Title Page

Exploring an extended role for pharmacy assistants on inpatient wards in UK hospitals: using mixed-methods to develop the role of Medicines Assistants

Dr Adam Pattison Rathbone[1,2,3]
Teaching Fellow, adam.rathbone@ncl.ac.uk *(Corresponding author)*

Dr Kimberly Jamie[2]
Assistant Professor, Kimberly.jamie@durham.ac.uk

Mrs Jayne Blackburn[3]
Technical Service Lead, Jayne.Blackburn@northumbria-healthcare.nhs.uk

Dr William Gray[3]
Statistician, William.gray@northumbria-healthcare.nhs.uk

Dr Wasim Baqir[3]
Lead Pharmacist, Wasim.baqir@nhs.net

Ms Elaine Henderson[3]
Director of Nursing, Elaine.henderson@northumbria-healthcare.nhs.uk

Mr David Campbell[3]
Director of Pharmacy david.campbell@northumbria-healthcare.nhs.uk

1. School of Pharmacy, Newcastle University, King George VI Building, Newcastle upon Tyne, NE2 7RU, U.K, 0191 208 2345

2. Department of Sociology, Durham University, Old Elvet, Durham University, DH1 3JA, U.K, 0191 334 2000

3. Northumbria Healthcare NHS Foundation Trust, North Tyneside General Hospital, Rake Lane, North Shields, NE29 8NH, U.K, 0191 293 2757

Key messages:

What is already known on this subject -

- Omitted medication doses can lead to increased morbidity and mortality.
- Pharmacy assistants are unregistered members of the pharmacy workforce.
- There is some evidence that pharmacy assistants can reduce dose omissions when deployed to hospital wards.

What this study adds -

- A model for pharmacy assistants to be deployed into patient-facing roles in secondary care as 'medicines assistants'
- Preliminary evidence that pharmacy assistants can save nursing time safely by supporting medicines administration.
- Further evidence that pharmacy assistants can reduce omitted doses.

Abstract

Objectives: This project explored the deployment of pharmacy assistants to inpatient wards in a new role as 'medicines assistants'.

Methods: Ward-based medicines assistants (MAs) were introduced to six wards across two UK hospitals to support medicines administration. Each 30-bed ward delivered acute inpatient services with MAs supporting typical nursing medication administration rounds to 15 patients. Data was collected using activity diaries, observations, clinical audit and semi-structured interviews with pharmacy assistants, pharmacy technicians, clinical pharmacists, nurses, ward managers and pharmacy managers. Thematic analysis, descriptive statistics and the Mann Whitney U Test were used to analyse qualitative and quantitative data, respectively.

Results: MAs were able to act as a point of contact between the ward and the pharmacy department and were perceived to save nursing time. A statistically significant reduction in the length of time to complete morning medication administration to 15-patients was observed (mean 74.5 vs. 60.8 minutes per round, $p < 0.05$). On average 17.4 hours of medicines-related activity per-ward-per-week was carried out by MAs rather than by nursing staff. Participants identified broader training and clarity was needed in relation to the accountability and governance of patient-facing roles.

Conclusion: Pharmacy assistants deployed as MAs can contribute to saving nursing time and bridge the gap between nursing and pharmacy professionals.

Background

Medicines management represents a unique challenge for hospital pharmacy services. Errors involving medicines remain the third largest reason for incidents in the United Kingdom (UK) National Health Service (NHS).[1,2] Errors that result in dose omissions can result in death, serious harm and prolong hospital admission.[3] The incidence of missed doses varies across the literature, ranging from 1.4% to 20%.[1,4]. Large-scale epidemiological studies, as well as smaller single site audits, report multiple reasons for omitted doses, with 'patient refusal' and 'drug not available' being the most frequent acceptable and unacceptable reasons, respectively.[5] Despite a move towards the use of electronic prescribing and medication administration systems, which are reported to reduce the frequency of omitted doses,[4] much of the literature documents that existing strategies have shown limited success and present new challenges, such as vulnerability to cyber-attacks..[4-9] This evidence suggests that omitted dose rates remain problematic, with new ways of supporting administration needed to improve patient care.

