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Electronic Medication Record Accuracy in Haemodialysis Outpatient Settings

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Abstract

Aims

Irish haemodialysis (HD) units operate the electronic Kidney Disease Clinical Patient Management System (KDCPMS). KDCMPS is not always used as the primary electronic patient record. At this study setting, KDCPMS information accuracy has not been examined to date. This study aims to identify, characterise and quantify medication discrepancies within KDCPMS records of HD outpatients.

Methods

Prospective, observational study conducted on the HD unit of Tallaght University Hospital. Medicine reconciliation was conducted to identify KDCPMS discrepancies with medication review to document Drug Related Problems (DRPs). Clinical pharmacists issued recommendations to resolve DRPs.

Results

All KDCPMS records examined contained intentional and unintentional discrepancies (n=36). Unintentional discrepancies corresponding to 8.8 discrepancies per patient (5.13SD) was observed. One-hundred-and-forty-three DRPs were identified in 34 patients (94.4%). Sixty-five per cent (65%) of pharmacist recommendations were accepted (n=93), 22.4% rejected (n=32), 8.4% (n=12) referred to the renal multidisciplinary team (MDT) and 4.2% not actioned (n=6).

Conclusion

KDCPMS contains inaccuracies potentially leading to systemic error. Robust clinical governance supported by national policy is required to support KDCPMS as the primary platform for renal patients. Enhanced pharmaceutical care by specialist clinical pharmacists should be supported within national models of care for chronic disease management to improve patient outcomes.

Introduction

The use of multiple electronic and paper systems across numerous care providers in a variety of primary and secondary settings, increases the risk of systematic error for patients. This is of particular concern in complex medical areas such as renal medicine.

In Ireland, 2014 patients received maintenance in-centre haemodialysis (HD) for End Stage Kidney Disease (ESKD) in 2020.[1] HD units operate a national electronic Kidney Disease Clinical Patient Management System (KDCPMS). The proposed benefits of KDCPMS are to provide complete clinical data for renal patients, including medical history, laboratory data, medication and dialysis prescriptions to the renal multidisciplinary team (MDT). KDCPMS aims to improve patient safety during HD, and at transitions in care for all renal patients.[2]

KDCMPS is used variably in practice. In most centres, KDCMPS is not used as the primary electronic patient record (EPR) but rather in conjunction with other electronic and paper systems including hospital EPR, paper charts and prescriptions.

Incomplete documentation and discrepancies between EPR and other sources result in error. In one study, HD outpatient medication discrepancies are reported at a rate of 3.4 discrepancies per patient.[3] Unintentional discrepancies – where changes have been made either inadvertently or deliberately by the patient (or other clinicians) unbeknown to the prescriber – are reported in up to 78% of HD patient records.[4]

HD patients average 6 co-morbidities and have the largest pill burden for any chronic disease; consuming 19 oral doses per day, comprising of 12 different medicines.[5,6] Frequent medication changes, polypharmacy, co-morbidities and non-adherence, increase the risk of Drug Related Problems (DRPs) in HD patients. In one study, 66% of DRPs in ESKD patients at hospital admission resulted from communication gaps at transitions in care.[7] In HD patients, DRPs are prevalent at a rate of one for every three medication exposures.[5] and can elicit negative outcomes, including worsening morbidity, mortality and increased healthcare expenditure.[8]

At this study setting, information accuracy within KDCPMS has not been previously examined. This study aims to identify, characterise and quantify medication discrepancies within KDCPMS records of HD outpatients.

Methods

This prospective, observational study was conducted on the HD unit at Tallaght University Hospital. Following ethics approval data was collected over eight-weeks commencing January 2019.

All patients with KCDPMS records receiving maintenance HD therapy attending the hospital HD unit were eligible for inclusion. Patients were approached to participate if inclusion criteria were met and informed consent was obtained. Inpatients and patients with poor proficiency in English were excluded from the study. Data collected included patient demographics and descriptive data relating to KDCPMS accuracy.

Consented patients underwent medicines reconciliation (MedRec) by the research pharmacist to produce a Gold Standard Pre-Admission Medication List (GS-PAML) – a comprehensive list of all the medicines a patient is taking including prescribed, over-the-counter and complimentary therapies.[9] The GS-PAML was compared to the KDCPMS medication list to identify discrepancies within the KDCPMS record. Discrepancies were classified as either undocumented intentional (deliberate), or unintentional discrepancies according to established criteria.

