

Dietitians can improve accuracy of prescribing by interacting with electronic prescribing systems

Susan De Waal,¹ Laurie Lucas,² Simon Ball,³ Tanya Pankhurst³

To cite: De Waal S, Lucas L, Ball S, *et al.* Dietitians can improve accuracy of prescribing by interacting with electronic prescribing systems. *BMJ Health Care Inform* 2019;**26**:e000019. doi:10.1136/bmjhci-2019-000019

Received 30 October 2018
Revised 05 March 2019
Accepted 18 March 2019



© Author(s) (or their employer(s)) 2019. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

¹Department of Nutrition and Dietetics, University Hospitals Birmingham NHS Foundation Trust, Birmingham, UK

²Clinical Systems and Development/EPR, University Hospitals Birmingham NHS Foundation Trust, Birmingham, UK

³Department of Renal Medicine, University Hospitals Birmingham NHS Foundation Trust, Birmingham, UK

Correspondence to

Susan De Waal;
susan.dewaal@uhb.nhs.uk

ABSTRACT

Background Dietitians increasingly interact with electronic health records (EHRs) and use them to alert prescribers to medication inaccuracies.

Objective To understand renal dietitians' use of electronic prescribing systems and influence on medication accuracy in inpatients. In outpatients to determine whether renal dietitians' use of the electronic medication recording might improve accuracy.

Methods In inpatients we studied the impact of dietetic advice on medical prescribing before and after moving from paper recommendations to ePrescribing. In outpatients, when dietitians recommended changes in dialysis units, we assessed the time to patients receiving the new medications. We trained dietitians to use the ePrescribing system and assessed accuracy of medication lists at the start and end of the study period.

Results Inpatients: before the use of EHRs, 25% of proposals were carried out and took an average of 20 days. This rose to 38% using an EHR and took an average of 4 days.

Outpatients: in dialysis units dietitians recommend initiating and stopping medications and advise on repeat medications. Most recommendations were during multidisciplinary team (MDT) meetings; the average time to receive medications was 10 days. Drug histories updated by dietitians increased after the start of the study and accuracy of medication lists improved from 2.4 discrepancies/patient to 0.4.

Conclusion Dietitians can make medication suggestions directly using EHR, delivering more timely change to patient care and improving accuracy of patients' medication lists. Allowing the whole of the MDT to contribute to the EHR improves data completeness and therefore patient care is likely to be enhanced.

INTRODUCTION

In 2015, 1083 million prescription items were dispensed in the community overall in the UK, a 1.8% increase on the previous year and a 50% increase since 2005.¹ In our institution, University Hospitals Birmingham, Queen Elizabeth Hospital (UHB, QE), electronic prescribing for inpatients is ubiquitous across the whole hospital. There is no paper prescribing. The total number of prescription items for all inpatients increased from 1.7 million in 2012 to 2.4 million during

Summary

What is already known?

- ▶ Patients with kidney disease have highly complex medication regimens and with multiple prescribers involved in their care, a systematic multi disciplinary approach using electronic prescribing may reduce medication errors and improve patient safety.
- ▶ Dietitians interact with EHRs and as technology advances it is possible to utilise proposals and notes to alert prescribers to changes or inaccuracies in patient medication lists.
- ▶ From the initial pilot study the majority of dietetic advice recorded in the inpatient medical notes was not acted on by medical staff.

What does this paper add?

- ▶ Dietitians are able to make medication suggestions directly utilising EHR and can deliver more timely change to patient care.
- ▶ Dietitians can contribute to medication accuracy by interacting with the EHR and effectively update drug histories.
- ▶ Dietitians increasingly interact with EHR utilising the system to alert prescribers to medication changes/inaccuracies and this can be extended to the wider MDT.

2016 (6500 medications/day (hospital informatics data). Prescription accuracy reduces medication errors and patient harm, and also reduces cost and medicine wastage.