Internationally the pharmacy workforce is recognised for its involvement in medicines administration,[10] however many organisations have yet to optimise the availability of the pharmacy team to deliver ward-based patient-facing activities routinely.[2] . Ward-based pharmacy services can include reviewing prescriptions, annotating orders to improve clarity and safety, carrying out medication-related calculations, patient consultations and counselling, and providing patients and staff with information that improves patient care.[11] In the UK, these activities have typically been reserved for pharmacy technicians and pharmacists rather than pharmacy assistants.[12] However the complex and lengthy nature of pharmacy technician and pharmacist training (see Figure 1) and associated cost may limit the availability of these personnel to contribute to medicines medication administration routinely or at scale.

Although education, and supervision of pharmacy team members vary considerably across the globe,[13] pharmacy assistants typically have less extensive training, are cheaper and easier to recruit and have a predominantly product-focused role in aseptic manufacturing, distribution and dispensing.[14] The pharmacy assistant role then, may provide an alternative workforce to support medication administration. However, whilst pharmacy assistants may be readily recruited the majority of studies within the literature report findings in relation to pharmacists or pharmacy technicians.[15] Baqir et al. suggests pharmacy assistants that were patient-facing and ward-based, referred to as 'medicines assistants' to differentiate from other pharmacy assistants working on wards doing product-focused tasks (*e.g.* topping up stock), can significantly reduce unacceptable omitted doses of prescribed inpatient medications.[16] However that study did not report how MAs fitted in within existing ward-based teams of nurses, healthcare assistants, pharmacists and technicians or the broader day-to-day activities and experiences of the new role at ward-level.

Aim

The aim of this study was to implement and explore the role of MAs working on hospital wards in the UK. The primary objective was to examine the experiences of ward-based staff and MAs to identify key components of the role. The secondary objectives of this study were i) to explore the amount of nursing time saved by MAs; ii) monitor the number of patients that had more than one omitted dose of a prescribed medicine; and iii) monitor the number of patients that had more than one omitted dose of a critical medicine, prior to and following their deployment into ward-based teams.

Methods

Current service provision

Six wards were identified across two hospitals and matched for their patient turnover and clinical speciality. Each ward used paper-based prescribing and had a 'standard pharmacy service', which consisted of a visit each day by a pharmacy technician and pharmacist to review new patients and resolve queries. The pharmacist and pharmacy technician would be responsible for visiting multiple wards and would spend, on average, two hours per day on each ward. Members of nursing staff used a single-check procedure to administer oral and inhaled doses and a double-check procedure to administer controlled drugs or medicines via other routes. Medication administration 'rounds' took place in the morning, midday, afternoon and evening. Nurses administered medication to small groups of patients on the ward as per conventional practice (e.g. one nurse administers medication to patients in Bed 1 to 15 and another nurse administers medications to patients in Bed 16 – 30). Medicines were supplied to wards as original packs labelled for discharge (*i.e.* with a patient's name and instructions for use) when pharmacy staff ordered them or as ward stock when ordered by nursing staff.

Description of the new service

Eight conventional pharmacy assistants were recruited in June 2016 and timetabled to work 7:30am until 3:30pm, with a thirty-minute lunch break. The pharmacy assistants were advised that they would be working as ward-based medicines assistants in a new role. Six assistants were assigned to specific wards (three per site) with two assistants assigned to the dispensary (one per site). Assistants rotated every twelve weeks between the ward environment and the dispensary, with the assistant assigned to the dispensary covering MA absences, such as annual leave or