Where KDCPMS medication entries contained more than one discrepancy compared to the GS-PAML, each component was categorised as an individual discrepancy. Entries where medicines and directions on KDCPMS matched patient use, but community pharmacy directions differed, were recorded as unintentional discrepancies because clarification from the prescriber was required to confirm intended directions for use.

Medication review of the patient's GS-PAML was conducted by the specialist renal pharmacist to identify DRPs and were characterised according to established criteria. Identified DRPs were resolved following discussions between the specialist renal pharmacist and the patient's consultant. Pharmacist recommendations were categorised as accepted, rejected or not actioned. Alternative interventions to resolve DRPs made with the consultant were also described and quantified.

KDCPMS medication records were updated by the research pharmacist and the final, updated GS-PAML was sent to the patient's general practitioner. Additions, amendments and deletions to correct KDCPMS were also quantified.

Data was collated in Microsoft Excel® and analysed using IBM® SPSS Statistics v25. Descriptive statistics were used for patient demographics and categorical variables. Data was presented using percentages, median and interquartile range (IQR) where appropriate. Discrepancies and DRPs per patient were reported using mean and standard deviation (SD). Drug class identified as discrepancies and/or DRPs were categorised as per the World Health Organization's ATC/DDD Index 2019.55 then grouped according to therapeutic area.

Results

Ninety-three patients attended the unit for maintenance HD during the study. Fourteen patients were excluded as per pre-defined criteria and 7 declined inclusion. Seventy-two patients met inclusion criteria and 36 patients agreed to participate in the study. Patient baseline characteristics are outlined in Table 1.

Table 1: *Participant Baseline Characteristics and Demographics.*

	Total n = 36	**Male** n = 18	**Female** n =18
Demographics	**Median (IQR)**	**Median (IQR)**	**Median (IQR)**
Age (years)	70 (17)	63.5 (15.75)	70 (11.25)
HD Duration (months)	29 (33.75)	28.5 (27.5)	30 (51.5)
Chronic Kidney Disease (CKD) Cause	**Total (%)**	**Total (%)**	**Total (%)**
Not documented	2 (5.6)	2 (11.1)	-
Unknown Aetiology	4 (11.1)	2 (11.1)	2 (11.1)
Diabetes Mellitus	11 (30.6)	6 (33.3)	5 (27.8)
Hypertension	4 (11.1)	3 (16.7)	1 (5.6)
Primary Kidney Disease *e.g. Polycystic Kidney Disease*	7 (19.4)	3 (16.7)	4 (22.2)
Secondary Kidney Disease *e.g. vasculitis, amyloidosis*	8 (22.2)	2 (11.1)	6 (33.3)

The median number of days since last update of KDCPMS medication lists was 37 days (IQR 55.25) and were most frequently updated by nurses (50%, n=18), dieticians (41.7%, n=15) and nephrology consultants (8.3%, n=3).

Allergy status was recorded in 63.9% (n=23) of KDCPMS records. Thirty percent (30.4%, n=7) of allergy status documented differed to that recorded by pharmacist MedRec.

Discrepancies between KDCPMS and GS-PAML were observed in all records examined (n=36). Discrepancy type and categories are displayed in Table 2. Unintentional discrepancies corresponding to 8.8 discrepancies per patient (5.13SD) was observed.

One-hundred-and-forty-three DRPs were identified in 34 patients (94.4%) corresponding to 4.2 DRPs per patient (2.72SD), or one DRP for every 4.3 medication exposures. Ninety-three DRPs were co-categorised as discrepancies. DRP type and characteristic are displayed in Table 2.

Table 2: *Discrepancy & Drug Related Problem Characteristics.*

Medication Discrepancies Between KDCPMS and GS-PAML	**(n =420)**	**(%)**
Intentional Discrepancies (undocumented)	**103**	
Hospital Only Medicines	103	(24.52)
Unintentional Discrepancies	**317**	
Omission	121	(28.81)
Commission	65	(15.48)
Wrong drug	2	(0.48)
Wrong dose	48	(11.43)
Wrong frequency	61	(14.52)
Wrong strength	3	(0.71)
Wrong formulation/device	11	(2.62)
Wrong route	4	(0.95)
Duplication of therapy	2	(0.48)
Drug Related Problems (DRPs) Identified During Medication Review	**(n = 143)**	**(%)**
Drug without indication	38	(26.57)
Indication without drug	21	(14.69)
Wrong drug	3	(2.1)
Dose too low	11	(7.69)
Dose too high	21	(14.69)
Adverse drug event	4	(2.8)
Inappropriate adherence	37	(25.87)
Interactions (drug/drug, drug/disease, drug/food)	8	(5.59)

The specialist renal pharmacist made 143 recommendations to resolve DRPs. Sixty-five percent (65%) of pharmacist recommendations were accepted (n=93). Where recommendations were rejected (n=32, 22.4%), or not actioned (n=6, 4.2%); valid clinical reasons were provided. Twelve recommendations for MDT review were made during consultant discussions to resolve DRPs (8.4%).