Patients with kidney disease have highly complex medication regimens and a large pill burden with an average of 10–12 prescribed medications.^{2 3} Several studies have shown a high prevalence rate of medicine-related problems in patients undergoing dialysis of all types.³ Complex medication regimens, where numerous medications are taken at frequent or unusual times, may also lead to non-adherence, with consequent disease progression, reduced functional ability, lower quality of life and increased use of medical resources. Multiple prescribers play a part in the care of renal patients and can influence adherence.⁴

Renal patients experience frequent care transitions with an average of 1.9 admissions to hospital per year. A significant proportion of medicine-related problems in hospitalised dialysis patients are associated with gaps in transfer of medical information between patients, caregivers and different healthcare settings.^{3,5} Reducing medication errors through a systematic multidisciplinary approach and use of electronic prescribing may improve patient safety and ultimately reduce the hospitalisation rate.^{3,6}

Renal dietitians assess and review inpatients making proposals for phosphate binders and alfacalcidol changes and communicating these to the clinicians. Often these changes are not carried out in a timely manner, although there are few published data in this area. With the advent of electronic health records (EHRs) and embedded prescribing systems, renal dietitians are now able to propose medication changes directly into the EHR, which might facilitate swifter action by the medical teams. The objective of this study is to test whether this is indeed the case.

In outpatients, dietitians are involved in monthly quality assurance (QA) meetings. Renal consultants refer patients for dietary assessment, advice on optimum phosphate binders and to reinforce medication adherence.⁷ During dietetic reviews, primary care medication lists are reviewed for correlation with secondary care medication lists.

Before this study, when medication discrepancies were identified, dietitians contacted consultants to change medication lists, resulting in delays to patients receiving the correct treatment, and inaccurate drug histories in the patient record. The renal dietitian, with regular reviews of patient's monthly blood results is in an ideal position to identify errors, discrepancies or required modifications in the drug history.

UHB, QE is a 1200-bed urban hospital providing secondary and tertiary care services. The renal department provide both inpatient and outpatient services, with 72 inpatient beds, and specialist outpatient clinic services. The UHB, QE dialysis programme has 1200 patients undergoing haemodialysis, including home haemodialysis (50 patients), and 150 patients are receiving peritoneal dialysis treatment. A total of 31 224 patients are seen across renal outpatients clinics each year (hospital informatics data 2018). The institution has an EHR which encompasses an electronic prescribing system (Prescribing, Information and Communication System (PICS)) and is used ubiquitously throughout the hospital and by all members of the multidisciplinary team. There is extensive clinical decision support, which includes advice at the point of prescribing for renal impairment and failure. Blood results, diagnoses and observations are all gathered in the electronic patient record and can be triangulated to provide clinical decision support for prescribers and drug administrators. Links to the British National Formulary⁸ are available for drug prescribers, and the Renal Drug Handbook⁹ is available through the help menus.

AIMS

The aims of this study are as follows:

1. In inpatients, to understand current renal dietitians' practice for recommending dose changes or initiation of medications and the reasons for these recommendations; to determine how long it takes for these recommendations to be carried out; and subsequently to use the EHR to recommend medication changes and understand if this reduces the time from recommendation to medication change.
2. In outpatients, to establish whether the process of renal dietitians being involved in reviewing and updating the electronic list of medications in outpatient records might improve the accuracy of a patient's drug history.

METHODS

Inpatient study

We asked renal dietitians working on the renal wards to record recommendations they made in the medical notes for medication changes over a period of 4 months from 1 January 2016 to 30 April 2016. Data were collected using an electronic audit tool, developed in Microsoft Excel by the investigating team. We then asked our informatics department for reports to determine when drug changes had been made in the EHR.

After this period, we asked the dietitians to propose medications directly into the EHR over a 7-month period (figure 1), or use notes against an existing drug for dose changes (figure 2). The audit tool was adapted to collect additional information. We then asked for informatics reports to understand if this has had any effect on the time to change medications.

The prescribing of medication is initiated through the prescription tab in PICS where medications can be initiated, changed, reviewed or paused. Proposals can be made by authorised dietitians and nursing staff by selecting the proposal tab and adding the proposed drug, with suggested dose and frequency. The system also provides the option of adding annotation notes to explain reasons for proposing a drug.

For dietitians to suggest that an existing drug should be paused, or a dose changed, the drug is highlighted in the medication list, and using the review function, a review note can be added. A small grey eye icon appears in the patient's medication list and against the patient's name on the ward list.

Outpatient study

We studied how dietitians recommend changes to medications in outpatient dialysis units. We asked dietitians to collect reasons for medication changes and what had prompted these requests. We recorded how dietitians communicated these request changes to medical staff and then audited how long these changes took, and how quickly the proposed medication changes were implemented. An audit tool was used to collate all information.

