboration and job satisfaction.'

Pharmacist (focus group)

In addition, ward pharmacists reported that the model reduced their workload burden when admitted patients had already been charted by a PPMC pharmacist. Only occasional interpersonal issues were reported as requiring resolution within pharmacy departments as the

project was implemented, typically because roles and responsibilities needed further clarification. One example cited was a patient who required medication in ED due to a delayed admission process. It was unclear whether it was the role of the PPMC pharmacist or ED pharmacist to organise supply of this medication. As a result, both pharmacists declined a request from the nurse seeking assistance with this process.

The increase in demand for pharmacist involvement in admissions from doctors acted as a major source of positive reinforcement around the value of the PPMC role. PPMC pharmacists also reported more frequent queries on a range of non-PPMC general medication issues as a result of greater familiarity among nurses and doctors.

'…certainly the feeling on the ground is that it has reduced errors … the intangible things I guess are just the creation of a more cohesive team in managing patients and so you know, the medical registrars know the names of the pharmacists, they interact with them regularly because they're sort of having that initial discussion, it then opens up discussion about other things.'

Doctor (interview)

For doctors, there was a widespread appreciation of the convenience of having a pharmacist available to support the charting process, particularly for junior medical officers. In addition to saving time, doctors reported that it also made junior medical officers feel supported, and offered a learning opportunity. This situation was particularly appreciated when under pressure to complete multiple admissions in ED. A small number of medical interviewees reported one or two colleagues complaining about the new model. They were unclear of the exact reason for dissatisfaction, but the complaints did seem focused on experiences of charting where the PPMC model was perceived to take more time than the previous doctor-led approach.

'The pragmatic advantage of the pharmacist is doing the physical prescribing of the vast majority of the patient's medications and of the patient cohort that we look after in general medicine, that's significant, it's time that has been saved from their admission processing but also knowing that there's a discussion between the pharmacist and the medical staff, and just that communication that's improved the result…'

Doctor (interview)

One Director of Pharmacy highlighted that a key motivation to maintain the PPMC was the potential impact on staff recruitment and retention resulting from improved job satisfaction.

Likewise, a key medical informant from another hospital felt that it could assist with retaining their junior medical staff by helping staff to feel more supported. There was very little discussion of concerns around medical deskilling, nor was there any sense that the PPMC model compromised the relationship between the patient and doctor.

The nurses who participated in interviews were also satisfied with the impact of the new model of care. Some reported that PPMC reduced their workload associated with medication administration, while others noticed no difference. For those that did, an increased accuracy of charts led to less time spent chasing doctors to clarify medications or correct errors. One nurse also reinforced that pharmacists were being accessed more frequently as a resource. Several nurses at different hospitals also indicated a greater sense of reassurance around medication administration when they realised a pharmacist was involved in the charting.

'I've noticed with the nursing point of view, there were stages there where we would want to know information, we go find the doctors but now because the pharmacists are in the team, we're using them as a resource, because they know the patient. They know the history and what's there…'

Nurse (focus group)

iii. Harnessing existing capacity for integrated care

Several hospitals had already made significant system changes prior to the project to embed their pharmacists within clinical teams. Additionally, a number of hospitals reported long-standing supportive relationships between their pharmacy and general medicine departments. Therefore, the impact on integration may have depended on where hospitals were at in this evolution prior to project commencement.

Key informants from several hospitals indicated that considerable strides towards inclusive interdisciplinary care had already been made prior to the PPMC program. In these cases, PPMC was a logical progression. Even at such hospitals, integration of care and inter-professional discussions often appeared 'patchy' prior the project, particularly during the admission phase of an inpatient stay. In one hospital, it was felt by a key informant working in ED, that PPMC pharmacists also enhanced integration between ED and the rest of the hospital. This integration was achieved by providing wards with extensive documentation of decisions in ED, and by linking with wards via ward pharmacists to ensure continuity of care.

'…there's been a sensation or feeling of a bit more multi-disciplinary support. Rather than just being isolated in the emergency department and you know there's also been a positive effect from the pharmacist on the department…'

Doctor (interview)

Interestingly, the physical layout of the hospitals was also reported to act as a positive or negative mediator of pharmacist integration. In particular, the availability of desk space for pharmacists in ED dictated how strong a presence they could have there. Likewise, the close proximity of the pharmacy in one of the smaller hospitals was felt by one key informant to have allowed pharmacists to respond quickly and in person to requests. The ongoing physical presence of pharmacists appeared to facilitate greater willingness to engage pharmacists in matters unrelated to the PPMC. According to one key informant, the improved patient to pharmacist ratio, required as a precondition for trial participation, may have helped with this increased visibility. Crowded ED departments were seen by one pharmacist to potentially hamper pharmacists, as finding the patients could be difficult if they were being moved around.

'I think it became much more common for us to be asked questions when we were physically in that area and also because they get to know us better, then they are keen to ask us questions when we are not there too.'

Pharmacist (interview)

Coordinating time for the clinical conversation was the most commonly cited challenge to completion of the PPMC process; an issue for both doctors and pharmacists. This challenge occurred due to difficulty with mobile phone reception in some areas of the hospital, or difficulties with the paging system. It was noticeable, however, that issues with coordinating the clinical conversation were reported less by participants in the late phase data collection when compared with participants in the early phase data collection. In late phase interviews, most doctors reported satisfaction with wait times for pharmacists, however, few also reported delays when pharmacists had multiple patients awaiting review. Several key informants and clinicians in late phase interviews discussed that rostering differences between medical and pharmacy departments in their hospitals had resulted in difficulty in coordinating a mutually agreeable time for the clinical conversation. Several doctors and pharmacists reported that initial difficulties with getting doctors to engage in the PPMC process in ED, whether through failure to

remember or lack of motivation, had largely dissipated by the end of the project phase. Concerns expressed by doctors around loss of charting skills were very few during late phase interviews

Improving the integration of care also meant that pharmacists were required to adapt to a new context of care. In practice, pharmacists reported having to be proactive in identifying and prioritising patients for review, and adaptable in making recommendations for patients without a confirmed diagnosis. Conversely, doctors reported having more information upon which to base their decisions in ED. Several ward pharmacists and doctors identified the usefulness of having a clearly documented plan for medications from the outset. One doctor commented that PPMC documentation also lessened the likelihood of errors compared with their current oral handover practice between ED and ward nurses.

2. Implementing, disseminating and sustaining practice changes

Issues pertaining to successful implementation of the trial, maintaining the PPMC model as implemented during the trial, expanding the scope of the service, disseminating the service to other hospitals, and adapting and sustaining the PPMC model, were all strong concepts in the late phase evaluation. As a result, multiple subthemes were identified which included:

(i) implementing the PPMC model;
(ii) reliance on pharmacy resources;
(iii) meeting credentialing requirements;
(iv) expanding the scope of the model;
(v) need for ongoing leadership; (vi) developing an adaptable model; and;
(vi) transferring the model to other settings.

The inclusion of key informant interviews in the late phase evaluation provided additional insights, particularly around model funding and sustainability. This process also included the integration of the PPMC model with other local and statewide policies and initiatives.

i. Implementing the PPMC model

As the course of the evaluation proceeded, it became very clear that participants considered implementation as a complex undertaking. Significant individual and organisational resources were required to implement the PPMC in addition to the funded project officer. Furthermore, it became equally clear that there were many additional benefits to the PPMC model, both

tangible and intangible, some of which would not be captured by the planned economic analysis. In addition to the obvious time spent delivering the clinical intervention, the inputs that were commonly identified across multiple hospitals were:

- Funded project officer.
- The need to reallocate pharmacy resources away from other areas towards the PPMC program.
- Reorganisation of pharmacies to support reallocation of resources.
- Hospitals approvals, steering committee input, delivery of credentialling.
- Awareness raising among doctors.
- Multidisciplinary leadership and team building activities.

Participants from several pharmacy departments observed that the introduction of the PPMC model was an evolution rather than a revolution; the culmination of multiple organisational, cultural and clinical initiatives. The general view was that the model did not impose additional burdens on general medicine to the extent that they needed extra resources to manage the workload. The majority consensus was that there were time savings overall, but occasionally patients would take more time than if charted by a doctor alone.

The outputs that were mentioned across different hospitals, in addition to the obvious issues of quality of care and medication safety, were:

- Improved efficiency, mitigating duplication of medication reconciliation processes, reducing correction of errors.
- Time savings for doctors.
- Increase in pharmacy leadership and accountability.
- Enhanced teamwork and integration of care.
- Flow on effects for non-PPMC patients.
- Reducing workload for ward pharmacists.

Table 4 presents a more comprehensive range of inputs applied during implementation, and outputs, as identified by stakeholders. In short, from this evidence alone, the benefits of the PPMC model it would be expected to include a lowering of costs from:

- more efficient processes which may offer savings in time-costs (which would be reflected in shorter LOS) and/or
- reduced hospital acquired complications attributable to errors including medication errors (which would be reflected in shorter LOS and lower acuity of patients during their admission).

The implications for costs and outcomes are discussed in the Economic study results section below.

Table 4. Inputs and outputs identified by stakeholders as having been applied during implementation of the PPMC model

Inputs	Description	Outputs	Description
Reallocation of pharmacist time	• To meet required pharmacist to patient ratios and to recruit to target, the project often used resources that could have been allocated elsewhere	**Better quality of care for PPMC patients**	• Project resulted in safer, higher quality care with fewer errors or delays relating to medication use, in addition to the systematic planning of patient care
Approvals, governance, committees, planning	• Several key informants outlined an intensive process of seeking engagement and endorsement from heads of departments, clinical committees and steering groups	**More timely administration of medications for PPMC patients**	• The model reduced medication administration delays and queries • Pharmacists could also ensure that non-urgent medications were charted and available
Credentialing process	• Time was spent by consultants and senior pharmacists in training and assessing pharmacists undergoing credentialing • Train-the-trainer accreditation also took time for individuals involved	**Better quality of care generally, for both PPMC and non-PPMC patients**	• Improved clinical care due to pharmacists being more accessible for general queries and able to deliver opportunistic interventions • Doctors learning from pharmacists • Reducing work burden on doctors and ward pharmacists
Data entry	• Entry of trial data onto REDCap system	**Improved pharmacists' and**	• Higher-level interaction achieved through the intervention was considered to have led to the upskilling of both professions

Inputs	Description	Outputs	Description
		doctors' competencies	• Credentialling process was viewed as an upskilling opportunity for pharmacists
Dissemination	• Considerable effort was required from both the pharmacy personnel and medical lead to raise awareness of the project among doctors	**Pharmacists assuming accountability for medication charting**	• Pharmacists were widely reported to take great care in ensuring comprehensive documentation and an accurate medication chart
Evidence of benefit	• Evidence from the Alfred Health trial was viewed as highly important in justifying the current trial	**Avoiding unnecessary use of resources**	• Avoids duplication in medicines reconciliation, resulting in a reduction of time in amending errors
Clinical conversation time, ED charting time	• Some doctors indicated that on occasion PPMC took more time than standard practice	**Time savings for doctors when treating PPMC patients**	• A general reduction was reported in time spent with patients by doctors during the admission process
Leadership	• Several key informants identified the need for leaders in pharmacy and medicine to regularly provide oversight and coordination.	**Potentially improved hospital KPIs**	• Perception of reduced medication errors with potential to reduce length of stay

Inputs	Description	Outputs	Description
Pharmacist overtime	• Several pharmacists and key informants reported the need for both voluntary and paid overtime (sometimes to facilitate weekend or extended hours)	**Pharmacist efficiency improved**	• Pharmacists identified other tasks that could be completed during any down-time in the PPMC process
Pharmacy reorganisation and team building	• Key informants discussed the efforts required to prepare the hospital for the PPMC model, e.g. adapt pharmacy rosters, cultural change.	**Teamwork and multidisciplinary care**	• PPMC model perceived to have had a profound impact on embedding pharmacists in the multidisciplinary team
Project officer	• Role of the funded project officer role was valued • Sometimes also took on the role of PPMC pharmacist team leader	**Staff recruitment and retention**	• Although not a direct experience of the trial, some key informants noted that staff retention could be enhanced due to (1) pharmacy professional development and (2) additional support for junior doctors
More efficient ward-based medicines reconciliation	• Ward pharmacists reported spending less time on correcting errors, freeing up time for other clinical activities.	**Staff shortages from pharmacist reallocation (negative)**	• For some hospitals, continuing the PPMC model meant drawing on resources from other areas
Unnecessary PPMC reviews	• Although not a common occurrence, some pharmacists reported initiating		

Inputs	Description	Outputs	Description
	PPMC reviews of patients who eventually did not get admitted		

ii. Reliance on pharmacy resources

There was general agreement that the availability of pharmacists was the key challenge for delivering the PPMC model on an ongoing basis. Most pharmacy departments did not operate with patient to pharmacist ratios, as recommended by the Society of Hospital Pharmacists of Australia (SHPA). This lack of alignment in relation to staff ratios resulted in the need to re-distribute pharmacy staff in order to meet the PPMC project requirements. It was continually implied that reallocating the same resources after the trial was unsustainable. Additional funding was identified as a requirement to maintain the PPMC model. However, from the results of this study, any shortfall in the pharmacy budget due to additional staffing requirements should be more than covered by the consequent savings from less costly inpatient care.

