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Final Project Report

Evaluation of pharmacy TECHnician supported MEDication administration rounds (TECHMED) on reducing omitted doses: a pilot randomised controlled trial and process evaluation in a university teaching hospital

Principal Investigator: Dr Richard N Keers

Project Team: Dr Elizabeth Seston, Dr Evangelos Kontopantelis, Elizabeth Lamerton, Ailsa Burgess, Fiona Morris, Faith Mann, Lindsay Harper and Professor Darren M Ashcroft

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Centre for Pharmacoepidemiology and Drug Safety, Division of Pharmacy and Optometry, School of Health Sciences, The University of Manchester, Manchester Academic Health Sciences Centre (MAHSC)

MANCHESTER 1824
The University of Manchester

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Introduction

Worldwide, medication administration errors (MAEs) affect a median estimate of 19.1% doses administered or omitted in hospitals.[1] Doses given at the wrong time and dose omissions are among the most common MAE subtypes observed[1,2] and the risk of omitted and delayed doses to patients can be life-threatening.[3] Studies of omitted doses in hospitals report rates of 1.9-12.4% of administrable doses,[4-8] 20-30% of drugs [8,9] and 17-79% of inpatients,[5,8-10] with significant heterogeneity in design and setting. The most common reasons for omitted doses in hospitals include patient refusal to take the dose, prescriptions not signed to record administration or medication not available on the ward, the latter two of which could be considered 'preventable'.[5,7-9,11]

A number of different interventions have been suggested to reduce the number of omitted doses in hospitals including ward-based pharmacy team support,[12-14] nurse education/training,[15] patient self-administration programmes [16] and a mixture of approaches including an omitted dose dashboard, warning system and root cause analysis investigation.[17] Pharmacy support during medicines administration rounds may be of particular interest in the UK given how frequently 'preventable' omissions such as unavailable medicines and unsigned dose administration records cause omitted doses. A UK study [12] examined the difference in 'unacceptable' (unavailable drug or prescription not signed for administration) dose omissions between pharmacy assistant supported medicines administration and standard practice across medical and surgical wards in a hospital during two one week periods. This study found statistically significant ($p<0.05$) lower rates of unacceptable dose omissions compared to both intra-ward controls (pharmacy assistants were on the ward but not actively supporting nurses during medicines administration) and inter-ward controls (where no pharmacy assistant medicines administration support was provided). However, this study did not provide baseline or more longitudinal outcome measurements. In light of recent recommendations for pharmacy technicians to have a more prominent clinical role in NHS hospitals [18] there is a need to robustly evaluate the potential impact of more direct involvement of pharmacy technicians on medication rounds in reducing omitted doses. This project was therefore undertaken to evaluate pharmacy TECHnician supported MEDicines administration (TECHMED) using a pilot randomised trial with concurrent process evaluation, [19] taking advantage of readily accessible electronic health records.

Aim and objectives

The aim of this research study was to pilot and evaluate the impact of introducing a pharmacy TECHnician supported MEDication administration (TECHMED) service on ward medication rounds on the frequency of omitted doses at a NHS teaching hospital.

Objectives:

1. To conduct a pilot randomised controlled trial (RCT) of TECHMED on medical and surgical wards to determine the impact on the following measures:
    a. all omitted doses,
    b. 'preventable' omitted doses (overdue doses, omitted doses without reason provided, unavailable medication, medication error), and
    c. omitted doses of 'critical list' medicines.
2. To evaluate the feasibility and acceptability of the TECHMED service via an accompanying process evaluation with nursing, pharmacy technician and managerial stakeholders.

Method

This study took place at a university teaching hospital in the North West of England, and consisted of a pilot randomised controlled trial (RCT) of the TECHMED service on selected wards to determine its impact on omitted doses, together with a qualitative process evaluation study of how the service was delivered and experienced by stakeholders.

The TECHMED service

Trained (Agenda for Change band 5) ward-based pharmacy technicians already employed by the hospital delivered the TECHMED service. These trained technicians accompanied nursing staff on three of four (8am, 12pm, 5pm) medication administration rounds on all 5 weekdays during a four week 'active service' period (i.e. a total of 20 days between February and March 2016). During the medicines administration rounds, pharmacy technicians accompanied nurses and were asked to directly support them during this process, including supporting the following activities (they also made their presence known to other nursing staff for support):

- Sourcing medicines currently unavailable on the ward (e.g. from pharmacy),
- Assisting with locating medicines on the ward ready for timely administration,
- Supporting nursing staff in accurate and timely documentation of medicines administration, and
- Working with nurses to liaise with ward pharmacists and medical staff when patients refuse to take doses.