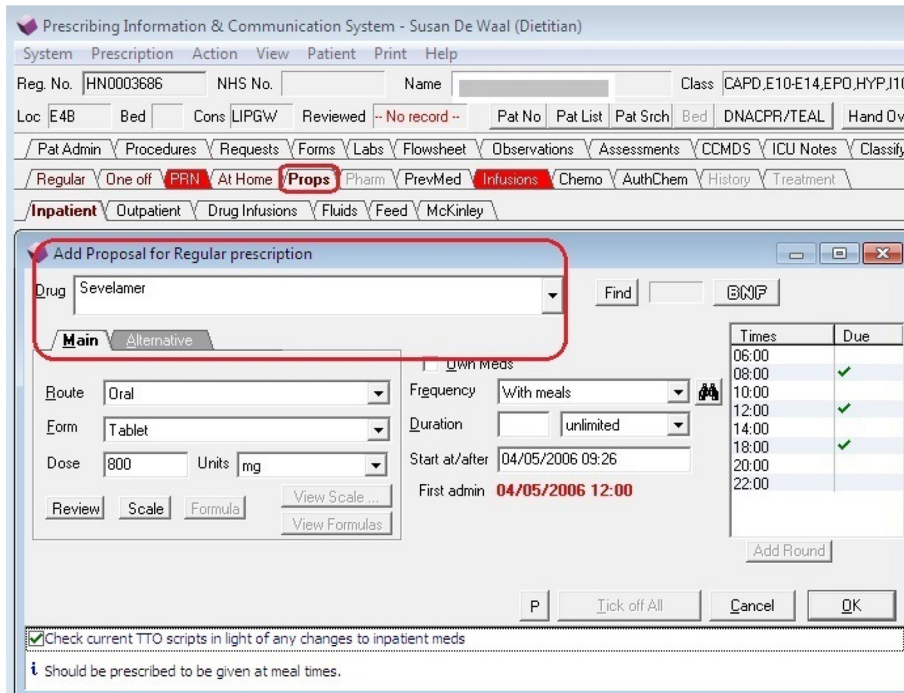


Figure 1 Proposal of the phosphate binder ‘Sevelamer’ in PICS ready for the medical team to authorise or delete. (PICS: Prescribing, Information and Communication System).

In the second half of the study (January 2016 to July 2016), dietitians were asked to use the EHR to update drug histories (figure 3) at points of patient contact at four satellite dialysis units after QA meetings, in telephone conversations with patients and in consultations with patients with medication lists from primary care

using an audit tool. Data were compared with informatics reports for accuracy for the 6 months preceding the study and for the duration of the study.

All patients from unit 3 were asked to bring their GP medication lists in at the beginning of the study period. Dietitians updated the hospital EHR and discrepancies