Several Directors of Pharmacy indicated that it would be difficult to maintain the patient to pharmacist ratios after the trial. Some departments had already reduced the hours of operation and number of participating pharmacists on the completion of the trial. The most commonly identified barrier to this issue was the ability to manage competing tasks and high workloads with limited resources for the pharmacy department. A couple of key informants also highlighted an additional barrier, which was the inflexible structure of pharmacy departments. An example involved when there was seasonal or some other temporary extra demand for beds, and possibly opening of additional beds to cope with demand. While other professions, such as nursing, could call upon agency or locum staff to meet extra demands, this was not possible for the pharmacy department. This situation made it difficult to continue operating at a high level of general service across the hospital as per the PPMC model.

'…we've tried to implement from the very start a sustainable model. Unfortunately, it can be dependent on things like sick leave and that's the same with any of the professions, sick leave and unplanned leave that then might require us to shuffle things around or reduce the pharmacist time in ED so our priority is always to try and get someone down there, have them down as long as possible but of course it's always going to be subject as to what else is going on…'

Pharmacist (focus group)

Most key informants were strongly supportive of continuing the PPMC model as trialed or a hybrid version of the PPMC model. However, key informants from several hospitals discussed that the availability of additional pharmacists would be the determining factor. Key informants from other hospitals felt that current resources were adequate or nearly adequate but they would need to be reoriented from ward-based care to ED. The need to develop a business case to obtain additional internal funding was also discussed. Key informants varied in their accounts of the likelihood of success. For some, it was felt that there was a reasonable chance of success if improved quality of care could be demonstrated (i.e. reduced errors).

However, in at least one hospital, it was felt that there would need to be direct cost savings demonstrated for funding to be considered. In the absence of additional funding, one Director of Pharmacy suggested that he might assess the PPMC program against alternative current uses of clinical resources to determine which offered the greatest potential benefit. An alternative strategy might be to adapt the PPMC model to enable efficiencies in the discharge process and thereby free up pharmacist resources. If funding was not obtained, several Directors of Pharmacy indicated that the likely path, at least on an interim basis, was to continue PPMC but with restricted hours of operation and fewer pharmacists involved.

'*… I think the big thing will be the discharge...do you look at another model where we just sign off a script and it goes outside to be dispensed if it's simple. We're doing a bit of that now. Or the technicians play a greater role. Some way of making sure, we can get discharges done in a timely way because there's access alerts when they're trying to discharge a lot of patients*.'

Key informant (interview)

'… there's good acceptance [of the model] with clinical champions and to support you from the medical side and buy in from the exec [executive] and if we've got the staffing base to allow that to happen or re-engineer some of our processes to free up time as that is a priority.'

Key informant (interview)

iii. Meeting credentialing requirements

At large hospitals, it was reported that maintaining a cadre of credentialed pharmacists was difficult during the trial because only one pharmacist was trained to provide credentialing. Clinicians trained in delivering the credentialing program also reported that it was a time-consuming process. Turnover of staff, extended periods of leave (e.g. maternity leave), and roster changes were all characteristics of large hospital pharmacy departments. This situation meant that individuals favoured a longer-term model that delivered increased capacity to credential on an ongoing basis.

'*…So credentialing the pharmacists…is a very time consuming process. The resources to be able to credential pharmacists, ongoing and building that capability within the health service. So, we've relied on the Alfred hospital credentialing our physicians…. And we've been the only ones who've been allowed to credential our own pharmacists and that's not sustainable. We just don't have the time to do that. It's creating that capability within this health service to be able to credential our own pharmacists…*'

Pharmacist (interview)

iv. Expanding the scope of the model

A related workforce issue was the challenge of extending the hours of operation of the PPMC model. Clinicians and key informants felt it was integral to the future validity of the model. A restricted daytime model of care was seen as slightly incongruous with their hospitals' needs, given the perceived value of the intervention and the 24-hour nature of admissions. It seemed untenable to some that most eligible patients would not be provided access to PPMC care. While some doctors felt that ongoing 24-hour cover would be welcomed, they identified that this may not be feasible at their hospital. As an alternative, support for extended hours of operation was communicated. It was identified that coverage until midnight would be sufficient to capture the majority of evening admissions. Experiences during the trial of extending opening hours to even 7 or 8pm were widely perceived as having significantly increased coverage.

Directors of Pharmacy highlighted that a divergence from traditional working hours of pharmacy might be more feasible in larger hospitals rather than small hospitals. It was speculated that larger hospitals might have more employees willing to undertake shift work (e.g. parents looking for flexibility and to alternate childcare with a spouse). However, there was reluctance to impose rosters that might adversely affect staff retention. Navigating the terms and costs imposed by enterprise bargaining agreements was also identified as a barrier to this issue.

The partial counter-argument to needing extended hours, made by several key informants at different hospitals, was a belief that poor alignment between pharmacy and general medicine rosters may be limiting the true potential of credentialed pharmacists to chart more patients during business hours. While patients were in ED and could be reviewed by a PPMC pharmacist in the early afternoon, a review by the medical registrar could not occur until later in the afternoon due to the rostering. There appeared to be a desire on both sides to reconcile this issue, but this had not yet been worked through. A second issue identified with extending hours was whether or not the PPMC process would be as effective, given that community pharmacists might not be accessible as an information source after hours.

'*…Look, definitely. Even things around, when our medical teams have roster stressors and things like that, we notice differences in the rates of charting occurring and the like, and just being able to respond to those, identify the issues and when necessary implement changes around that…*'

Key informant (interview)

'*… whether it's a pharmacist not working late enough or the registrar not working early enough, the patients are there, it's a mismatch… at [other hospital campus name] we did move our pharmacists later, we haven't here because it's sort of, it's almost a medical model which is problematic for other reasons as well, so there's sort of completely up to our rosters to fit in with what's a partly dysfunctional model, didn't really make sense,*

if you see where I'm coming from. So, we'd sort of rather see them fix their end a little bit before we completely just, aligned…'

Key informant (interview)

v. Need for ongoing leadership

It was also felt by several clinicians and key informants from medical and pharmacy backgrounds that sustainability of the program also depended on continued leadership and program oversight. Ongoing audits were conducted to ensure that patient quotas and quality of care were maintained. The level of communication from pharmacy to medical and nursing personnel was seen as integral to the success of implementation. Those providing leadership recounted repeated efforts to maintain an adequate level of engagement about the project; however, the challenge of how to reach out to a workforce with high levels of turnover and multiple shifts appeared to be profound and there remained a common perception of being only somewhat informed about the trial. The challenge of doctor engagement particularly manifested with difficulties in getting ED doctors to stop writing up medication charts for eligible patients. In several focus groups with doctors, it became obvious that there remained some uncertainty as to the exact hours when the service was available, when colleagues would correct each other.

Sustainability was also seen to be supported through routinisation and embedding of processes into routines – for example, transfer of governance from a project steering group to an existing safety committee, or adopting a more flexible model of delivery to accommodate a dynamic hospital environment.

vi. *Developing an adaptable model*

Some key informants, from pharmacy and medicine, also cautioned against an inflexible PPMC model if it was to be sustained long-term. Rather, they argued that the principles should be embedded into care but that the model should be flexible to cope with a rapidly shifting healthcare environment. One key informant, from a pharmacy background, expanded on whether dedicated training for a specific intervention was the best approach to future credentialing, for example as opposed to a formal qualification (e.g. postgraduate clinical qualification) that would enable ongoing acknowledgement of the various skills developed for different purposes.

Furthermore, some doctors felt that accommodating the clinical conversation was sometimes difficult, and one doctor hoped that the requirements could be made 'a bit less formal' once the trial phase was completed. Support for conducting the conversations by phone was offered. Removing a physical sign off process by doctors was also favoured by some in order to allow for a 'smoother' process. This flexibility was considered to be particularly important if the intervention was to be expanded to other settings where the

doctor might not be available (e.g. if scrubbed up in surgery). Another doctor suggested that it might also make the process more efficient for them if pharmacists could chart antibiotics with oral approval from doctors, rather than requiring doctors to chart these orders.

vii. *Transferring the model to other settings*

The close working relationship between general medicine and pharmacy was widely acknowledged. In terms of expanding the scope of the project within hospitals, most participants felt that the PPMC model was transferable to other areas of the hospital, albeit sometimes with a need to adapt the model. These areas included, but were not limited to, surgical, short stay units, palliative care, cardiology, haematology, oncology, orthopaedics, paediatrics, neuroscience and the ED. Patient groups at particular clinical risk and with complex medication regimens were identified as the priority recipients of this model. Several participants identified the importance of strong engagement with the leadership of a unit in order to roll the model out. It was notable that often the units being advocated by key informants for inclusion in a PPMC expansion were those where the medical or surgical leadership was known to be keen to explore this option.

Surgical patients were the most commonly nominated group by some margin. There was a general feeling that drug safety and medication charting were not well managed in surgical units at present. Charting often occurred after surgery, at which point patients were not fit to provide information. Some expanded to specify certain types of surgery (e.g. vascular) as being more of a priority. Whether or not these units would be accepting of the PPMC model or interested was discussed. However, multiple key informants indicated that these units would value the time saved by having a pharmacist conduct the medication review as opposed to the surgical registrar. A couple of participants also suggested that the PPMC process would be very popular among theatre staff, who often must push a registrar or other medical practitioner to write up charts after surgery. It was felt that charting might best be undertaken during pre-admission clinics for elective surgical patients, as registrars would typically be gowned up and in theatre, and therefore unavailable for a face to face clinical conversation.

When considering how a PPMC model could cater for more than general medicine patients, many participants expressed uncertainty about the best place for credentialed pharmacists to be based. Being based in ED and charting for all participating units was felt to have the advantage of building rapport with the ED team, and allowing pharmacists to advise patients who would not be admitted, or who would be sent to the short-stay unit. Conversely, if ward pharmacists from individual teams were called from their ward to see patients who were likely to be admitted to their team, it would further enhance continuity of care. It was also flagged that credentialing requirements would become more complex if the intervention expanded beyond general medicine. For example, new case studies might need to be developed for different clinical areas.

However, it was generally felt that the PPMC model of care could be rolled out to most Victorian hospitals, including smaller rural hospitals. This possibility was subject to pharmacy staffing and the organisational culture.

A number of project risks were identified regarding the sustainability of the project. One risk was the potential for complacency among doctors and pharmacists in regards to the PPMC requirements (i.e. clinical conversation). Some participants communicated concern around the potential for doctors to become complacent due to their confidence in the quality of pharmacist support and charting. The risk of pharmacists also becoming complacent was mentioned by some individuals. Some participants indicated that the combination of having to conduct handover to the ward and double checking by a ward pharmacist should maintain a high level of diligence. Several key informants also advocated for continued monitoring of performance to ensure that both quality of care and patient receiving PPMC care, were maintained.