Between one and six pharmacy technicians were assigned to each ward receiving TECHMED by NHS management according to local resource capacity and whether technicians had prior experience working on particular wards, with alternative technicians acting as a "bank" of replacement staff if cover was required. Each technician continued to perform their usual duties (e.g. medicines supply, medicines-related queries) alongside TECHMED. A total of twelve pharmacy technicians were trained to deliver TECHMED, with ten actually providing it during the 'active service' period. Training was delivered by the research team and involved attendance at one face-to-face interactive workshop covering (a) research evidence concerning the prevalence and nature of omitted doses as well as

current internal policy with regards to medicines administration and omitted doses, and (b) clinical case scenarios designed to explore appropriate courses of action and sources of medication when faced with 'missing/refused dose' scenarios. Following training technicians signed a declaration stating that they were happy to provide the TECHMED service; formal consent was not required as TECHMED was considered a NHS trust service development. Nursing staff on wards receiving TECHMED were also provided with a short presentation (ward managers) and poster (staff nurses) about the service. A patient information leaflet was also developed which explained the purpose behind the presence of technicians during ward medication rounds; pharmacy technicians were responsible for distributing these on the ward.

Pilot randomised trial

One ward from each of three matched (on speciality and bed numbers) pairs of general medical, elderly medical and gastro-intestinal surgical wards was randomly selected using a random number generator to receive the TECHMED service. Randomisation was single blinded (researchers), and the random allocation sequence was generated by the research team who enrolled and assigned wards to the intervention group receiving TECHMED. The ward pairs were purposively selected following consideration of the number of available wards with sufficiently similar characteristics for pairing and the resources available in the pharmacy department to deliver the TECHMED service. Control wards continued to receive existing pharmacy team input (including routine medicines supply and variable pharmacy technician/pharmacist ward presence).

Electronic prescribing and medicines administration data were obtained from the study hospital following pseudo-anonymisation in order to determine the number of scheduled, administered and omitted medication doses across all six wards. Additional data collected included patient gender and age (in years). Prescribing and medication administration data were collected for three evaluation periods each comprising four calendar weeks – 'pre-implementation' (January-February 2016), 'active service' (February-March 2016) and 'post-implementation' (March-April 2016). Electronic data was pseudo-anonymised by the NHS trust information technology team before being transferred by secure portal to a data safe haven. This process was repeated at each phase of the study. The researchers then securely transferred this data to encrypted university network storage. In order to prepare it for formal analysis, the electronic data was organised and cleaned by the study statistician (EK) and lead author (RK) which included clinical interpretation of omitted dose data with advice from the project team and wider study hospital information technology team. Once cleaned and organised, the data files were imported into STATA v13 (StateCorp LLC®) for analysis. Outcome rates (% of scheduled doses omitted) were calculated by dividing the number of omitted doses by the total number of eligible scheduled doses and multiplying the answer by one hundred. Such calculations were performed for the outcome of any dose omission as well as 'preventable' dose omissions (doses omitted as unavailable on the ward, recorded medication errors, overdue 'blank box' doses or omitted doses without a reason given). We used multilevel logistic regression to quantify the effect of the intervention on primary and secondary outcome measures, controlling for all available covariates (patient age, gender, admission type, days since admission, medication BNF chapter, medication on 'critical list', and time period medication was (supposed) to be administered). Accounting for the nested structure of the data (doses nested within patients; patients nested within wards), we performed the analyses at the lower level i.e. doses. We accounted for the data-structure using random-effects at the patient level (i.e. accounting for

clustering due to multiple doses and medications for a single patient) and fixed effects for the ward level, through which we quantified the effect of the intervention. Outcomes from the logistic regression model were presented as predictive margins of omitted dose probability (%) for each model with corresponding 95% confidence intervals (CI).

Whilst the allocation and delivery of TECHMED on wards at the study hospital was not blinded to any party, analysis of the electronic prescribing and drug administration data was blinded to all (including the research team) except the NHS trust information technology team who pseudo-anonymised this data (this team was not involved in any way in study design, conduct, or analysis). Once data was analysed the lead author then requested that the NHS trust information governance team identify whether individual wards and ward groups were either control or intervention – individual patient data remained anonymous.