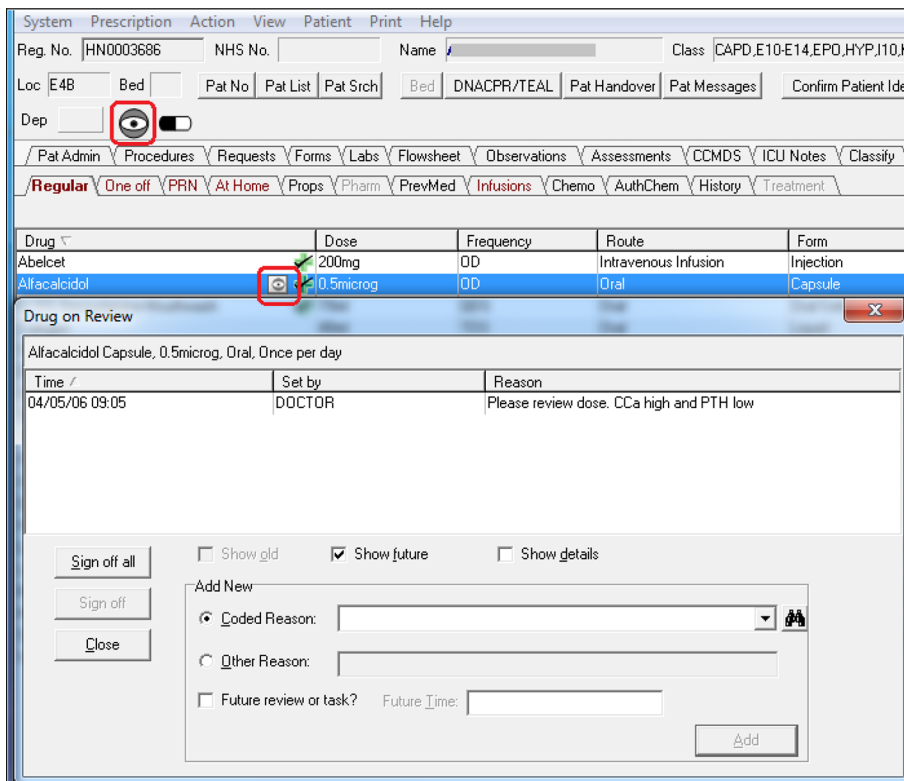


Figure 2 PICS review note against existing medication. (PICS: Prescribing, Information and Communication System).

Figure 3 Process to update drug history in PICS for an outpatient. (PICS: Prescribing, Information and Communication System).

were noted. Patients were asked to bring their GP medication list again after the 6 months study period and the accuracy of the medication lists was compared again. Discrepancies were compared for each patient and average discrepancies were calculated.

We used informatics reports to determine how many changes dietitians made in comparison with other healthcare workers interacting with medication lists.

RESULTS

Inpatient results

In the first 4 months of the study, data for 12 patients were collected who had proposals for medication changes made in the medical notes. Two of these patients were excluded; one was placed on a palliative care programme, and in the other phosphate improved spontaneously and cessation of phosphate binders was no longer relevant. For the 10 patients studied, dietitian medication advice was followed in only three patients.

Where dietetic recommendations were followed, this took an average of 20 days. In one patient, the recommendation was followed after the dietitian reiterated the advice on the ward round.

In the seven remaining patients, where dietetic advice was not followed, the advice was to stop a phosphate binder in two patients and start a phosphate binder in five patients. At discharge, the dietetic advice was still relevant in five of these seven patients.

Following this audit, dietitians changed practice to propose medications directly into the EHR.

In the 7-month study period, 14 proposals and seven review notes for changes to dose, were made by dietitians. Four of these fourteen proposals were converted into prescriptions (one on day 2; one on day 3 and two on day 7). For dose changes following a review note, four of the

seven were made (one on day 1; two on day 3 and one on day 7).

Of these eight proposals and review notes which were acted on, four were discussed in multidisciplinary team meetings, resulting in swifter action.

Of note, clinicians often had to be prompted by dietitians to enact suggested changes proposed in the EHR—for example, by talking to doctors on the wards directly.

In summary before the use of the EHR, dietitian advice was followed in 25% of patients and took 20 days from advice to action and this rose to 38% of patients with advice being followed within 4 days on average. Of note, the study numbers here are small, so that the significance of this requires further study (figure 4).

Outpatient results

Data from 89 patients were collected. Of all the recommendations made by dietitians, 27% involved initiation of a new prescription; 34% involved stopping current medication and initiating an alternative medication; 21% represcribing the calcimimetic drug Cinacalcet and 16% adjusting medication doses (2% had more than one of these actions).

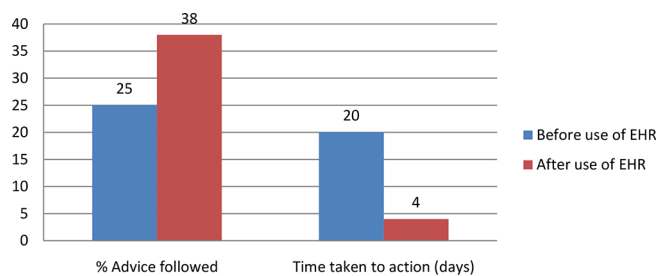


Figure 4 Number of proposals actioned and time taken before, and after, use of EHR. (EHR: Electronic Health Record).