Credentialing

Credentialing of pharmacists is a foundation requirement for the implementation of PPMC. The approach taken to credentialing Alfred Health involves both doctors and pharmacists attending for a single 'train the trainers' day for accreditation with the aim which of equipping them with the skills and knowledge to pass on the capability to train others clinicians and pharmacists in the PPMC model. The entire process of PPMC training is completed by a further 3-days of advanced training in the PPMC model.

Limitations of evaluation

Patients were often considered to have had positive experiences in relation to the PPMC model, although this may have depended on pharmacists explaining the potential benefits of early medication review. Many pharmacists indicated that patients generally did not differentiate between the PPMC model and standard care. Owing to concerns for the confidentiality of participants, it was deemed potentially inappropriate to conduct individual reports of findings for each hospital.

Online survey results

Findings from the online survey – involving 172 participants reinforce the findings above from interviews and focus groups, and suggest that these qualitative findings are valid. They also add some reassurance that there was not a 'hidden' dissatisfaction among the surveyed professions. Most respondents agreed that care was safer and that medication incidents were fewer following introduction of the PPMC model – and nobody

reported that safety had worsened. There was a general welcoming of increased interdisciplinary interactions, a more effective role for pharmacists, and a reduced workload related to resolution of medication issues.

As with the qualitative findings above, there was general agreement that the model should be continued as delivered, that it should be expanded to other areas of their hospitals, and that the model was transferable to other hospitals. The survey report also outlines key results on a hospital-by-hospital basis. Owing to the relatively small numbers of participants within each profession, and responding from most hospitals, it was not considered appropriate to compared responses from each hospital.

Economic study results

Baseline comparisons of patients enrolled to the study

Given the trial design was essentially a cross-sectional study of the two models of medication charting (PPMC vs standard care), critical to the interpretation of the economic results of the study is establishing the similarity of the two patient cohorts with respect to the key determinants of cost (for example; age, acuity, comorbidities, etc). That is, establishing that the results are free of bias from any differences in key variables between the two cohorts.

From data collected during the study, Table 2 shows that the two cohorts were very similar with respect to age, gender, comorbidities and triage categories with no significant differences. A pairwise comparison of hospitals also found no significant differences. Additional data sourced from the Victorian Centre for Data Linkage (within Department of Health and Human Services) showed the anticipated or intended length of stay was also similar. Although the difference of 0.03 days (1.95 vs 1.98) between PPMC patients at baseline compared to those in standard care was statistically significant (p=0.03), the absolute value of the difference is small and does not alter the interpretation of results. It was therefore concluded that the two groups were essentially the same.

Table 2 : Comparison of PPMC and standard care patient enrolments

Parameter	PPMC	Std Care
No. enrolled	3036	5612
Mean age	75.3	74
Gender (Male %)	44.5	46.9
Charlson Co-Morbidity Index (median)	5	5
Triage Category (median)	3	3
Admissions (includes readmissions)	9100	14679
Intended length of stay (days)†	1.95	1.98

† Data provided by Victorian Centre for Data Linkage. Difference of 0.01 was statistically significant p=0.03

The actual LOS for both cohorts was much longer than the intended length stay at around 2 days. However, the important conclusion from Table 3, is that there was an average reduction of 0.77 days in actual LOS for the PPMC model compared to the actual LOS for those in standard care. In clinical studies it is conventional to report median results as this description is considered a better indicator of the expected outcome. In economic studies, the choice between mean and median results is less clear though as cost distributions are commonly 'right-skewed' with the presence of outliers which contribute materially to the associated

budgets. For interest, the median difference in LOS was a reduction in favour of PPMC of 1.0 day and which is consistent with expectations from the exclusion of outliers.

Table 3: Results for Length of Stay (LOS)

	PPMC model	Std Care	Difference
Mean (days)	5.80	6.57	-0.77†
Standard error	0.109	0.091	

† ($p<0.01$)

Table 4 shows results for the secondary outcome of medication charting errors. Consistent with the results of the pilot trial of the PPMC model at Alfred Health, the reduction in errors was substantial.

Table 4: Results for medication charting errors

	Pre-phase		Intervention (PPMC)	
	Medications charted	Charting errors (%)	Medications charted	Charting errors (%)
Study totals	53,371	10,235 (19.2)	31,658†	146 (0.5)

† The medications charted in the PPMC stage were fewer than in the pre-phase as there were fewer patients. The medications per patient though was similar in each group
Source: Alfred Health, Dr Erica Tong

Comparison of weighted inlier equivalent separations (WIES).

Hospital funding in Victoria includes payments for each admission based upon the type and number of patients treated. At discharge, a diagnosis related group (DRG) code is assigned to the patient admission based upon the diagnosis and treatment received. Each DRG has a cost weight assigned and which is calculated from the average recurrent cost of treating patients assigned to that DRG across the state in the previous year. Every eligible patient episode is funded at a flat rate based upon the DRG cost weight and price paid per cost weight. The cost weight itself is known as the weighted inlier equivalent separation score (WIES) and as such represents a measure of acuity[3]. To be precise, it is more accurately described as a measure of the intensity of resource use in treatment, but as intensity (particularly LOS) is a correlate of

[3] For example, using the 2014/15 national cost weights, the WIES assigned to Liver Transplant was 6.85 (ALOS of 19.2 days) but a colonoscopy had a cost weight of 1.02 (i.e. close to the average weight of 1.0) and haemodialysis a cost weight of 0.11. The payments when multiplied by the multiplied by the Department determined price paid per Weighted Activity Unit ($5007) was then $145,991 (=6.85 x 5007) $5,104 (=1.02 x 5007) and $491 (=0.11 x 5007) respectively.

clinical severity, WIES is often used as a measure of clinical severity or acuity. The results for comparing WIES from the PPMC study are shown in Table 5.

Table 5: Results for Change in Clinical Severity (WIES)

	PPMC	Std Care	Difference
Mean	1.154	1.291	-0.136†
Observations	9100	14679	

† ($p < 0.001$)

The reduction of 0.12 in WIES represents a 7.3% percent reduction in acuity compared to patients in the standard care medication charting. It is important to recall at this point that given that the intended length of stay was found to be similar for each cohort at the time of admission (Table 2). Thus, if the reduction in medication errors under the PPMC model had no impact upon the quality of clinical care, then the actual LOS would be expected to be similar for each cohort. Whilst causality is not 'proven' by this observed reduction, it is clearly consistent with a significant contribution coming from a reduction in hospital-acquired complications. It should also be acknowledged that the WIES funding model is continually evolving and therefore any changes after the period of standard care charting may bias the results obtained during the PPMC period of charting medications. However, informal advice from the Department was that the most significant funding policy change over the period lead to an increase in WIES over the period of PPMC charting[4]. Thus, to the extent this influenced the final average WIES for the PPMC cohort, the underlying influence of PPMC must have been even greater than observed in this study.

Comparison of costs of admissions (unadjusted for background LOS trend)

If medication errors are reduced, it follows logically that overall patient outcomes must improve. It would be implausible for them to be worse (refer to the section Patient outcomes for additional comment). The important finding from this study relates to effect of the PPMC model upon overall costs. For the post-hoc analysis of actual admission costs, Deakin requested individual patient data for each admission for all patients enrolled in the study. This request was submitted through the Victorian Centre for Data Linkage who provided a number of data fields relevant to each submission (refer Appendix I.).

[4] Coding rules relating to constipation changed such that constipation was recorded more frequently and thus the acuity or severity of patients increased.

Table 6: Comparison of PPMC and standard care costs of admission

	PPMC	Std Care	Difference
Mean	$8,802	$9,803	-$1,002†
Admissions (for which data were available)	2840	3182	

† $p < 0.004$

The observation in Table 6 of an average saving of $1,002 from PPMC patients compared to those receiving medication charting under standard care represents a 10% reduction in costs.

In the PPMC study data, it was found that elderly patients and polypharmacy patients showed a greater reduction in LOS than the total population (the two groups are most likely correlated). This also appeared to be the case with respect to costs where the difference was larger again at a saving of $1,221 per admission for patients aged over 64 years of age (Table 7).

Table 7: Comparison of PPMC and standard care costs of admission; patients aged >64yrs

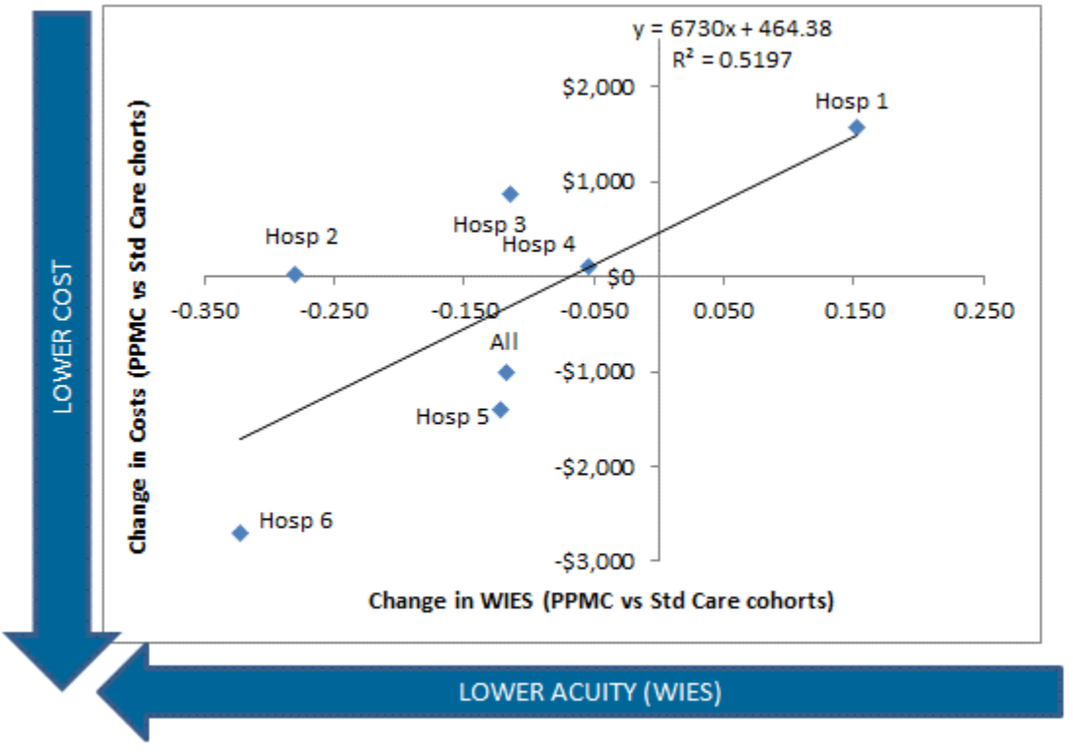
	PPMC	Std Care	
Mean	$7,315	$8,537	-$1,221†
Observations	6564	10432	

† $p < 0.001$

The intention was to analyse the effect upon enrolled patients of Aboriginal and Torres Strait Islander decent. However the numbers enrolled were too small to make any reliable statistical inferences.

During the evaluation, a scatter-plot of the change in WIES against the change actual admission costs was developed. Figure 3 shows a roughly linear relationship exists between the two (the names of hospitals are not given in Figure 2 to comply with confidentiality undertakings). At the conclusion to the study, one hospital reported they had deliberately recruited more complex patients as these patients stood to gain most from the PPMC approach to reducing medication errors and which explains a higher WIES and higher cost during the PPMC intervention phase. This was unfortunate from a study perspective endeavouring to compare the two approaches in equivalent populations.

Figure 3: Correlation of WIES and admission costs differences; PPMC vs standard care†



†The change in WIES from Std Care to PPMC was found to be statistically significant (lower) for All Hospitals combined. The change in costs was also statistically significant (lower) for All hospitals combined.

The correlation in Figure 3 provides potentially useful insights into the effect mechanisms of the PPMC model.