sickness. The assistants spent their first rotation in the dispensary under the supervision of pharmacy managers, enabling familiarisation with dispensing procedures, computer software and pharmaceutical products. Assistants were introduced to ward managers from July 2016, with ward-specific inductions led by senior nurses. Each assistant was given flexibility to test and develop the boundaries of their role whilst under the supervision of pharmacy and nurse managers. A governance structure was developed and distributed (See Figure 2) to include multiple members of dispensary and ward-based teams. Managers, MAs and other members of ward and dispensary staff held a series of meetings with wider organisational stakeholders to delineate a ward-based pharmacy assistant's job description, modified from the conventional dispensary-based pharmacy assistant's job description. MAs were directed to 'support medication administration' which included a number of different activities ranging from obtaining medicines required for the medication round that were not available in the medicines trolley or patients' bedside medicines cabinet, obtaining water for patients to take medication with and optimising medicines storage in patients' personal medication cupboards. MAs also prepared packaged medications (*i.e.* took them out of the cupboards) for nursing colleagues to administer unit doses and acted as an extra pair of eyes for nursing colleagues, for example, making sure patients had ingested the doses left by the nurse once the nurse had moved on to the next patient.

Evaluation of the new service

Data collection took place between June 2016 and May 2017. This study used mixed methods in a sequential exploratory design.[17] This design collects data in distinct phases, building on qualitative work using quantitative methods to explore research questions. Using Leech and Onwuegbuzie typology (cited in Hadi et al.[18]) this was a

partially-mixed sequential dominant status design (with qualitative research given dominant status). Data were mixed at the interpretation stage.

Qualitative aspects of the study

Qualitative research methods were chosen as appropriate to explore the perspective of assistants, nursing and pharmacy colleagues. This component of the study was underpinned by a transcendental phenomenological approach, whereby subjective experiences are used to understand the textural and structural components of reality.[19] All interviews were conducted by the same interviewer (APR), an embedded team member conducting research across the organisation, with experience of qualitative research. Participants were aware that the interviewer was involved in a number of research projects at the organisation as well as having roles within external academic institutions.

A purposive convenience sample was recruited to include a range of experiences including senior and staff nurses, healthcare assistants, ward managers, clinical pharmacists, pharmacy technicians and pharmacy managers, as well as the MAs themselves. Participants were approached face-to-face and via email and invited to take part in the study by the interviewer (APR).

Qualitative data was collected in a number of different work places that were convenient to the participants and provided a quiet and private space for the interview. This included clinic rooms, quiet rooms, classrooms and offices. No non-participants were present during the interviews. The majority of participants were female, with only one male participant. This study used semi-structured interviews underpinned by a transcendental phenomenological approach. Participants gave informed written consent. Each interview used a pilot-tested interview schedule, was

audio-recorded and transcribed. Identifiable information was removed from the transcript. Interviews lasted approximately 20-30 minutes. All transcripts were returned to participants as a quality control mechanism, all transcripts were approved without amendment. Inductive thematic analysis was conducted by APR, KJ, and JB, manually to familiarise the researchers with the data and then electronically using NVivo Version 11. Data analysis was conducted independently and then at regular data meetings to cluster codes and develop themes. Theoretical data saturation was determined via consensus and reached after nineteen interviews, with a further four interviews conducted to confirm saturation had been reached. The Pharmacy Academic and Research Group (PARG) interrogated the data analysis at regular intervals. PARG includes clinical pharmacists, consultant pharmacists, postgraduate research students and academics. Participants were invited to offer feedback on the findings at two participant engagement meetings to add validity to the analysis where findings were presented to participants using a PowerPoint slideshow.

Quantitative aspects of the study

Findings from the qualitative interviews indicated MAs may save nursing time in relation to medicines administration. The hypothesis that were tested were:

> Null hypothesis: The presence of the medicines assistants does not influence the time taken for medication administration by nursing staff.
>
> Alternate hypothesis: The presence of the medicines assistants influences the time taken for medication administration by nursing staff.