Process evaluation

Pharmacy technician, qualified nurse and senior pharmacy and nursing management stakeholders with direct involvement in implementing and/or delivering the TECHMED service were invited to participate in a semi-structured face-to-face interview with a researcher to discuss their experiences. Potential participants were approached by a member of the research team in the clinical environment and provided with written and verbal information about the study. Researchers collected staff contact details and made regular visits to the hospital to recruit participants. Interviews were digitally audio recorded and took place on hospital premises; each participant provided informed written consent to take part prior to interview. The interviews took place during the 'active service' and 'post-implementation' study phases to minimise recall bias and to capture experiences of early delivery and normalisation through to re-adjustment after the TECHMED service was withdrawn. The interview audio files were transcribed verbatim before being coded in NVIVO 10 (QSR)® and analysed according to the Framework approach.[20] Thematic analysis was guided according to Carol Weiss' Theory Based Evaluation model.[21]

Approvals

This study was granted approval by The University of Manchester Research Ethics Committee (UREC2:15501), the Board responsible for authorising transfer of pseudonymised electronic patient data and by the Research and Development department of the participating NHS hospital. The TECHMED study is registered as a clinical trial (ISRCTN11642788).

Results

Pilot Randomised Controlled Trial (RCT)

The pilot RCT data included 1076 patients and 36,599 scheduled medication doses, as described in Table 1. Each ward received the TECHMED service for the full 'active service' phase – only 2 from a possible 180 medication rounds were not supported by pharmacy technicians during this time period. Patient characteristics were broadly similar between control and TECHMED groups with the exception of gender differences (as each group included a female and male only ward, respectively).

As presented in table 1, the percentage of total, 'critical list' (CL) and 'preventable' omitted doses did not decrease in the TECHMED group following the 'pre-implementation' period, with indications that rates of particularly 'preventable' omitted doses may have increased during this time. In the control

group a decrease in most outcomes was observed between 'pre-implementation' and 'active phase', with most continuing to decrease into the 'post-implementation' phase (except total omitted doses).

After adjusting for patient factors (age, gender, elective/emergency admission, days since admission), medication factors (BNF chapter, 'critical list') and time period of administration logistic regression, analysis revealed that the predicted probability of both an omitted dose or 'preventable' dose omitted was similar both within the ward group receiving TECHMED during the 'active service' phase compared to the 'pre-implementation' phase (there was an increase in 'preventable' omitted dose probability during 'post-implementation' phase compared to 'pre-implementation'), and between the ward group receiving TECHMED and the control group during the 'active service' and 'post-implementation' study phases. For more details please see table 2 below.

A completed CONSORT checklist [22] for the TECHMED pilot RCT can be found below as Appendix 1.

Table 1: Descriptive data

Descriptor	Group receiving unchanged pharmacy team input (control)*			Group receiving TECHMED service (intervention)			Total
	'Pre-implementation'	'Active phase'	'Post-implementation'	'Pre-implementation'	'Active phase'	'Post-implementation'	
Patient details							
Patient Number	222	201	206	223	204	221	1076
Mean age (SD)	67.6 (18.9)	65.6 (19.7)	71.5 (16.8)	67.2 (20.2)	66.8 (17.5)	67.2 (19.7)	66.7 (19.2)
Female (%)	70.7	73.1	71.4	34.1	29.9	30.3	50.6
Mean LOS (SD)	21.6 (31.9)	21.8 (29.7)	22.5 (30.5)	17.4 (19.2)	19.9 (31.0)	14.7 (18.7)	16.6 (23.5)
Mean medicines prescribed (SD)*	4.1 (3.3)	4.2 (3.6)	4.1 (3.3)	4.0 (3.3)	4.0 (3.2)	4.0 (3.2)	4.7 (3.9)
Mean scheduled doses (SD)*	27.4 (35.3)	34.4 (58.4)	30.5 (40.1)	27.4 (36.6)	28.4 (40.7)	24.4 (32.2)	34.0 (50.9)
Details of scheduled and omitted doses							
Scheduled doses	6061	6914	6285	6121	5786	5402	36599
Scheduled CL doses	1497	1431	1251	1326	1304	1467	8276
Admin. doses	4901	5871	5119	5019	4717	4430	30057
Admin. CL doses	1291	1241	1123	1195	1132	1326	7308
Omitted doses (%)	1055 (17.3)	902 (13.0)	1070 (17.0)	965 (15.8)	954 (16.5)	874 (16.2)	5820 (15.9)
Omitted CL doses (%)	171 (11.4)	150 (10.5)	113 (9.0)	95 (7.2)	137 (10.5)	117 (8.0)	783 (9.5)
'Preventable' omitted doses (%)	307 (5.1)	276 (4.0)	248 (3.9)	242 (4.0)	282 (4.9)	272 (5.0)	1627 (4.4)

Admin = administered; CL = critical list medication; LOS = length of stay (days); SD = standard deviation.
% = percentage; * = including routine medicines supply and variable pharmacy technician/pharmacist ward presence; ** = excluding 'when required' prescriptions.
'Preventable' omitted doses include omissions coded as 'drug not available', reported medication errors, overdue doses and omitted doses with no reason specified.