Given that there was no difference in demographic, comorbidity or acuity levels (measured by intended LOS) between PPMC and standard care patients at the time of enrolment to the study (Table 2), it is therefore unlikely that there was any systematic bias towards the recruitment of lower acuity patients during the intervention phase. Therefore, the inference follows that the most likely cause of any differences in outcomes are attributable to the adoption of the PPMC model. Furthermore, from the qualitative study results, it was apparent that the benefits of PPMC in lowering costs may be categorized as arising from:

- more efficient overall delivery of patient care which enables productivity/savings in time-costs and/or;
- reduced hospital acquired complications attributable to errors including medication errors.

Both of these benefits are consistent with the observation of a shorter LOS (Table 3), but only reduced hospital acquired complications are consistent with a lower WIES. The basis of this statement derives from the differing impacts that can be predicted from these two benefits as described in Table 8.

Table 8: Predicted impacts of economic benefits of PPMC upon WIES and cost of inpatient care

Possible economic gains from PPMC	Expected impacts upon WIES and cost of inpatient care
• More efficient overall patient care which enables increased productivity/savings in time-costs	Under the PPMC model, increased efficiency in the delivery of care will enable realization of savings which will be reflected in lower overall costs. If the patient is treated for the condition for which they present and discharged without any pre-existing complication, the WIES should be no different than would have been anticipated.
• Reduced hospital acquired complications	Coding to a DRG (which determines the WIES applying to that admission) is performed at the time of separation from the hospital, not at the time of admission. Thus if a patient presents for a minor procedure, but experiences a major complication during the course of their inpatient care, the admission will be coded upon separation to the more severe event (normally with a higher WIES than would have applied without the complication). Thus a reduction in the rate of complications, including those from medical errors, will be reflected by a reduction in WIES. As treatment costs correlate to WIES, a lowering of WIES can be expected to be associated with lower average costs as the cost of treating complications has been avoided.

From Table 8, the key observation is that a lower WIES may drive down costs, but the relationship is not reciprocal. Lower costs through increased efficiency will not reduce patient complexity and therefore will not reduce WIES. Therefore, if most of the savings calculated in Table 6 were derived from increased efficiency in the delivery of care, there would be little or no change in WIES at each campus, and the regression line in showing correlation would become close to vertical. Instead, the observation that costs appear to be closely correlated to WIES is suggestive that most of the savings are driven by reduced WIES and thus the benefits of PPMC appear mostly attributable to reduced complications, rather than increased productivity/time savings.

For interest, it is relevant to note the number and distribution of the clinical impacts of medication errors in the PPMC study as assessed by the expert panel review of a randomly selected 10% sample of the medication errors recorded in the trial (Table 9).

Table 9: Medication Error Panel Analysis

	PPMC		Std Care	
Insignificant	16	12.3%	132	12.9%
Low	58	44.6%	319	31.3%
Moderate	29	22.3%	298	29.2%
High	27	20.8%	268	26.3%
Extreme	0	0.0%	3	0.3%
Total	130	100.0%	1020	100.0%

Source: Alfred Health

Proportionally, there were fewer moderate, high and extreme errors in the PPMC model (from which it follows that proportionally there must be more errors in the PPMC model that were categorized as low or insignificant). Thus not only were the number of medication errors substantially reduced by the PPMC model from 19.2% of medications to 0.5% (Table 3), the impact of the average error was less also.

Thus for every 10,000 medications charted, these data suggest that there will be approximately:

- Standard care: 1,920 errors with high clinical impact and 6 with extreme impact
- PPMC model: 50 errors with high clinical impact and 0 with extreme impact

The difference in the absolute number of high or extreme errors is supportive of the conclusion that reduced costs from treating fewer hospital acquired complications is the most important source of benefits. However, the number of PPMC model patients reviewed in Table 9 is relatively small and more importantly there is considerable potential for confounding however. The result should therefore be explored in any further exploration or evaluation of PPMC models in settings outside of the present study.

Readmissions

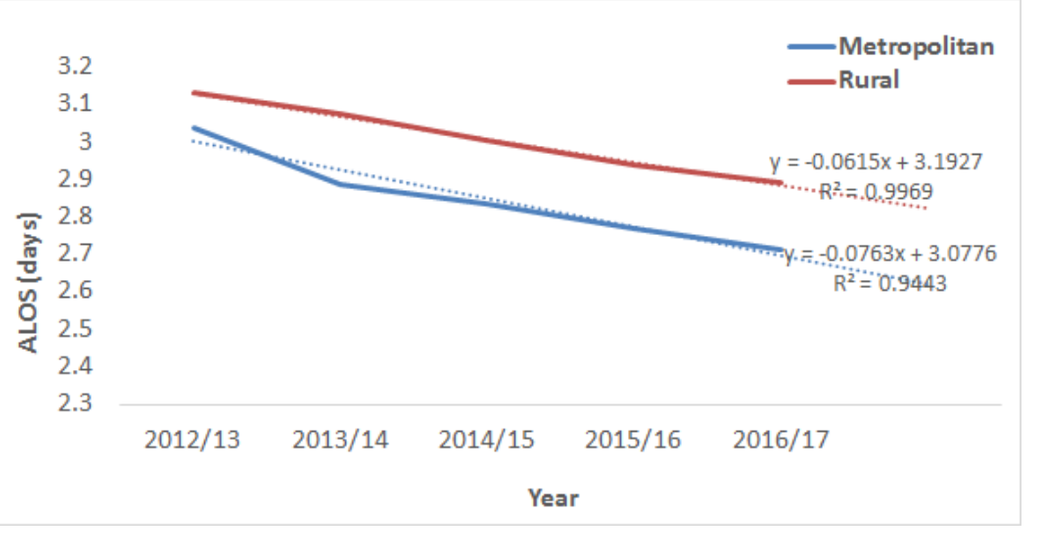
The probability of patients having a readmission within 30 days was very similar for each of the PPMC model patients the standard care patients. Of most interest to the analysis is the rate of unplanned re-admissions which would most likely best reflect any impact of medication errors. However, these were not clearly coded in the CVDL data.

Background Changes in LOS

Average LOS data for all general medical admissions in Victoria over the past 5 years was obtained from the Department (HOSdata). A simple trend analysis of these data showed an average reduction in LOS of 0.07

days per year had occurred over this period for metropolitan hospitals and a slightly lower reduction of 0.06 days for rural hospitals (Figure 4).

Figure 4: Victorian Average Length of Stay; 2012/13-2016/17.



Importantly, this reduction in LOS would have occurred irrespective of the PPMC study and would reflect on-going efforts to lower costs and improve efficiencies in the delivery of care.

Comparison of costs of admissions (adjusted for background LOS trend)

As the PPMC study cost data provided related only to metropolitan hospitals (cost data for the regional were not available), the reduction in LOS of 0.07 days (Figure 4) was used to adjust for the contribution of background reductions in LOS to the reduction of 0.7 days observed in the PPMC study. This estimate of 0.07 days was applied to the standard care average LOS of 2.7 days in 2016/17 and average cost of $9,803 (Table 6) used to calculate the value of the average background reduction in LOS as $276 per admission.

- The adjusted savings from the PPMC model become **$726 per admission** (rounded ≈ $1,002 – $276)

Recurrent costs of implementing the PPMC model.

The estimated saving of $726 per admission does not take into account the cost of implementing the PPMC model. In the late phase qualitative survey, it was noted earlier in this paper that participants considered

implementation as a complex undertaking with significant individual and organisational resources required to implement the PPMC in addition to the funded project officer. In addition to the time spent delivering the clinical intervention, a number of inputs that were commonly identified across multiple hospitals (Table 10):

Table 10: Resource Inputs Required Implementing PPMC Model

Resource consequence identified in quantitative survey	Economic perspective summary
Funded project officer.	The extent to which additional EFT pharmacists will be required is not yet clear as the adoption of the PPMC model is still in evolution to some degree. Costings for this paper assume 1.5EFT per hospital may be an overestimate
The need to reallocate pharmacy resources away from other areas towards the PPMC program.	A strength of the PPMC model is more efficient use of staff resources. Reallocation of resources has an inconvenience and disruptive effect during transition but as such has no incremental effect upon recurrent costs
Reorganisation of pharmacies to support reallocation of resources.	
Hospitals approvals, steering committee input, delivery of credentialing.	The provision of a new central credentialing service at Alfred Health has been costed. For participating hospitals, although there is some limit to the degree to which busy staff can absorb extra work, this is likely to be absorbed within existing resources.
Awareness raising among doctors.	
Multidisciplinary leadership and team building activities.	Likely to be absorbed within existing resources.

The general view in the late phase qualitative survey was that the PPMC model enabled time savings overall. As described in Table 10, the costing here allows for additional recurrent costs with respect to a new credentialing service and staffing of EDs. The work to develop the credentialing course for general medical patients has already been undertaken and thus the cost already incurred. Only the recurrent costs of comprises the cost of credentialing the pharmacists in the operation of PPMC, and the cost of staffing the ED with an additional pharmacist have been costed.

- **Credentialing service costs**: The proposal for any roll-out statewide of the PPMC model is that Alfred Health provide a central service for credentialing of health professionals. It is envisaged that a full-time senior pharmacist would be appointed for this role. The function of the service would be to deliver the training modules over time with the capacity to provide on-going service support and re-credentialing periodically. Alfred Health has competency and experience in the delivery of this training with approximately 150 credentialed pharmacists already working in the Victorian health

system. Costings here are based upon this service delivery model. The cost of a senior pharmacist full-time at Alfred Health would be approximately $120,000 allowing for on-costs.

- **Emergency department staffing costs**: It is difficult to estimate the resource requirements of the five health services precisely. Their experience to date with the PPMC model has occurred within the constraints of a study protocol and is also subject to evolution. During discussions with individual health services, opinions ranged from the adoption of the PPMC model being cost-neutral to requiring an extra 1.5 EFT. This is consistent with the results of the qualitative survey where responses indicated that the service configuration will vary, particularly as a consequence of the limited availability of pharmacists for staffing of night shifts. An illustrative 'ideal' service being considered is 8am-8pm Mon-Fri (with 2 EFT pharmacists overlapping for the afternoon when the majority of referrals are received), plus a single pharmacist service for 4 hours on Saturday/Sunday/Public holidays. This service would operate on the existing EFT allocation plus an extra EFT pharmacist. The cost implications of would be this are shown in Table 11 and would amount an extra $100,000-$125,000 per EFT depending upon grade and on-cost allowance.

  Since the conclusion of the PPMC study, the authors have become aware that some of the participating hospitals started to credential pharmacists who were not involved in the study and have also got other Medical Consultants to participate in the assessment process. Whilst they have reportedly used the model from the Alfred, it is not clear whether this credentialing is of similar, better or worse quality, and neither is it clear that regional delivery of an otherwise centrally delivered credentialing service is more cost-efficient.

Table 11: Illustration of possible cost of pharmacists to implement the PPMC model

Hours of Operation	Staff (EFT)	Salary cost †	AH rates
M-F **8-4:30pm**	1 (38hrs/week)	$43.76/hour = $1663.10/week	
M-F **11:30-8pm**	1 (38 hrs/week)	$43.76/hour + SA =$1784.60/week	Shift allowance $24.30/day
Sat/Sun/PH **9-1pm**	8 hrs/week	$87.52/hour (DT) =$700.16/week	Double time

† Rates based on Grade 2 year 4 hospital pharmacists without higher qualifications (credentialed charting pharmacists vary across Grades 1-3).

For this evaluation, the savings realized during the PPMC study (refer section Comparison of costs of admissions) were achieved with the operation of one extra EFT pharmacist working generally during the hours 8.00-4:30pm. That is, the effect size is derived from 1 EFT and therefore the cost-benefit ratio reported in this evaluation is based upon an indicative budget of approximately $110,000 for one additional pharmacist at each hospital working full-time (allowing for 25% on-costs).

To be conservative, costing results below for the statewide roll out of PPMC are based upon the highest EFT estimate of 1.5EFT per hospital.

Patient Outcomes

Patient outcomes were not measured in the PPMC study. However, it is reasonable to assume that if medication errors were reduced, that patient outcomes were likely to have improved as well, and certainly be no worse. It is also relevant to note the results for the frequency and severity of the medication errors in Table 9. These results suggest that quality of life gains would come from both the reduced frequency of errors but also the reduced clinical impacts of those errors.