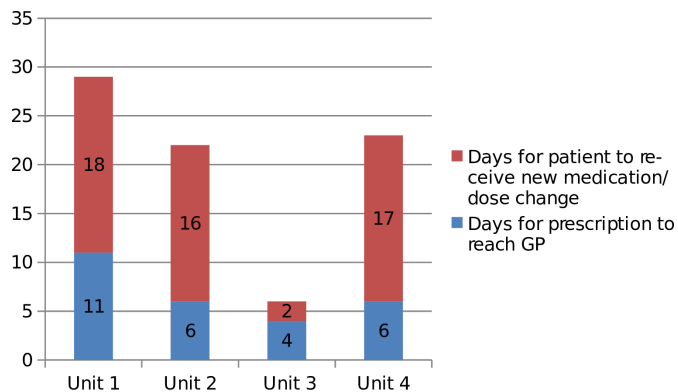


Figure 5 Length of time for prescription to reach GP/appear in EHR and patient to receive new medications. (EHR: Electronic Health Record).

Dietitians suggested changes to medications for various reasons. These included a response to changes in monthly blood levels for phosphate, calcium, parathyroid hormone and folate levels; in response to medication intolerance and because patients were running out of hospital-supplied medications.

Most changes to medication (69%) were discussed and suggested during QA meetings. Dietitians also informed consultants about the need for medications changes via email (31%), particularly where patients were running low on medications and needed supplies before the next QA meeting.

Following discussions about prescription changes it took between 4 and 11 days (average 7.5 days) for letters requesting medication changes to be typed, checked and sent out to GPs (simultaneously appearing in the EHR). This varied between units (figure 5). Emailed requests took longer than face to face discussions.

The length of time that it took patients to receive medications was between 2 and 18 days (average 10 days) across the four units studied.

Medication changes were much swifter when they were made through the hospital pharmacy (unit 3 had only requested repeat prescriptions for Cinacalcet, which is supplied through the hospital, and patients received their medication within 2 days of this decision). These medications are usually posted to the patient/dialysis unit or collected by healthcare professionals travelling from UHB, QE to dialysis units where they are given directly to the patients.

Updating drug histories

Before the study period, there was minimal activity in updating drug histories in the EHR with an average of 15 drug histories a month being updated by dietitians. This increased to an average of 41 updates per month after start of the study in January 2016.

During the study period, dietitians updated drug histories in 132 patients. One hundred and two patients had previous drug history recorded in the audit tool and of these 26 patients had no previous medication history recorded in the EHR—that is, dietitians were the first to

enter a drug history. In the other 76 patients, 50% had had their drug histories updated in the previous 1–3 months, 26% within 1 month, 13% within 3–6 months, 7% longer than 6 months, and 4% (three patients) had had no medication review recorded in the EHR for more than 2 years.

In general for most of the 76 patients, the previous episode of updating was completed by a doctor; only 11 patients had had an update by a dietitian.

Most of the 132 patients updated by dietitians (64%) had one drug updated, 18% two drugs updated, 4% three drugs updated and 14% had four or more drugs updated.

Of the 132 patients 67% of patients had updates following a QA meeting. Dietitians either updated medication lists immediately after QA meetings if this had not already been done within the QA, or during dietetic review with the patient to explain QA changes. For 23% of patients the dietitian reviewed or checked a GP medication list that patients brought in. For 10% of patients, errors in hospital medication lists were identified and corrected in the electronic drug history.

Accuracy of medication lists was reviewed for 11 patients identified from dialysis unit 3 who had their medication list updated over the study period. All of the 11 patients had discrepancies, ranging from 1 to 5 discrepancies at the start of the study. After the study period only 3 of the 11 patients had discrepancies. Accuracy of medication lists improved significantly from 2.4 discrepancies per patient at the start of the study to 0.4 discrepancies per patient after the study period.

DISCUSSION AND CONCLUSION

Inpatient proposals

From the initial pilot it was clear that the majority of dietetic advice recorded in the medical notes was not carried out by the medical teams despite its ongoing-relevance to the patients. In the small proportion of patients where advice was followed, this generally took a long time and required further intervention by dietitians before medication changes were made. Changing dietetic practice to propose medications directly into EHR resulted in a greater number of patients having dietetic advice acted on and the process was much quicker than with the initial study. However, the sample size was small and further validation of these findings is required.

Fifty percent of these medication proposals were discussed during a multidisciplinary team (MDT) meeting and resulted in more prompt action. Our study shows that dietitians can therefore exert greater influence on patient care if they can make medication change suggestions directly in the EHR. However, the overall numbers of proposals acted on remained small and some direct contact from the dietetic team was still needed for changes to be made.