Table 2: Multilevel logistic regression analysis summary - predictive margins of omitted dose probability on control wards and wards receiving TECHMED across study time phases

	Adjusted analysis predictive margins: probability of omitted dose event (%, 95% CI)			
	Total omitted doses		'Preventable' omitted doses	
Study phase	Control wards	TECHMED wards	Control wards	TECHMED wards
'Pre-implementation' time period	19.6% (17.6-21.7%)	17.5% (15.4-19.5%)	2.9% (2.2-3.6%)	1.8% (1.2-2.3%)
'Active service' time period	19.0% (16.9-21.2%)	19.2% (16.8-21.5%)	2.6% (1.9-3.3%)	3.0% (2.2-3.7%)
'Post-implementation' time period	20.8% (18.5-23.1%)	20.8% (18.3-23.2%)	3.0% (2.2-3.8%)	3.2% (2.4-4.0%)

% = percentage; 95% CI = 95% confidence intervals; TECHMED = pharmacy TECHnician supported MEDicines administration.
'Preventable' omitted doses: doses omitted as unavailable on the ward, recorded medication errors, overdue 'blank box' doses or omitted doses without a reason given.

Process Evaluation

Between February – April 2016 a total of twenty two stakeholder interviews were conducted that lasted up to forty minutes each, including all ten pharmacy technicians who provided the service, nine with nursing staff involved in medication administration on the TECHMED allocated wards and three with senior pharmacy/nursing management at the hospital. All participants demonstrated good understanding of the purpose of TECHMED and the role of their professional group within it, with pharmacy technicians reporting high levels of satisfaction with their service training. Whilst the workload impact of TECHMED was described in positive terms by nurses, some pharmacy technician respondents reported a positive and others an equivocal impact due to flexible working options the technicians were offered at the time. Some pharmacy technicians commented that the timing of the lunchtime medication round did disrupt their duties and they also perceived managing their workloads difficult in the future unless their existing duties were reduced.

There were a number of examples of how the presence of the pharmacy technician on the medication round helped to solve medicines administration challenges, educated the nursing staff, promoted collegiality between stakeholders and even addressed medicines issues outside the service remit (e.g. facilitating hospital discharge). Pharmacy technicians helped to unpack medication deliveries, avoided omissions of high risk drugs (e.g. medicines for Parkinson's disease) and sourced medications in a variety of ways including dispensing databases, other ward stocks and the pharmacy department. However, some pharmacy technicians felt that the nurses relied on them to source medications, with others questioning whether their presence on the medication round was worthwhile as they did not make many interventions to avoid omitted doses.

Some pharmacy technicians indicated that they did not always directly accompany nurses on the medication round to provide support, and instead followed alternative supportive strategies such as positioning themselves to be within ear-shot of nursing conversations. Reasons provided for these behaviours included feeling like their presence was not required during certain (particularly lunchtime) rounds as many medicines were kept as ward stock, as well as perceiving that their presence disrupted nursing activity or was intrusive and risked errors, as illustrated by the quote below. In contrast, none of the nurse participants described such feelings.

> *"I think the nurses were happier that we didn't stand over them, especially if…some of the nurses I worked with were only qualified for two years and/or less and, you know, standing over them will only precipitate an error rather than help them." [Pharmacy Technician, ID04]*

The majority of participants had positive attitudes towards TECHMED and were in favour of extending it to other wards, but some commented that this must not be at the expense of increased pharmacy technician workload or a lack of investment in staff numbers. The concept of a more targeted approach to service delivery received general support, whereby high volume/risk medication rounds and wards with greater omitted dose rates would benefit the most from receiving TECHMED.

Discussion

This study has shown that the TECHMED service can be introduced onto medical and surgical wards in an NHS hospital, which was made possible through effective inter-disciplinary working between university, IT and NHS clinical staff which also ensured successful and timely extraction, cleaning and analysis of pseudo-anonymized electronic prescribing and drug administration data.