Extrapolation to statewide implementation

The qualitative study found that medical officers spent less time on charting and ward pharmacists had to follow up fewer issues when reviewing medications charted under the PPMC model. Nurses interviewed also stated that they had more confidence in the medication charts. The commitment and desire to adhere to the PPMC model therefore extended across all clinical disciplines. The only limitation expressed was the need to ensure the availability of sufficient PPMC-accredited pharmacists to deliver the service. The overall results of the qualitative survey combined with the economic evaluation outcomes reported here already make a strong case for the wider adoption of the PPMC model in EDs of Victorian public hospitals. For completeness, the statewide implications are nevertheless examined here to provide insights to the possible magnitude of the costs and savings.

Detailed information on the patients currently treated in the EDs of Victoria's public hospitals is available on the website of the Victorian Agency for Health Information (Victorian Agency for Health Information, Accessed 23 July 2018). This includes quarterly information on the number of patients presenting to EDs, and the total number of emergency patients admitted to hospital. It can be calculated from this information that 39.9% of patients presenting to Victorian public hospital EDs during the 12 months ending March 2018 were admitted to hospital.

The PPMC study though only provides information with respect to admissions to general medical wards from EDs. Therefore, to maintain the validity of the cost estimates developed below, the numbers of emergency patients admitted to hospital were further adjusted in order to identify only those admissions from EDs to general medical wards. From AIHW data for Victoria, the proportion of all admissions to public hospitals that are medical is reported as 71% (AIHW, 2016). The proportion of 71% is therefore used as an approximation of the proportion of admissions through EDs that go to general medical wards. It is acknowledged that the proportions of patients admitted to medical wards through EDs will differ from that for all admissions as used here as the two populations (that is, all inpatients vs ED admissions only) are likely to differ. However, published data specifically for ED medical admissions vs surgical could not be identified.

This approach leads to an estimate of approximately 479,332 ED patients in Victoria per annum who would be eligible for medication charting under a PPMC model. Calculations are shown in Table 12.

During the qualitative survey, the most commonly cited limitation of the PPMC model was the business hours of operation, which failed to capture the large proportion of eligible patients being admitted after hours. This observation prompted a review of presentation patterns for this evaluation. The AIHW publish information from which it can be calculated that 58% of presentations to EDs per week occur during the hours of 8am-

6.00pm (Figure 5). These are the hours in EDs typically staffed by credentialed pharmacists during the PPMC study. Given that difficulties were also reported in attracting pharmacists to night-shifts, scaling up of the PPMC model may well be constrained to these hours in any event.

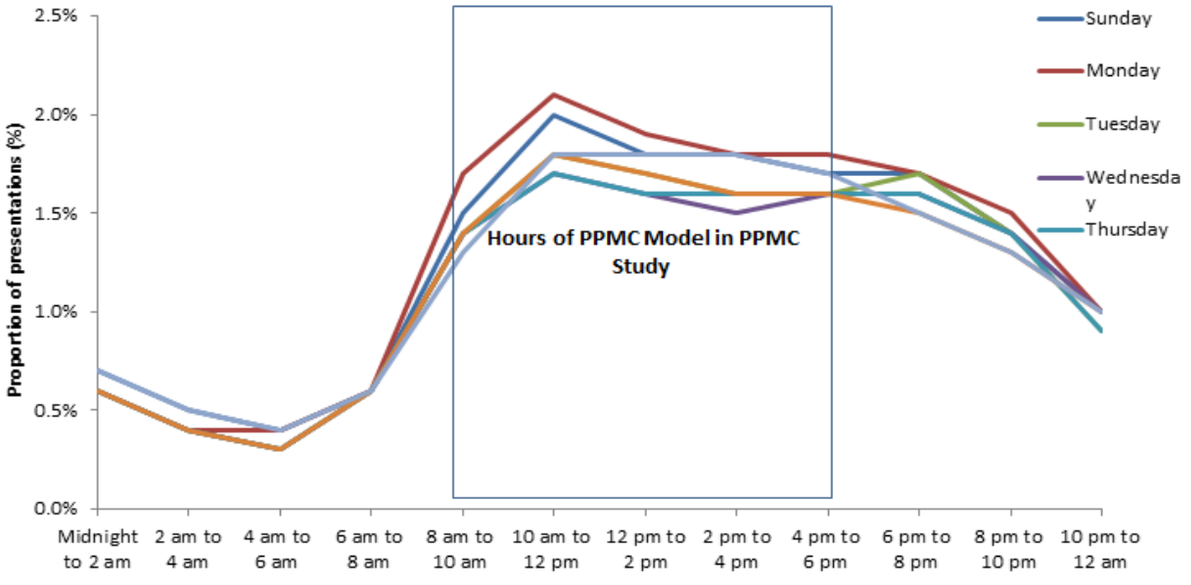
Table 12: Emergency patients presenting to Victorian public hospitals; Apr 2017 – Mar 2018

Victoria	Apr- Jun 2017	Jul - Sep 2017	Oct - Dec 2017	Jan - Mar 2018	Total
Total patients (triage Category 1-5) treated in EDs.†	409,453	415,431	425,378	427,988	1,690,225
Proportion of emergency patients admitted to hospital	40.2%	39.8%	39.7%	40.1%	39.9%
Total number of emergency patients admitted†	161,389	166,948	169,260	169,721	675,115
Proportion of all ED admissions that go to medical wards					71%‡
Approximate no. of all ED admissions that go to medical wards					**479,332**

† (Victorian Agency for Health Information, Accessed 23 July 2018) (http://performance.health.vic.gov.au/Home/Report.aspx?ReportKey=155

‡ (AIHW, 2016);

Figure 5: Emergency department presentation times by day



Adapted from: (AIHW, 2014); Table 2.7

Therefore, to calculate the statewide implications, the estimate of the annual ED patients in Victoria who would be eligible for medication charting under a PPMC model has been further adjusted for the likely hours of operation. This adjustment reduces the estimate of 479,332 to approximately 278,000 (Table 13). Applying the economic results for the PPMC model in this evaluation (Table 6) produces potential savings of $232M per year from the roll-out of the PPMC to all EDs in public hospitals. Importantly, this estimate is net of the recurrent costs of the PPMC model.

Table 13: Potential savings from statewide roll-out of PPMC model

Number of admitted ED patients admitted to Medical Ward (Table 12)	479,332
Adjustment for Hrs of Operation 8am-6pm (Figure 5)	58.1%
Number of admitted ED patients admitted to Medical Ward charted	278,492
Saving per admission (Table 6)	$726
Potential state Gross Savings in total (rounded '000)	$202,220,000

At this time, it is difficult to estimate the implementation costs of scaling up the PPMC model to a statewide roll-out. As noted in the text supporting the per hospital calculations in Table 11, the operation of the PPMC model in hospitals is still evolving. The views of the Directors of Pharmacy ranged from budget neutral to 1.5EFT being required. An extra 1.5EFT pharmacists would mean an extra $6.5M across the 40 (Victorian Agency for Health Information, Accessed 23 July 2018) EDs in Victoria's public hospital system.

Workforce capacity is an important consideration. For this evaluation, it is noted that if 1.5EFT were appointed to each of the 40 EDs, then:

- Charting at 10/day × 228 days[5] × 40 hospitals × 1.5EFT = 136,800 patients

This estimate is well short of the estimated 278,000 presenting and eligible as general medical ward admissions from EDs (Table 13). Medication charting of the balance of approximately 50% of presenting and eligible patients would need to be absorbed within current staffing. During the qualitative survey, great emphasis was given to the time-savings experienced from the PPMC model such that this may be possible. Indeed, during some interviews, the comment was made that the work volume had not increased, only the setting in which it occurred.

[5] Approx. work-days per year after allowing for annual leave, weekends and public holidays

Discussion

Themes developed from interviews and focus groups suggest a favourable assessment of several key domains within the VIRIAF framework used to evaluate the impact of new workforce initiatives. The effectiveness of the new model, particularly with regards to safety and quality, were a focal point for interviews with clinicians involved in the delivery of PPMC to patients. These observations are supported by the economic evaluation which found evidence that patients who had had their medications charted at the time their admission under the PPMC model had experienced lower acuity during the time of their admission than patients whose medications were charted under standard care as evidenced by the acuity weighting assigned to them at the time of their separation from hospital. This outcome occurred even though there was no clinically significant difference between the two patient cohorts at the time of their respective admissions.

Freeing up of time for ward pharmacists and admitting medical officers also seemed to allow them to better manage their overall workload and address pressing clinical concerns for non-PPMC patients. The initiative appeared to have the strong support of pharmacists and their departments, and also the general medicine units at each hospital. There was widespread satisfaction with the model from a professional perspective among doctors and pharmacists, thanks to perceived positive impacts on upskilling of pharmacists, recognition and utilisation of pharmacy skills, efficiency of medicines charting, and continuity of care during the admission.

The caveat for all perceived clinical benefits of the PPMC model is that it generally applied during the business hours of operation, and a significant proportion of eligible patients admitted over a 24-hour period missed the opportunity to receive PPMC care. Respondents also indicated a perceived benefit to expanding the service to other units within the hospital. There was also a realisation that a lot of groundwork was required to before implementing this system, particularly around embedding pharmacists into teams and dissemination of information to medical officers. From an economic perspective, whilst the missed patients represent a missed opportunity to realise the efficiencies offered by the PPMC model, the fact remains that significant savings, and its corollary of health benefits to patients, can be realized during business hours. These should not be forgone because larger savings cannot be captured after-hours. Additionally, a potential constraint that applies to both the expansion of PPMC to after-hours for general medical patients, and to the adoption of the PPMC model by other hospital units, is the capacity of the Victorian workforce to meet the demands of the model. The PPMC model may therefore be limited to business hours in any event.

The qualitative findings alone provide a strong justification for the adoption of the intervention. That said, the economic evaluation and analysis of trial outcomes provide further evidence in strong support from the demonstrated cost-effectiveness of the PPMC model. Furthermore, it is possible that the benefits of PPMC reported here underestimate the true benefits for two reasons. Firstly, the data are derived from the pre-phase of the PPMC study (Figure 1) which was originally intended as the transition phase. This was later changed after it was found the pre-pre-phase data were not suitable for use, and that the take-up of the PPMC model had been slow. However it is not known whether some implementation of the PPMC had nevertheless occurred during the pre-phase, and therefore to what extent the 'standard care' data may have been slightly contaminated by some early implementation of the PPMC model. Secondly, we identified multiple benefits in the areas of workforce satisfaction, optimal use of clinician skills, and an integrated workforce, which represent important goals for most health services but which would not be measured directly and thereby incorporated into an economic analysis. They occur because of learning experiences that result from more frequent and more in-depth interactions between doctors and pharmacists, and the trust developed from these clinical discussions, which had positive ramifications for care provided to all patients, not just those who received the PPMC intervention. It is reasonable to expect that these benefits will continue to grow as the model matures.

Our findings outlined the probable 'causal pathway' for this intervention –in other words, how the constituent elements of the PPMC model combined to produce a change in quality of care and subsequently the desired clinical and health economic outcomes. More so, the effect pathway is explained in the context of different cultural, clinical and organisational environments at participating hospitals. As such, the qualitative results form a natural adjunct to the economic evaluation by providing insight and plausibility to the strength of the quantitative results from the PPMC study.

By understanding the integral elements of the intervention (e.g. the clinical conversation), attempts to adapt the model for greater flexibility can be undertaken in a more informed manner. Findings can also provide additional guidance to additional hospitals seeking to introduce the PPMC model verbatim; for example, by explaining the level of effort required to effectively disseminate information to medical staff, and the key organisational changes in pharmacy departments that act as enablers of implementation.

In the absence of further funding for pharmacy departments to deliver the model, it may be that PPMC can be sustained with more limited resources in most hospitals since completion of the trial's data collection, pending the outcome of business case submissions to their hospital executives. This interim solution offers important continuity to the program in terms of maintaining its profile and governance structures. However, the obvious ramification of reduced funding is that outcomes such as patient access and workforce

satisfaction may decline. Likewise, if demand from doctors for the service remains, it may lead to overstretched PPMC pharmacists being delayed in getting to patients and not meeting the needs of busy doctors in ED. An ideal model would not just fully fund the PPMC during business hours, it would also provide funding for extended hours so that more eligible patients can be captured. It will be difficult to fully routinise the process for doctors in ED without these extended hours.