A classification for omitted doses had been developed as part of an earlier study.[16] Acceptable omitted doses were classified as cases when a non-administration code had been recorded indicating the patient was 'nil by mouth', refusing, asleep or another clinical reasons (e.g. low blood pressure). Unacceptable omitted doses

(UOD) were defined as a non-administration code not being recorded or a non-administration code that indicated the medication was not available. Medicines were classified as critical based on the NPSA Rapid Response Alert (See supplementary information). The number of patients with more than one unacceptable omitted dose (≥1 UOD) and more than one unacceptable omitted dose of a critical medicine (≥1 UODc) was routinely collected through clinical audits conducted by hospital staff as part of quality improvement processes. Key outcome measures included i) the duration of morning medicines administration rounds, ii) percentage of patients with more than one unacceptable omitted dose and iii) percentage of patients with more than one omitted dose of critical medications (e.g. anticonvulsants).This data was collected for a four-week period in June 2016 at the start of the project and a four-week period in March 2017, across six wards where assistants had been deployed.

Qualitative findings also indicated that MAs may save nursing time more broadly through ward-based activities. The research team (APR, JB, WB, WG EH, DC) had previous experience of developing key outcome measures and developed a process to collect the fourth outcome measure iv) total nursing time saved by pharmacy assistants per week. Data that enabled the calculation of total nursing time saved per week was collected using observations and activity diaries from six nurses and six pharmacy assistants for two four-week periods after the deployment of the MAs. Nurses and MAs were trained to complete the diaries together by one author to ensure a standard taxonomy and layout was used. MAs recorded activities and duration of time spent completing the activity. Nurses validated the diaries, confirming that they or nursing colleagues would otherwise have completed activities now being completed by MAs.

Quantitative analysis was conducted using SPSS Version 22 (IBM Corp, Armonk, NY, USA) by a statistician (WG). Descriptive statistics and the Mann-Whitney U test was used to explore differences in outcome measures. Quantitative data was integrated with qualitative data following analysis, to enable complementary inferences to be made.

The study received approval from Durham University School of Applied Social Sciences research ethics sub-committee (no identification number was issued) and the Northumbria Healthcare NHS Foundation Trust Research and Development Department. NHS REC approval was not required for this study.

Results

Twenty-three qualitative interviews were conducted with eight medicines assistants, nine nurses, (including two sisters and one charge nurse, three nurse ward managers, three staff nurses,) two pharmacy managers, two registered pharmacists and two pharmacy technicians. Interviews lasted between 20 – 30 minutes. Four major themes were identified and are outlined below, these are i) saving time, ii) accountability, iii) identity and iv) training and development. Quotes are presented as supplementary material.

Saving time

Participants reported saving time supporting patients to take their medications and this freed up nurses to take on direct care activities (Quote 1 & Quote 2). Reviewing current supply levels of medicines saved nursing time and ensured continuity of supply (Quote 3). It was acknowledged that whilst some aspects of stock management would be carried out as part of routine nursing activities, Mas were able

to complete additional stock management tasks that are typically delayed or readily deferred (Quote 4). Participants described MAs as able to relieve pressures placed on nurses to manage medicines at ward level, and this was perceived to improve capacity to deal with more pertinent nursing priorities (Quote 5).

Accountability issues

The role was limited by the lack of accountability MAs had to perform particular tasks (Quote 6). Whilst there was a desire for MAs to be able to do more, concerns regarding governance and supervision were raised by some participants (Quote 7 & 8). There were also concerns about the accountability of MAs whilst supporting the medication round for particular pharmaceutical formulations that had legal or clinical complexity, e.g. controlled drug medication, intravenous medication and nasogastric feeds (Quote 9).

Identity

The perceived identity of the MAs as a 'pharmacy person' appeared to limit the role. MAs themselves described a juxtaposed identity between a pharmacy role and a nursing role, as being difficult to deal with (Quote 10 & 11). However this special identity enhanced the role of the MAs when working in the dispensary, enabling them to use knowledge from the ward to improve patients' pharmaceutical care (Quote 12). In one particular case, the pharmacy identity of the MA led to animosity between themselves and a nurse (Quote 13). Other participants felt that there were clear boundaries between their own nursing role and that of the MA, with the registered status of these participants preventing any job security concerns from the unregistered MAs (Quote 14 &15).