The pilot randomised trial of TECHMED to determine impact on omitted dose outcomes revealed that the service was associated with a similar predicted probability of a total or 'preventable' omitted dose occurring when compared to existing practice at the study hospital either during the 'active service' or 'post-intervention' periods and when compared with 'pre-implementation'. This is in contrast with indications from an earlier study of a similar service involving pharmacy assistants that it may be effective in reducing 'unacceptable' omitted doses, [12] but our study is not directly comparable as we evaluated a pharmacy technician-led service in a different hospital using a larger dataset with process evaluation. The inclusion of process evaluation interviews was important in interpreting the RCT findings by revealing the reality of service implementation and delivery for stakeholders. [19]

Whilst the TECHMED service was understood and warmly welcomed by stakeholders, who also provided important examples of how the presence of pharmacy technicians averted potential dose omissions, educated nursing staff about medicines supply and storage and fostered closer working relationships, a minority did not share this view with some experiencing difficulty finding opportunity to prevent omitted doses. Some pharmacy technicians also portrayed the reality of service delivery differently than the original specification due to a lack of perceived need to follow nursing staff directly and concerns over the impact of their presence on nursing staff. It is therefore conceivable that the potential impact of the TECHMED service on total and 'preventable' missed doses may have been limited by these issues, and highlights the need to define more clearly the mechanism of change for TECHMED [19] which can then be used to inform service configuration.

The strengths of this study include the use of a randomized pilot trial design involving multiple matched wards to evaluate the impact of TECHMED on omitted doses, as well as concurrent qualitative process evaluation of stakeholder groups which included all pharmacy technicians who delivered this service (helping to minimize selection bias). The use of routinely collected electronic prescribing and medication administration data also facilitated the design of a large scale trial as the relatively laborious task of manual data collection from medication records was avoided. This study did have some important limitations, including a lack of generalisability to the wider NHS given that this was a single centre pilot study that involved a hospital with electronic prescribing and medicines administration systems which are not common place in NHS hospitals. [23] The potential impact of the service on omitted doses occurring overnight and at weekends is also unknown, as the service ran only during the daytime on weekdays. Whilst the process evaluation interviews took place either during or immediately after the 'active' TECHMED service period recall bias cannot be ruled out. Use of other qualitative techniques such as direct observation may have helped strengthen the validity of the process evaluation findings through triangulation of methods. [24]

Moving forwards, this project has highlighted that whilst TECHMED was associated with similar predicted probabilities of omitted dose outcomes compared to the control group and 'pre-implementation' on this occasion, a number of important targets for further research of this concept

and for service configuration have been identified. This is important as interest in the concept of greater involvement of pharmacy teams in medicines administration continues to grow in the United Kingdom.[12, 25, 26] Process evaluation participants gave indications that a targeted approach focusing on particular medication rounds and wards where omitted doses may be more prevalent, as well as utilising pharmacy technicians on wards which they are most familiar with may help to optimize benefits of the service and maximise efficient use of limited resources. Targeting limited resources to areas of most need aligns with recent efficiency recommendations in the sector made by Lord Carter of Coles.[18] However, before any revised TECHMED service is piloted and evaluated further research must be undertaken to explore qualitatively (e.g. using observation) exactly how nurses and technicians interact and form working relationships during service provision, whether this is influenced by individual knowledge/perceptions and how this may then lead to differential outcomes in total and 'preventable' omitted doses across ward settings. When such work has been carried out it is important that subsequent larger evaluations capture enough data to measure outcomes, whilst also evaluating the financial implications of introducing this service.

Conclusion

This study has demonstrated that pharmacy technician supported medicines administration may be both acceptable and potentially feasible to implement in NHS hospitals, but that it has no impact in reducing omitted doses which may be a result of service fidelity and configuration issues. Suggestions to optimize TECHMED for the future include use in a more targeted manner based on need to maximise limited resources, but further research is first required to better understand how stakeholders interact with each other and deliver the service in order to achieve its intended outcomes. Subsequent research may then test the feasibility and effectiveness of any updated TECHMED service using larger multisite studies with in-built process and economic evaluations.