In relation to the trial design, the failure to minimize potential biases through development of a strict study protocol, particularly in relation to patient recruitment criteria, creates some uncertainty in relation to the actual magnitude of the impact of PPMC. However a corollary of the trial design is that the flexibility allowed in the implementation of the trial by hospitals was that the study reflected a more 'naturalistic' setting. That is, the choice of patients in the study was driven by clinical choice at the time and specific to each hospital, rather than in compliance with a detailed protocol. Similarly, whilst it is understood that the pharmacist/bed ratio fell short of the specified target of 1/20 on occasions, to the extent this occurred, it represents the reality of what might be expected in the operational setting. Confidence in the results reported here comes from the large size of the trial, the consistency of the 'dashboard' results including: medication errors, the clinical impact of the medication errors, LOS, WIES, admission costs and qualitative survey results all provide strong support for PPMC.

A natural next step for the PPMC model would appear to be expansion to further hospitals across Victoria. This may be easier for some hospitals than for others. Participating hospitals in the trial were not randomly selected and may represent a particular type of hospital. They were mostly metropolitan, had reputations for innovation within their pharmacy department, appeared to have existing strong links with their partnering PPMC medical units, and were often already moving towards team-based pharmacist roles. Given the importance of organizational culture and pharmacy resources to the success of the model, it is possible that PPMC care should represent an eventual rather than an immediate goal for some hospitals. This may be of particular relevance to some regional hospitals, where pharmacy departments' and medical unit capacity to expand service delivery might be stretched. It's important for such hospitals not to be left behind unnecessarily. Flexibility with credentialing, implementation support, and model delivery might be need to be reviewed to accommodate such settings. An ideal model might not be feasible everywhere, but hybrid models that still improves patient safety to some extent should be considered if necessary.

The transferability of the model to other areas of the participating hospital was enthusiastically endorsed. As discussed, surgical units were quite prominent among the wide variety of clinical areas considered to potentially benefit from the introduction of PPMC. As highlighted by participants, feasibility will be dependent on a variety of factors such as the motivation of doctors to have pharmacists involved in charting,

a culture of accepting inter-professional care, the availability of leadership, and the ability of pharmacists to integrate with that unit's workflows. Even with feasibility, effectiveness will depend on the risk profile of patients, and the capacity to prevent serious errors in that situation. Such factors should be more formally investigated before such efforts at transferring the model are made. An additional hurdle to expanding the scope of this model in other areas will be the development of suitable credentialing materials for other clinical specialties.

The qualitative study component of this evaluation was large by most standards. It is highly likely that issues of importance were explored to the point of saturation and that we can justifiably claim a reasonably comprehensive understanding of the breadth of perspectives pertaining to the impact of PPMC and one that is supported by the empirical evidence that has since been released and which underpins the economic evaluation component of this paper. Our interview schedule did seek to explore participants' perceptions of their colleagues' views and the absence of any substantial negative commentary suggests that most doctors and pharmacists were satisfied with the model of care. Subsequent to this qualitative study, we disseminated a related online survey to all pharmacy staff and relevant medical/nursing units. This survey allowed anonymous feedback from relevant health professional and avoided recruitment bias. Results of this survey correlate strongly with interview and focus group data and we conclude that they probably offer a reliable assessment of health professional views.

While health professionals felt that patients were either satisfied with care or unaware, we were unable to confirm this through direct interviews with patients owing to difficulty with recruitment.

Conclusion

In conclusion, our qualitative data suggests an overwhelmingly positive experience of the PPMC model. In addition to perceived improvements in patient safety and quality of care, it enhanced inter-professional relationships and professional satisfaction, which in turn facilitated engagement in the collaborative care process. It is not surprising then that the PPMC model was found to be highly cost-effective in the economic component of the evaluation with an estimated average saving of $726 per admission. PPMC not only offers clear net savings from a combination of improved efficiencies and reduced medication errors, but an inevitable corollary of the reduced medication errors is an overall gain in patient outcomes.

It is reasonable to conclude from the evidence produced by this study shows that the PPMC model may actually save lives by reducing the rate of medication errors that may be categorized as extreme (Table 9). However, given the uncommon occurrence of extreme errors, the required size of a trial which has the

statistical power to demonstrate the superiority of PPMC over standard care with respect to survival gains renders it completely impractical to ever conduct such a trial. Whilst collecting patient outcomes may have further strengthened the case for PPMC, the absence of data quantifying patient survival and/or quality of life is not a shortcoming as the case for funding support of PPMC with respect to general medicine patients at metropolitan hospitals, and most likely at regional hospitals also, has already been made in this study.

Attention must be paid towards exploring the possibility of wider dissemination and sustainability of the model.

References

1. Australian Institute of Health and Welfare (AIHW). Australia's health 2014. [Internet]. Canberra: Australian Institute of Health and Welfare; 2014 [cited 2018 March 5]. Available from: https://www.aihw.gov.au/reports/australias-health/australias-health-2014/contents/table-of-contents

2. Australian Commission on Safety and Quality in Health Care (ACSQHC). Literature Review: Medication Safety in Australia. [Internet]. Sydney: ACSQHC; 2013 [cited 2018 March 5]. Available from: https://safetyandquality.gov.au/wp-content/uploads/2014/02/Literature-Review-Medication-Safety-in-Australia-2013.pdf

3. Tong E, Roman C, Mitra B, Yip G, Gibbs H, Newnham H et al. Partnered pharmacist charting on admission in the General Medical and Emergency Short-stay Unit - a cluster-randomised controlled trial in patients with complex medication regimens. Journal of Clinical Pharmacy & Therapeutics. 2016; 41:414-418.

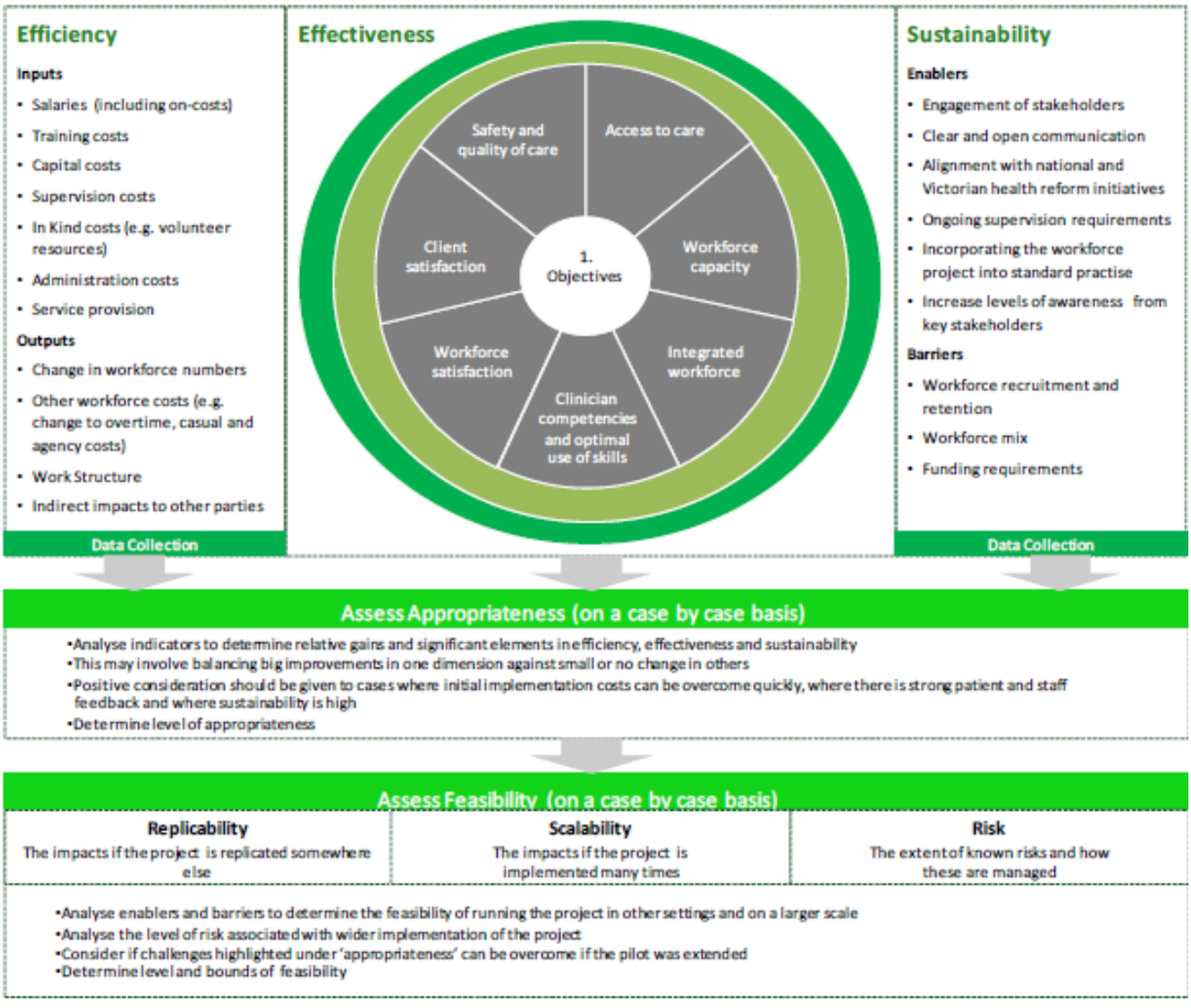
4. Department of Health Victoria. Victorian Innovation and Reform Impact Assessment Framework (VIRIAF). [Internet]; 2012 [cited 2018 March 5]. Available from: https://www2.health.vic.gov.au/health-workforce/reform-and-innovation/supporting-workforce-reform/victorian-innovation-and-reform-impact-assessment-framework

5. Braun V, Clarke V. Using thematic analysis in psychology. Qualitative Research in Psychology. 2006; 3(1): 77-101.

6. Saldaña J. The coding manual for qualitative researchers. Los Angeles: Sage; 2009.

Appendix I.

The Victorian Innovation and Reform Impact Assessment Framework



Citation: Department of Health Victoria. Victorian Innovation and Reform Impact Assessment Framework (VIRIAF). [Internet]; 2012 [cited 2018 March 5]. Available from: https://www2.health.vic.gov.au/health-workforce/reform-and-innovation/supporting-workforce-reform/victorian-innovation-and-reform-impact-assessment-framework

Appendix II.