Training and development

Integration with the ward team appeared to translate into enthusiasm for taking on additional nursing activities, in this case moving patients (Quote 16). Assistants reported that differences between the ward-based and dispensary-based roles developed increased empathy with patients (Quote 17). Additional training to develop the role was identified (Quote 18) although 'the on the job training' provided by the nursing team was acceptable (Quote 19). The majority of the participants were supportive of the further development of the MA role (Quote 20).

Key outcome measures

Key outcome measures included i) the duration of morning medicines administration rounds to 15-patients, ii) percentage of patients with more than one unacceptable omitted dose, iii) percentage of patients with more than one unacceptable omitted dose of critical medications and iv) total nursing time saved by pharmacy assistants per week.

Table 1

Supporting morning medication administration ward rounds to 15-patients reduced the time taken from a mean average of 74.5 minutes to 60.8 minutes. Data was collected from 124 administration rounds (62 standard practice, 62 with pharmacy assistant support). Over the investigational period, pharmacy assistants spent 63 hours and 28 minutes supporting medicines administration rounds directly. The data was non-normally distributed and therefore a non-parametric test was used to establish statistical significance. The Mann-Whitney U test was used and showed the difference between the data was statistically significant (p value 0.002). Standard deviation from the average increased after the assistants began supporting the administration rounds. This suggests that at some sites, administration rounds were

not reduced – this supports qualitative data reporting animosity between a nurse and an MA that prevented the MA being involved in administration rounds.

Aggregated data collected for four weeks in June 2016 prior to the deployment of the MAs to wards and in March 2017 following the deployment of the MAs to wards was collected through exiting clinical audit practices included data for 123 patients and 113 patients, respectively. The number of patients with more than one unacceptable omitted doses reduced from 22% (n = 27) to 10% (n = 12) and the number of patients with more than one unacceptable omitted doses of critical medicines reduced from 2% (n = 3) to 0% (n = 0) following the introduction of the assistants. There was not sufficient data to test for statistical difference.

The time spent conducting medicines-related activities by the assistants ranged from 8.4 to 28.4 hours per week. This varied between individual assistants. A mean average of 17.4 hours of medicines-related activity per week was recorded as being carried out by the MAs that would have previously been undertaken by members of the nursing team - including staff grade nurses, sisters/charge nurses and ward managers. The recorded activity of the assistants indicates that the additional actions found in the qualitative data (such as getting patient's cups of water to take their medication) were not recorded in the activity diaries. These additional activities are likely to make up the discrepancy between a full-time position (contracted as 37.5 hours per week) and the recorded average, however further work is needed to support these findings.

Discussion

The findings demonstrate that the role of pharmacy assistants deployed as medicines assistants can be varied, can contribute to saving nurses time and highlights an opportunity for unregistered members of the pharmacy team to support patient-facing activities in secondary care organisations. Boundaries of the role were demarcated by perceptions of identity, accountability and training and development. The amount of time was released to nursing staff was experienced as significant however there were views amongst participants that this role could go further to release more time, if appropriate training and governance was put in place. Of particular pertinence was the limited training available for staff working in this patient-facing capacity, as opposed to product-focused roles.

This study supports existing work that demonstrates a reduction in medication administration omissions when MAs assist nurse-led administraiton.[16] Although a pilot trial reported by Keers et al. revealed only a small impact on the average number of omitted doses when pharmacy technicians supported administration,[15] our study suggests that this outcome may also be achieved with MAs. A comparative study is needed to observe if MAs may be better placed to support medicines administration than pharmacy technicians. This work justifies critical reflection by policy makers on the most appropriate member of the team to perform medication administration support services, which varies considerably across the globe.[10]

The knowledge base is pushed further by this study as it provides an account of the capability of MAs to contribute to patient facing ward services at a time when the nursing workforce is under unprecedented pressure. The direction of travel for the hospital workforce appears to focus on extending roles for unregistered professionals, for example physicians' associates and nursing assistants.[10,20-22] The role of the assistant within this project has improved nursing experiences and saved time. This work therefore brings much needed attention to, and provides evidence of, the

opportunities to develop unregistered members of the pharmacy team. The relative ease of recruitment and training of these staff may provide significant opportunity to help address some of the immediate challenges within the wider healthcare workforce and health service delivery.