Patient and Public Involvement

We successfully integrated a patient and public representative as part of our project team and specifically our project advisory committee, Ms Faith Mann. Faith was a member of the NIHR Greater Manchester Primary Care Patient Safety Translational Research Centre Research User Group. She played an important role as part of the advisory committee in ensuring that the TECHMED service evaluation was relevant to and protected patients, and she was influential in designing a patient-orientated information leaflet which was distributed by pharmacy technicians delivering TECHMED on the wards. In the near future, we are planning for Faith to be involved in preparation of our process evaluation manuscript so that we may integrate contrasting views on the project, and we expect her to have an influential role in disseminating the findings of TECHMED to wider patient and public audiences through her relevant networks.

Outputs

Thus far, research findings from the TECHMED project have been presented locally at a university research symposium (August 2016), as well as at two professional conferences (Science of Improvement Conference, Harrogate, November 2016; and UKCPA Conference, Manchester, November 2016). Both the RCT and process evaluation components are currently being prepared as

manuscripts for publication in peer reviewed journals. Plans are currently being made to present findings from the project to stakeholders and wider staff at the NHS trust involved in the project.

Changes Made From Original Proposal

In all there were very few changes made to the original proposal as the project progressed; of those that were made changing circumstances necessitated these modifications rather than as a result of design flaws in the study. This was largely due to extensive planning between The University of Manchester and NHS hospital staff before the final project proposal was submitted for consideration by the funders. These changes are summarised below:

- Due to the availability of wards with similar characteristics that could be paired for inclusion in the pilot RCT, only 3 rather than 4 pairs of matched wards were included in the study. Despite this change, more than 36,000 scheduled doses were included in the analysis; this was achieved as TECHMED service was instead delivered across 3 (rather than 2) medication rounds on weekdays. This change was possible following review of current and immediate future workload of the pharmacy department along with the number of technicians who agreed to deliver the pilot TECHMED service.
- The number of scheduled doses included in our study did meet requirements for statistical power calculations we performed (two tailed large sample z test) before undertaking this project based on baseline omitted dose rates gathered at the study hospital in 2015 from a random sample of 60 inpatients. However, we encountered unexpected high variability in omitted dose rates over time for the wards included in this study. After consultation we concluded that our original power calculations were no longer valid as they did not account for this variation and our findings in Table 2 are therefore presented as predictive margins without formal significance testing – these findings have informed our recommendations for a larger study and will inform our future work.
- More pharmacy technicians (n=10) took part in delivering the TECHMED service (n=12 were trained) than expected (n=6) – this was due in part to local enthusiasm for the project but was also as a result of the need to distribute staff workload by departmental managers.
- Participants of the process evaluation study did not include wider pharmacy support and ward medical staff as originally intended; the decision was made not to approach these individuals for interview as there were already a large number of nurses and pharmacy technicians available and anecdotal evidence suggested that these other stakeholder groups were minimally affected by the TECHMED service.
- The 'preventable' omitted dose category was updated from the original submission following examination of electronic medicines administration coding which revealed that 'blank box' (prescriptions not signed to record administration) omissions were not captured in the same way, and were instead found to include 'overdue doses' (scheduled dose not administered on time but not recorded as given or omitted) and 'omitted doses with no reason given' (dose is recorded as omitted but no reason is given by the person omitting the dose). We also included a very small number of omissions which were clearly identifiable as medication errors within the 'preventable' omitted dose category.

Personal and Professional Development

As an early career pharmacist researcher, this PRUK/UKCPA Research Grant has enabled Dr Keers to plan, implement and evaluate his first RCT and associated process evaluation in a secondary care setting supported by the project team of experienced clinicians and researchers. Dr Keers is grateful to the funders for enhancing his development as a clinical academic through the acquisition of new skills and understanding during the execution of this project. Areas of development included:

- Leadership skills –developing a clear vision for the TECHMED service evaluation and its operation, and sharing that with others create momentum and to deliver the service.
- Management skills –Dr Keers was required to formally manage both staff and finances as well as his largest and most complex project to date which was split into parallel RCT and process evaluation projects (in addition to his existing workload). He has also attended training in performance review and development as part of line management duties.
- Understanding and knowledge of the access and manipulation of electronic health care data at scale – Dr Keers now has first-hand experience in using electronic health care and is in a position to translate this knowledge to improve the quality and efficiency of both his and other people's projects in future. Specific areas of importance to consider with use of electronic health care data include governance, formatting and quality.
- Process evaluations in health care - during this project Dr Keers has built on his existing theoretical knowledge of process evaluation theory and developed his understanding and insight into how theories are applied in clinical practice settings to explain how and why new interventions are implemented and function in everyday practice.

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