The EHR is therefore not a complete solution. Streamlined processes and efficient technology are tools that

can help but they cannot change behaviour without simultaneous change in operational processes.¹⁰ In combination with operation change, EHRs have been shown to change behaviour, making prescribing practices safer^{11–13} and reducing missed medications.¹⁴

Design of the EHR is important and the criteria for a good EHR can vary for different user groups.¹⁵ In general, EHRs that have been designed by clinicians and with patient care as a driver are better received. Clinicians require EHRs that are interoperable and reliable.¹⁰

Outpatient dialysis

Our study confirms that dietitians can contribute to changes in medications for dialysis patients and effectively communicate these changes to patients and the medical team. They are in close communication with medical consultants and suggest changes to medications during QA meetings or inform consultants via email of suggested urgent medication changes. MDT meetings were the most reliable method for requesting medication changes, as these are where patient-focused discussions take place.

In our study we identified complex reasons why medications are not changed quickly, which include delays in GPs receiving letters; delays while GPs change medication doses requested via letters; patients continuing discontinued medications against advice in order to finish old supplies and patients refusing to take new medications owing to concerns about possible side effects. These findings are similar to previously recognised barriers to effective use of medicines.⁴

One of the most challenging aspects of improving medication safety is to ensure that accurate information about a patient's medication travels with the individual throughout the healthcare system and that any changes are shared with other providers.¹⁶ Our study confirmed that dietitians can contribute to medication accuracy by interacting with the EHR and effectively updating drug histories. The number of drug histories updated increased significantly during the study period, and updates were accurate in comparison with informatics reports.

Studies have found that a frequent cause of error in a medication list was the misreporting of medicine details by patients, and also the failure of clinicians to update the medication list when changes were made.¹⁷ Previous studies have compared medication lists in the renal clinic with GP medication lists and found that 75% of patients had discrepancies identified, with an average of 2.4 discrepancies per patient.¹⁸ The number of medication discrepancies per patient in our study before the intervention period was similar to these previous studies.^{2,4} However, the accuracy of the patient medication lists improved significantly after dietitians started updating drug histories.

To improve the accuracy of medication lists, active participation of all members of the healthcare team and

of the patient is needed throughout the patient journey. It is important to include all clinicians involved in the care who can potentially change medications when patient travel between various specialties.^{17,19} Lee *et al*²⁰ studied renal patients' views on medicines reconciliation on admission and discharge. Although electronic prescribing was viewed positively overall, patients felt frustrated that errors were being made with their regular medication, despite providing correct information to healthcare professionals, demonstrating that electronic prescribing cannot negate human error because health professionals transcribe medication details incorrectly into the electronic prescribing systems. Patients also reported that both before and after introduction of an electronic system, there were communication problems between primary and secondary care, due to lack of system interoperability. Consequently, patients and carers had poor understanding of medication regimens after discharge, with potentially detrimental consequences for adherence.²⁰

Our study supports the idea that dietitians should propose medications and this could be extended to other specialties to improve quality of patient care. Furthermore, since 2016, dietitians have had supplementary prescribing rights, where on completion of an approved postgraduate education and training programme, they can advise the patient on their diet, and supply the patient with prescriptions against an agreed clinical management plan without the need to refer back to a prescribing physician.²¹ A combination of both proposals and prescriptions is likely to improve patient safety by reducing delays in care, reducing hospital and GP appointments, streamlining the patient pathway and improving patient experience.⁷

This idea can be extended to the wider MDT—for example, dialysis centre staff have regular contact with patients and have knowledge of their medical histories and dialysis-related medications.⁶ By allowing the whole of the MDT to contribute to the EHR, the dataset in the EHR is more comprehensive, and this is likely to improve the quality of patient care.

Correction notice This paper has been amended since it was published Online First. The summary section was not updated according to the author's instructions and this has now been rectified.

Acknowledgements The authors thank the following UHB renal dietitians for their contribution in collecting data: Emma Taylor, Mary Wilson-Brown, Joanne Driscoll, Jill Tanner, Lyndsey Tomlinson, Winnie Chan, Kelly Slater, Rachel Watson; Clare Dale, Lewis Oxley.