Limitations of the study

It is likely that this work is not sufficient to generalise the findings broadly however insights can be gained and considered in similar settings and contexts. Data must be interpreted carefully however, as the majority of once daily medications are typically administered as part of the morning round and so the reduction in the duration of the medication administration round may be less substantial at other times, such as midday, afternoon and evening. Additionally, whilst nurses validated the MAs activity diaries to calculate the amount of nursing time saved on medicines related activities, this was a subjective measure – future studies should look to more objective quantitative measurements to build on these findings and also incorporate all activities where time is saved and not just those specifically medicines related using a time and space study. Further work is also required to understand the influence pharmacy assistants working at ward level as MAs may have had on nursing job satisfaction, stress levels and recruitment more broadly in the long term.

Conclusions

Pharmacy assistants are able to adopt the role of medicines assistants and use their experiences of product-focused activities, such as dispensing, to deliver patient-facing services and support nursing and pharmacy professionals in acute hospital settings at ward-level.

Table 1 Key outcome measures

	Mean	SD
Duration of morning medicine administration round (mins)		
Standard practice	74.5	9.0
With pharmacy assistant support	60.8	17.5
Time saved	13.7	19.6
Time saved per activity per week (hrs) **How many times an activity was recorded each week**		
Obtaining supply of temporary stock items	0.7 10.3	0.5 11.3
Obtaining supply from stock cupboard	0.9 15	0.9 8.1
Obtaining supply of pre-labelled products	0.5 6.3	0.5 6.4
Supporting medication administration	4.1 22.8	5.4 32.9
Visiting the dispensary to obtain medication	1.5 6.2	1.3 4.3
Supporting the supply of medicines for use post-discharge	4.4 7.8	4.9 8.1
Preparing products need for intravenous administration	1.2 14.0	1.2 14.3
Unpacking delivery	0.9 1.7	0.4 1.5
Tidying the treatment room	0.7 1.7	0.4 1.5
Waste management	0.4 1.3	0.2 0.75
Acting as a point of contact for pharmacy on the ward	1.1 1.3	0.9 0.75
Ordering pharmacy products to be held as stock on the ward	1.0 1.0	0.0 0.0
Total time saved per week	17.4	9.517
Point prevalence quality measures		
Per cent of patients with more than one unacceptable omitted dose baseline (June-16) (n = 123)	22% (n = 27)	0.1
Per cent of patients with more than one unacceptable omitted dose after deployment of Medicines Assistants (Mar-17) (n=113)	10% (n = 12)	0.1
Per cent of patients with more than one unacceptable omitted dose of a critical medicine baseline (June-16) (n = 123)_	2% (n = 3)	0.0
Per cent of patients with more than one unacceptable omitted dose of a critical medicine after deployment of Medicines Assistants (Mar-17) (n=113)	0% (n = 0)	0.0

References

1.   Elliott R, Camacho E, Campbell F, et al. Rapid evidence synthesis and economic analysis of the prevalence and burden of medication error in the UK. . Prevalence and Economic Burden of Medication Errors in The NHS in England Policy Research Unit in Economic Evaluation of Health and Care Interventions University of Sheffield, University of York, University of Manchester, 2018.

2.   National Patient Safety Agency (NPSA) Safe Medication Practice Team. Safety in doses: improving the use of medicines in the NHS. London: NPSA, 2007.