PPMC study demographics

	Pre-phase			Intervention (PPMC)		
	Mean age (SD)	**Male sex (%)**	**Median number of meds (IQR)**	**Mean age (SD)**	**Male sex (%)**	**Median number of meds (IQR)**
Total	**74.0 (± 16.7)**	**2634 (46.9)**	**9 (6-13)**	**75.3 (± 15.6)**	**1350 (44.5)**	**10 (6-14)**
- Hosp 1	70.0 (± 18.9)	226 (45.9)	8 (4-12)	73.5 (± 15.5)	205 (43.9)	9 (6-13)
- Hosp 2	76.3 (± 16.5)	485 (45.2)	9 (6-13)	79.2 (± 14)	300 (44.6)	10 (7-14)
- Hosp 3	70.2 (± 17.5)	564 (48.5)	9 (5-13)	69.7 (± 16.8)	252 (43.7)	9 (6-13)
- Hosp 4	71.7 (± 15.9)	164 (44.4)	8 (5-12)	74.7 (± 15.7)	84 (50.9)	9 (7-13)
- Hosp 5	73.7 (± 16.6)	363 (42.4)	9 (6-13)	75.7 (± 16)	187 (39.5)	10 (6-14)
- Hosp 6	75.2 (± 16.3)	428 (50.9)	10 (6-13)	76.8 (± 14.9)	144 (45.6)	11.5 (8-15)
- Hosp 7	78.5 (± 13.3)	404 (49.3)	10 (7-14)	77.8 (± 14.0)	178 (48.9)	10 (7-14)

	Pre-Phase		Intervention (PPMC)	
	Median Charlson score (IQR)	**Median ED triage category**	**Median Charlson Score (IQR)**	**Median ED triage category**
Total	5 (3-7)	3 (3-4)	5 (3-7)	3 (3-4)
- Hosp 1	5 (3-7)	3 (3-4)	5 (3-7)	3 (3-4)
- Hosp 2	5 (4-7)	3 (3-4)	5 (4-7)	3 (3-4)
- Hosp 3	5 (3-7)	3	5 (3-7)	3
- Hosp 4	5 (3-6)	3 (3-4)	5 (4-7)	3 (3-4)
- Hosp 5	5 (3-6)	3 (3-4)	5 (4-6)	3 (3-4)
- Hosp 6	6 (4-8)	3 (2-4)	7 (5-8)	3 (2-3)
- Hosp 7	6 (4-7)	3 (3-4)	6 (4-7)	3 (3-4)

	Pre-phase		Intervention (PPMC)	
	Medications charted	**Medications charting errors (%)**	**Medications charted**	**Medications charting errors (%)**
Total	53,371	10,235 (19.2)	31,658	146 (0.5)
- Hosp 1	4,183	691 (16.5)	4,467	2 (0.04)
- Hosp 2	10,316	1,656 (16.1)	7,352	44 (0.6)
- Hosp 3	10,738	2,072 (19.3)	5611	19 (0.3)
- Hosp 4	3,258	694 (21.3)	1,704	49 (2.9)
- Hosp 5	8,193	1,751 (21.4)	4,860	19 (0.4)
- Hosp 6	8,220	1,685 (20.5)	3,773	8 (0.2)
- Hosp 7	8,463	1,686 (19.9)	3,891	5 (0.1)

Appendix III. :

Data Fields collected in the PPMC study

Data entered to RedCap

In addition to key information relating to a patient's gender, age, campus, etc., remaining data collected included:

- Charlson comorbidity index
- ED Triage category
- Transfer to ward
- Length of stay in ED (hrs)
- Time of Medication charting
- Time from admission to completion of chart
- No. of PRN medications
- No. of regular medications
- Errors detected on chart
- Number of errors detected on chart
- List of medication errors
- Type of medication error
- Any MET calls during admission
- Any mechanical ventilation
- Discharge destination
- Readmission within 30 days
- Date of readmission
- Days between discharge and readmission

Data collected from Department of Health admission and cost data bases (VAED & VCDC)

• e_cluster_id1	Patient
• AGEGROUP	Age
• campus	Hospital campus
• CCUHRS	Time in CCU (hrs)
• HITHLOS	Length of stay for Hospital in the Home admissions (days)
• HITHSEP	Separated – Yes or No?
• ICUHRS	Time in ICU
• INT_REQ	Interpreter required
• INTDSTAY	Intended length of stay (days)
• LOS	Length of stay (days)
• MARITAL	Marital status
• READMIT	Readmission

• W22WIES	Weighted Inlier separation (WIES)
• W22VICDRG	DRG coded to (Victorian)
• COSTS	Cost of admission

Appendix V

Online survey

Online survey: health professional perspectives of the PPMC

Characteristics of respondents

A diverse sample of pharmacists, doctors and nurses responded to the online survey representing a broad range of age and experience (see Table 1). Eastern Health provided the largest proportion of respondents (75/172), followed by Monash Health and Royal Melbourne with 43 respondents each (Table 1). Those responding from a medical background were more likely to be relatively inexperienced as a health professional in Australia with 0-5 years' experience (74%) compared with pharmacy (42%) or nursing (55%) (Table 2). Most respondents had worked in one or more area directly relevant to the trial - among medical respondents, 48 had worked in general medicine, seven in short stay units (SSU), 17 in an emergency department (ED), and four in other areas during the trial period. Five doctors reported involvement with pharmacist training and credentialing, 22 had referred patients to PPMC pharmacists, 22 had experience of delivering the PPMC intervention with pharmacists, and 36 had received a PPMC patient on a ward.

Eleven pharmacist respondents were directly involved with PPMC training and project management, nine in pharmacy management and project oversight roles, 36 had worked as credentialed PPMC pharmacists, 47 had worked as ward pharmacists for wards that received PPMC patients (43 reported working in general medicine), 46 had worked within the pharmacy department, eight in ED, and four had worked in the SSU. Ten responding pharmacists reported no direct role in the project. Seven of the nurses had worked in ED during the trial, 14 had worked in general medicine, 11 in an SSU, and three reported other roles. Five were involved with project implementation, 8 had referred patients to PPMC pharmacists, and 11 had received PPMC patients on the ward.

Table AV 1. Profile of respondents (n=172)

	N	%
Profession		
Pharmacy	79	45.9
Medicine	66	38.4
Nursing	22	12.8
Other	5	2.9
Age profile		
20-29 years	88	51.2
30-39 years	47	27.3
40-49 years	21	12.2
50 years and over	11	6.4
Not provided	5	2.9

	N	%
Gender		
Male	52	30.2
Female	112	65.1
Other	1	.6
Not provided	5	2.9
Places worked during trial period (more than one may apply)		
Missing data	1	0.6
- Hosp 1	16	9.3
- Hosp 2	42	24.4
- Hosp 3	33	19.2
- Hosp 4	8	4.7
- Hosp 5	43	25.0
- Hosp 6	13	7.6
- Hosp 7	30	17.4

Table AV 2. Number of years working as a health professional in the Australian health system

	Years worked				
Profession	**0-5**	**6-10**	**11-20**	**>20**	**N**
Pharmacy	42.7%	33.3%	18.7%	5.3%	75
Medicine	74.2%	9.7%	9.7%	6.5%	62
Nursing	40.9%	13.6%	22.7%	22.7%	22
Overall	54.7%	21.4%	15.7%	8.2%	159

Overall perceptions of the trial and their engagement

The majority of respondents from all three professions reported that they were adequately or highly informed about the trial, but it was only pharmacists for whom a majority felt highly informed (Table 3). However, 68% overall including clear majorities for each profession felt very satisfied overall with the PPMC approach to charting, and very few reported any level of dissatisfaction.

Table AV 3. General perception of health professionals regarding the PPMC

Question		Highly informed	Adequately informed, but unsure of some details	Slightly uninformed, but aware of the basics	Very uninformed, but vaguely aware of the project	Completely uninformed – no knowledge of the project	Not relevant – I'm new to my role at this hospital	
How informed did you feel about the PPMC process and efforts to trial this at your hospital?	Pharmacy	67.6%	25.7%	2.7%	0.0%	1.4%	2.7%	74
	Medicine	21.1%	36.8%	26.3%	7.0%	5.3%	3.5%	57
	Nursing	18.2%	31.8%	22.7%	4.5%	13.6%	9.1%	22
	Overall	43.1%	30.7%	14.4%	3.3%	4.6%	3.9%	153
		Very satisfied	Somewhat satisfied	Neither satisfied nor dissatisfied	Somewhat dissatisfied	Very dissatisfied		
Overall, how satisfied are you with the PPMC approach to patient charting?	Pharmacy	71.0%	26.1%	2.9%	0.0%	0.0%		69
	Medicine	66.0%	18.0%	12.0%	4.0%	0.0%		50
	Nursing	62.5%	0.0%	31.3%	6.3%	0.0%		16
	Overall	68.1%	20.0%	9.6%	2.2%	0.0%		`35

Quality of PPMC care

Large majorities of respondents from each profession, and 76% overall, felt that patient safety was much improved or slight improved as a result of the PPMC intervention (Table 4). Even larger majorities felt that the accuracy of medication charts and the number of medication errors on charts had improved. Importantly, a large majority felt that the rate of medication-related incidents had either much improved (63%) or slightly improved (23%). Not one respondent indicated that overall patient safety, the number of medication errors, or the rate of medication-related incidents had worsened as a result of the intervention.

Large overall majorities (>80%) also felt that the coordination of medication management through the admission and discharge processes, and their workload associated with resolving issues in the documentation of medications had much or slightly improved. A majority (78.5%) also felt that the patient experience had been improved to some extent.

Table AV 4. Perception of the overall impact of the PPMC approach for patients, relative to the previous approach to care.

Compared with the previous approach to medication charting at your hospital, what is the overall impact of the PPMC approach on…		Much improved	Slightly improved	No significant change	Slightly worse	Much worse	No response	Total
Patient safety (from a medication perspective)?	Pharmacy	91.3%	7.2%	1.4%	0.0%	0.0%	0.0%	69
	Medicine	56.0%	26.0%	14.0%	0.0%	0.0%	4.0%	50
	Nursing	75.0%	18.8%	0.0%	0.0%	0.0%	6.3%	16
	Overall	76.3%	15.6%	5.9%	0.0%	0.0%	2.2%	135
The timeliness of completing medication charts for admission?	Pharmacy	65.2%	23.2%	8.7%	1.4%	0.0%	1.4%	69
	Medicine	48.0%	20.0%	26.0%	2.0%	0.0%	4.0%	50
	Nursing	50.0%	25.0%	0.0%	6.3%	12.5%	6.3%	16
	Overall	57.0%	22.2%	14.1%	2.2%	1.5%	3.0%	135
The administration of regular medicines to patients in a timely fashion?	Pharmacy	68.1%	21.7%	8.7%	0.0%	0%	1.4%	69
	Medicine	46.0%	26.0%	22.0%	2.0%	0%	4.0%	50
	Nursing	62.5%	18.8%	12.5%	0.0%	0%	6.3%	16
	Overall	59.3%	23.0%	14.1%	0.7%	0%	3.0%	135

Compared with the previous approach to medication charting at your hospital, what is the overall impact of the PPMC approach on...		Much improved	Slightly improved	No significant change	Slightly worse	Much worse	No response	Total
Accuracy of the medication charts?	Pharmacy	95.7%	2.9%	1.4%	0.0%	0%	0.0%	69
	Medicine	74.0%	14.0%	6.0%	2.0%	0%	4.0%	50
	Nursing	75.0%	18.8%	0.0%	0.0%	0%	6.3%	16
	Overall	85.2%	8.9%	3.0%	0.7%	0%	2.2%	135
The number of errors in medication charts?	Pharmacy	92.8%	2.9%	2.9%	0%	0%	1.4%	69
	Medicine	64.0%	20.0%	12.0%	0%	0%	4.0%	50
	Nursing	81.3%	6.3%	6.3%	0%	0%	6.3%	16
	Overall	80.7%	9.6%	6.7%	0%	0%	3.0%	135
Rates of medication incidents associated with errors in medication charts?	Pharmacy	81.2%	14.5%	2.9%	0%	0%	1.4%	69
	Medicine	42.0%	34.0%	16.0%	0%	0%	8.0%	50
	Nursing	50.0%	25.0%	18.8%	0%	0%	6.3%	16
	Overall	63.0%	23.0%	9.6%	0%	0%	4.4%	135
The coordination of medication management throughout the admission and discharge process?	Pharmacy	75.4%	17.4%	7.2%	0.0%	0%	0.0%	69
	Medicine	56.0%	24.0%	16.0%	0.0%	0%	4.0%	50
	Nursing	43.8%	31.3%	12.5%	6.3%	0%	6.3%	16
	Overall	64.4%	21.5%	11.1%	0.7%	0%	2.2%	135
Your workload associated with resolving issues relating to documentation of medications (incl. errors, omissions, concerns, uncertainty)?	Pharmacy	69.6%	23.2%	5.8%	1.4%	0.0%	0.0%	69

Compared with the previous approach to medication charting at your hospital, what is the overall impact of the PPMC approach on…		Much improved	Slightly improved	No significant change	Slightly worse	Much worse	No response	Total
	Medicine	58.0%	14.0%	20.0%	2.0%	2.0%	4.0%	50
	Nursing	50.0%	37.5%	6.3%	0.0%	0.0%	6.3%	16
	Overall	63.0%	21.5%	11.1%	1.5%	0.7%	2.2%	135
The speed with which patients are admitted?	Pharmacy	31.9%	34.8%	29.0%	1.4%	0.0%	2.9%	69
	Medicine	32.0%	24.0%	34.0%	6.0%	0.0%	4.0%	50
	Nursing	37.5%	31.3%	12.5%	0.0%	12.5%	6.3%	16
	Overall	32.6%	30.4%	28.9%	3.0%	1.5%	3.7%	135
The patient experience with respect to medication management?	Pharmacy	50.7%	37.7%	11.6%	0%	0%	0.0%	69
	Medicine	32.0%	32.0%	32.0%	0%	0%	4.0%	50
	Nursing	56.3%	25.0%	6.3%	0%	0%	12.5%	16
	Overall	44.4%	34.1%	18.5%	0%	0%	3.0%	135

Broader impacts of the PPMC intervention

A large majority of the health professional respondents (80%), agreed or strongly agreed that the PPMC had increased their job satisfaction, an effect which might have been more pronounced among pharmacists (Table 5). This idea is reinforced by the strong sense of reassurance brought about by knowing that a pharmacist had been involved with completing the charting. Most people were, broadly speaking, in favour of retaining the PPMC approach to charting although there was a small minority of doctors and pharmacists who preferred the previous approach. More than 80% in each profession also agreed that their colleagues in their unit/department reported similar positive experiences of the PPMC trial. Overall, 92% of respondents felt that PPMC had facilitated a more effective role for pharmacists in patient care.