Contributors TP, LL, SB and SDW conceived and designed the study. SDW conducted the research and coordinated data collection. SDW and TP analysed and interpreted the data, and wrote the manuscript. All authors read, revised and approved the final manuscript.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

REFERENCES

1. NHS Digital. Prescriptions dispensed in the community, Statistics for England - 2005-2015., 2017. 05 Jul 2016. Available: <http://content.digital.nhs.uk/catalogue/PUB20664> [Accessed 13 Oct 2017].
2. St Peter WL, Wazny LD, Patel UD. New models of chronic kidney disease care including pharmacists: improving medication reconciliation and medication management. *Curr Opin Nephrol Hypertens* 2013;22:656–62.
3. Barton A, Cardone K, Manley H, et al. Medication reconciliation and therapy management in dialysis-dependent patients: need for a systematic approach. *CJASN* 2013;142–213.
4. Jimmy B, Jose J. Patient medication adherence: measures in daily practice. *Oman Med J* 2011;26:155–9.
5. Fitzgerald RJ. Medication errors: the importance of an accurate drug history. *Br J Clin Pharmacol* 2009;67:671–5.
6. St Peter WL. Improving medication safety in chronic kidney disease patients on dialysis through medication reconciliation. *Adv Chronic Kidney Dis* 2010;17:413–9.
7. Allied Health Professions Medicines Project Team. Summary of the responses to the public consultation on proposals to introduce supplementary prescribing by dietitians across the United Kingdom, 2016. 26 Feb 2016. Available: <https://www.england.nhs.uk/wp-content/uploads/2016/02/dietitians-summary-consult-responses.pdf>
8. British Medical Association and the Royal Pharmaceutical Society of Great Britain. *British National Formulary*. 76th edn. London, 2018.
9. Ashley C, Dunleavy A. *The renal drug handbook: the ultimate prescribing guide for renal practitioners*. 5th edn. London, 2018.
10. Ajami S, Bagheri-Tadi T. Barriers for adopting electronic health records (EHRs) by physicians. *Acta Inform Med* 2013;21:129–34.
11. Hinojosa-Amaya JM, Rodríguez-García FG, Yeverino-Castro SG, et al. Medication errors: electronic vs. paper-based prescribing. Experience at a tertiary care university hospital. *J Eval Clin Pract* 2016;22:751–4.
12. Patel J, Ogletree R, Sutterfield A, et al. Optimized computerized order entry can reduce errors in electronic prescriptions and associated pharmacy calls to clarify (CTC). *Appl Clin Inform* 2016;7:587–95.
13. Sethuraman U, Kannikeswaran N, Murray KP, et al. Prescription errors before and after introduction of electronic medication alert system in a pediatric emergency department. *Acad Emerg Med* 2015;22:714–9.
14. 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. *Int J Qual Health Care* 2013;25:564–72.
15. McGinn CA, Grenier S, Duplantier J, et al. Comparison of user groups' perspectives of barriers and facilitators to implementing electronic health records: a systematic review. *BMC Med* 2011;9.
16. IHI.org. Accuracy at every step: the challenge of medication reconciliation, improvement stories. Institute for healthcare, 2011. 13 Jul 2013. Available: <http://www.ih.org/resources/Pages/ImprovementStories/AccuracyatEveryStep.aspx> [Accessed 18 Feb 2018].
17. Wagner MM, Hogan WR. The accuracy of medication data in an outpatient electronic medical record. *J Am Med Inform Assoc* 1996;3:234–44.
18. Smith I, Taylor J. FP371A quality improvement project addressing prescription discrepancies in renal patients. *Nephrol Dial Transplant* 2015;30(suppl_3).
19. Nassaralla CL, Naessens JM, Chaudhry R, et al. Implementation of a medication reconciliation process in an ambulatory internal medicine clinic. *Qual Saf Health Care* 2007;16:90–4.
20. Lee L, Williams R, Sheikh A. What does ePrescribing mean for patients? A case study of the perspectives of hospital renal patients. *J Innov Health Inform* 2015;22:391–8.
21. British Dietetic Association. Practice guidelines for dietetic supplementary prescribers, 2016. Feb 2016. Available: https://www.bda.uk.com/professional/practice/prescribing/practice_guidance_prescribing [Accessed 24 Mar 2018].