3.   National Patient Safety Agency (NPSA). Rapid Response Report NPSA/2010/RRR009: Reducing Harm from Omitted and Delayed Medicines in Hospital. London: NPSA, 2010.

4.   McLeod MC, Barber N, Franklin BD. Methodological variations and their effects on reported medication administration error rates. *BMJ Qual Saf* 2013;22(4):278-89. doi: 10.1136/bmjqs-2012-001330 [published Online First: 2013/01/17]

5.   Coleman JJ, Hodson J, Brooks HL, et al. Missed medication doses in hospitalised patients: a descriptive account of quality improvement measures and time series analysis. *International Journal for Quality in Health Care* 2013;25(5):564-72. doi: 10.1093/intqhc/mzt044

6.   Green E, Griffiths FH, F., Wyatt S. Desperately Seeking Certainty: Bone Densitometry, the Internet and Health Care Contexts. Hampshire: Palgrave Macmillan 2006.

7. Nettleman MD, Bock MJ. The epidemiology of missed medication doses in hospitalized patients. *Clin Perform Qual Health Care* 1996;4(3):148-53. [published Online First: 1996/06/06]

8. Ridge KW, Jenkins DB, Noyce PR, et al. Medication errors during hospital drug rounds. *Qual Health Care* 1995;4(4):240-3.

9. Nagar S, Davey N. Reducing avoidable time delays in immediate medication administration - learning from a failed intervention. *BMJ Quality Improvement Reports* 2015;4(1) doi: 10.1136/bmjquality.u206468.w2612

10. Hawthorne N, Anderson C. The global pharmacy workforce: a systematic review of the literature. *Human Resources for Health* 2009;7(48)

11. Onatade, Miller, Sanghera. A quantitative comparison of ward-based clinical pharmacy activities in 7 acute UK Hospitals. *Int J Clin Pharm* 2016

12. The General Pharmaceutical Council. Pharmacy technician education and training: The General Pharmaceutical Council; 2017 [Available from: https://www.pharmacyregulation.org/education/pharmacy-technician accessed 22nd October 2017.

13. Koehler T, Brown A. A global picture of pharmacy technician and other pharmacy support workforce cadres. *Res Social Adm Pharm* 2017;13(2):271-79. doi: 10.1016/j.sapharm.2016.12.004 [published Online First: 2017/02/14]

14. Health Education England. Pharmacy assistant: Health Education England,; 2017 [Available from: https://www.healthcareers.nhs.uk/explore-roles/pharmacy/roles-pharmacy/pharmacy-assistant accessed 23 October 2017.

15. Keers R, Seston E, Kontopantelis E, et al. Pharmacy TECHnician supported MEDication administration rounds (TECHMED) - Final Project Report. Manchester: University of Manchester, 2017.

16.   Baqir W, Jones K, Horsley W, et al. Reducing unacceptable missed doses: pharmacy assistant-supported medicine administration. *Int J Pharm Pract* 2015;23(5):327-32.

17.   Wimpenny P, Kirkpatrick P. Roles and systems for routine medication administration to prevent medication errors in hospital-based, acute care settings: a systematic review. *International Journal of Evidence-based Healthcare* 2010;8(3):200.

18.   Hadi MA, Alldred DP, Closs SJ, et al. Mixed-methods research in pharmacy practice: recommendations for quality reporting (part 2). *International Journal of Pharmacy Practice* 2014;22:99-100.

19.   Moustakas C. Phenomenological Research Methods. London: Sage Publications Ltd. 1994.

20.   Marchant R. The Scope of Medical Regulation: Physicians' Associates London: General Medical Council 2015.

21.   Frenk J, Chen L, Bhutta ZA, et al. Health professionals for a new century: transforming education to strengthen health systems in an interdependent world. *The Lancet* 2010;376(9756):1923-58. doi: 10.1016/S0140-6736(10)61854-5

22.   World Health Organization. Global Strategy for Human Resources for Health: Workforce 2030. Geneva: World Health Organization, 2016.