While 84% also agreed or strongly agreed that PPMC had resulted in better interdisciplinary coordination of care, more than one third of respondents reported that the mandatory clinical conversation had been difficult to coordinate. It also appeared to free up time for doctors and nurses to conduct other elements of patient care. There was a strong level of agreement by both doctors (80%) and pharmacists (94%) that PPMC pharmacists had the required competencies, and only 1% disagreement.

Table AV 5. Non-clinical impact of the PPMC intervention

Please rate your agreement with the following statements:		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	No response	Total n
Impact on health professionals								
Introducing the PPMC approach has increased my job satisfaction	Pharmacy	60.6%	27.3%	12.1%	0.0%	0.0%	0.0%	66
	Medicine	40.8%	32.7%	14.3%	4.1%	4.1%	4.1%	49
	Nursing	26.7%	40.0%	20.0%	6.7%	0.0%	6.7%	15
	Overall	49.2%	30.8%	13.8%	2.3%	1.5%	2.3%	130
I feel reassured about the quality of medication charting if I know that a pharmacist has completed the charting process for a patient I am looking after	Pharmacy	84.8%	12.1%	3.0%	0.0%	0.0%	0.0%	66
	Medicine	61.2%	26.5%	2.0%	2.0%	2.0%	6.1%	49
	Nursing	60.0%	26.7%	6.7%	0.0%	0.0%	6.7%	15
	Overall	73.1%	19.2%	3.1%	0.8%	0.8%	3.1%	130
I prefer the way that medication was charted prior to the introduction of PPMC	Pharmacy	7.6%	1.5%	6.1%	21.2%	62.1%	1.5%	66
	Medicine	12.2%	6.1%	22.4%	22.4%	32.7%	4.1%	49
	Nursing	0.0%	0.0%	20.0%	26.7%	46.7%	6.7%	15
	Overall	8.5%	3.1%	13.8%	22.3%	49.2%	3.1%	130
Colleagues in my department/unit report a mostly positive experience with PPMC	Pharmacy	71.2%	25.8%	1.5%	0.0%	0.0%	1.5%	66
	Medicine	40.8%	32.7%	24.5%	2.0%	0.0%	0.0%	49

Please rate your agreement with the following statements:		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	No response	Total n
	Nursing	40.0%	26.7%	20.0%	0.0%	6.7%	6.7%	15
	Overall	56.2%	28.5%	12.3%	0.8%	0.8%	1.5%	130
Introducing the PPMC process led to pharmacists contributing more effectively to patient care at my hospital	Pharmacy	81.8%	15.2%	1.5%	0.0%	0.0%	1.5%	66
	Medicine	57.1%	30.6%	8.2%	2.0%	0.0%	2.0%	49
	Nursing	53.3%	33.3%	0.0%	6.7%	0.0%	6.7%	15
	Overall	69.2%	23.1%	3.8%	1.5%	0.0%	2.3%	130
It has been easy to coordinate the mandatory clinical conversations between the PPMC pharmacists and doctors prior to charting	Pharmacy	24.2%	31.8%	19.7%	18.2%	4.5%	1.5%	66
	Medicine	30.6%	30.6%	26.5%	6.1%	2.0%	4.1%	49
	Nursing	20.0%	40.0%	33.3%	0.0%	0.0%	6.7%	15
	Overall	26.2%	32.3%	23.8%	11.5%	3.1%	3.1%	130
Introducing the PPMC process resulted in better interdisciplinary collaboration at my hospital	Pharmacy	57.6%	31.8%	9.1%	0.0%	0.0%	1.5%	66
	Medicine	42.9%	36.7%	12.2%	4.1%	0.0%	4.1%	49
	Nursing	33.3%	40.0%	20.0%	0.0%	0.0%	6.7%	15
	Overall	49.2%	34.6%	11.5%	1.5%	0.0%	3.1%	130
Having medicines reconciled by a PPMC-credentialled pharmacist has allowed me to be more productive in other areas of my work (doctors and nurses only)	Medicine	46.9%	22.4%	22.4%	4.1%	0.0%	4.1%	49
	Nursing	28.6%	50.0%	14.3%	7.1%	0.0%	0.0%	14
	Overall	42.9%	28.6%	20.6%	4.8%	0.0%	3.2%	63

Please rate your agreement with the following statements:		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	No response	Total n
The pharmacists who successfully completed the PPMC credentialing process at my hospital had all the competencies required to deliver the service (doctors and pharmacists only).	Pharmacy	77.3%	18.2%	1.5%	1.5%	0.0%	1.5%	66
	Medicine	69.4%	10.2%	18.4%	0.0%	0.0%	2.0%	49
	Overall	73.9%	14.8%	8.7%	0.9%	0.0%	1.7%	115
How would you rate the quality of credentialing/training provided to pharmacists? (Pharmacists only)		Very satisfactory	Somewhat satisfactory	Neither satisfactory nor unsatisfactory	Somewhat unsatisfactory	Very unsatisfactory	-99	
	Pharmacy	56.1%	31.8%	9.1%	1.5%	0.0%	1.5%	66

The overall impact of introducing PPMC was deemed to have been positive by most (Table 6), and even then half of those few who felt PPMC had a negative impact on workload believed that the benefits from this new process outweighed any increase in workload.

Table AV 6. Overall impact on workload

What was the overall impact of introducing the PPMC on your workload? [Note to PPMC-credentialed pharmacists - please answer with reference to workload other than the PPMC care process, e.g. ward pharmacy and dispensary work]		Very positive (significant time savings)	Somewhat positive	Neutral (not much different)	Somewhat negative	Very negative (significant imposition on time)	Not applicable	
	Pharmacy	54.5%	30.3%	4.5%	3.0%	0.0%	7.6%	66
	Medicine	46.9%	26.5%	20.4%	4.1%	0.0%	2.0%	49
	Nursing	42.9%	35.7%	0.0%	0.0%	14.3%	7.1%	14
	Overall	50.4%	29.5%	10.1%	3.1%	1.6%	5.4%	129

What was the overall impact of introducing the PPMC on your workload? [Note to PPMC-credentialed pharmacists - please answer with reference to workload other than the PPMC care process, e.g. ward pharmacy and dispensary work]	Very positive (significant time savings)	Somewhat positive	Neutral (not much different)	Somewhat negative	Very negative (significant imposition on time)	Not applicable	
If negative - was the negative impact on your workload adequately offset by benefits from the project, in your opinion?		No	Yes				
	Pharmacy	50.0%	50.0%				2
	Medicine	50.0%	50.0%				2
	Nursing	50.0%	50.0%				2
	Overall	50.0%	50.0%				6

Dissemination and sustainability

Most respondents wanted to see the PPMC model continued as it is or with minor modifications (Table 7). Moreover, it was generally agreed that the model should be extended to other parts of the hospital, and that it could be translated to other Victorian hospitals. Eighty nine percent of respondents felt that the quality of PPMC care would be maintained if it became standard practice at their hospitals.

It was generally perceived that only a minority of eligible patients received the PPMC intervention in a typical 24-hour period. A small majority (55%) felt that the current hours were enough to have a meaningful impact on overall patient care, although most of the remainder felt that the hours of operation were inadequate. Most who commented on this matter sought increased hours of operation.

Table AV 7. Attitudes and perceptions around continuation of the PPMC model.

I would like to see the PPMC model (or similar) continued at my hospital	Yes – but with some changes	Not sure	No (please explain why)	Yes – continue as it is			
Pharmacy	36.4%	1.5%	1.5%	60.6%			66
Medicine	28.6%	4.1%	4.1%	63.3%			49
Nursing	21.4%	0.0%	0.0%	78.6%			14

I would like to see the PPMC model (or similar) continued at my hospital		Yes – but with some changes	Not sure	No (please explain why)	Yes – continue as it is			
	Overall	31.8%	2.3%	2.3%	63.6%			129
The PPMC model should be extended to other parts of the hospital		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree		
	Pharmacy	84.6%	12.3%	1.5%	1.5%	0.0%		65
	Medicine	66.0%	31.9%	0.0%	2.1%	0.0%		47
	Nursing	78.6%	14.3%	7.1%	0.0%	0.0%		14
	Overall	77.0%	19.8%	1.6%	1.6%	0.0%		126
Suggested areas available as comments								
							-99	
The PPMC model is transferable to other Victorian hospitals	Pharmacy	63.6%	27.3%	9.1%	0.0%	0.0%	0.0%	66
	Medicine	66.0%	21.3%	10.6%	0.0%	0.0%	2.1%	47
	Nursing	57.1%	28.6%	14.3%	0.0%	0.0%	0.0%	14
	Overall	63.8%	25.2%	10.2%	0.0%	0.0%	0.8%	127
In an average 24 hour period, what proportion of all eligible patients received the PPMC model of care at your hospital?		0 - 19%	20 - 39%	40 - 59%	60 - 79%	80 - 100%	-99	
	Pharmacy	55.6%	18.5%	7.4%	9.3%	1.9%	7.4%	54
	Medicine	19.1%	29.8%	29.8%	8.5%	0.0%	12.8%	47
	Overall	38.6%	23.8%	17.8%	8.9%	1.0%	9.9%	101

I would like to see the PPMC model (or similar) continued at my hospital		Yes – but with some changes	Not sure	No (please explain why)	Yes – continue as it is			
Were the hours of operation for the PPMC program during the implementation trial adequate to have a meaningful positive impact on overall patient care?		Yes	No – hours were inadequate	No – PPMC has no impact or a negative impact on overall patient care			-99	
	Pharmacy	53.0%	47.0%	0.0%			0.0%	66
	Medicine	59.6%	31.9%	4.3%			4.3%	47
	Nursing	50.0%	35.7%	14.3%			0.0%	14
	Overall	55.1%	40.2%	3.1%			1.6%	126
Comments on preferred hours are available								
Do you think that your department/unit has adequate resources to sustain delivery of the PPMC model as it was implemented for the trial?		Yes	No				-99	
	Pharmacy	33.8%	66.2%				0.0%	66
	Medicine	72.3%	23.4%				4.3%	47
	Nursing	64.3%	35.7%				0.0%	14
	Overall	51.6%	46.8%				1.6%	126
The quality of PPMC care experienced during the trial would be maintained at my hospital if PPMC became standard practice		Yes	No				-99	
	Pharmacy	87.7%	10.8%				1.5%	66
	Medicine	87.2%	8.5%				4.3%	47

I would like to see the PPMC model (or similar) continued at my hospital	Yes – but with some changes	Not sure	No (please explain why)	Yes – continue as it is			
Nursing	100.0%	0.0%				0.0%	14
Overall	88.9%	8.7%				2.4%	126
Reasons why it will not be maintained are provided							