Discrepancies and DRPs by therapeutic area are shown in Figure 1. Parenteral anticoagulants and thrombolytics were the most common undocumented intentional discrepancy (48.6% n=50/103) followed by iron (32% n=33/103). Vitamin supplements and medicines used in the management of Chronic Kidney Disease related mineral bone disease (CKD-MBD) accounted for 35.66% (n=53/143) of all DRPs identified.

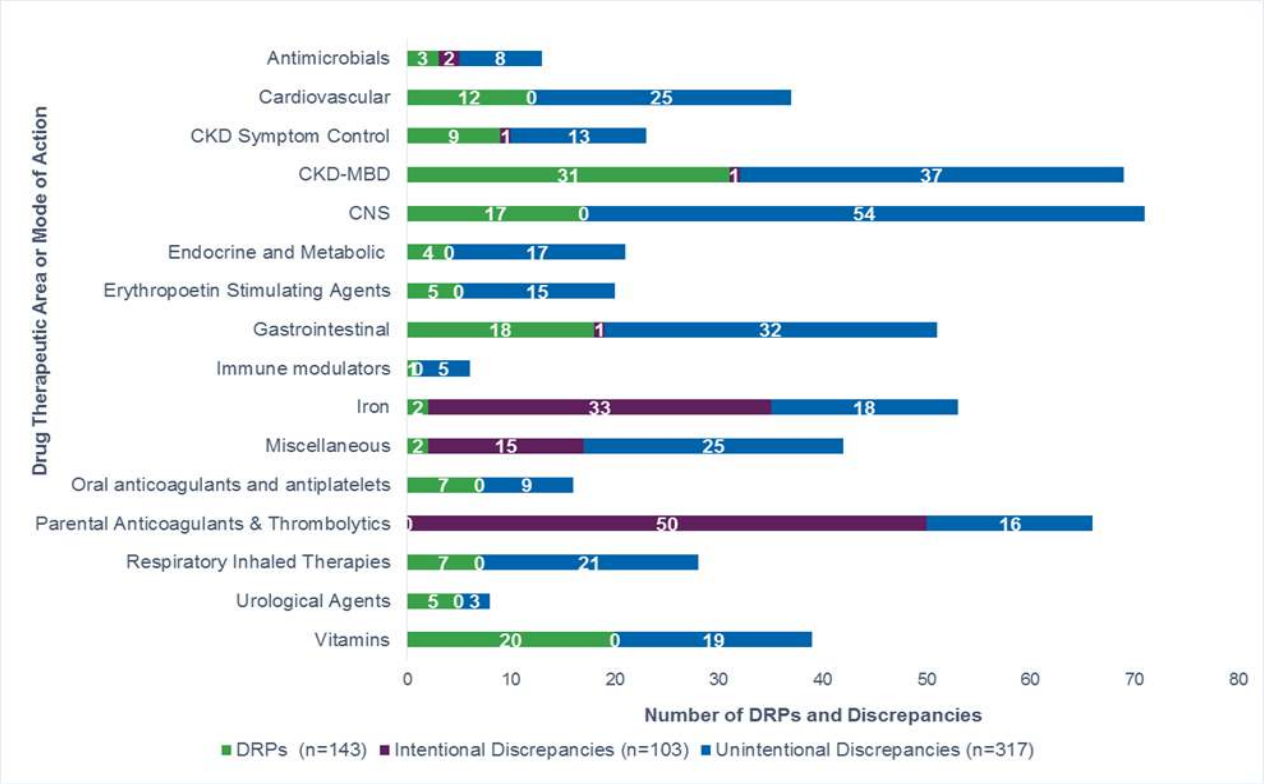

Figure 1: *Graph depicting number of intentional discrepancies, unintentional discrepancies and drug related problems identified by clinical pharmacists per drug therapeutic area / mode of action.*

Sixteen (44.4%) patients had at least one medicine de-prescribed. New prescriptions were issued for 26 patients (72.2%) for 81 medicines.

Table 3 demonstrates interventions, modifications and time analysis of updating KDCPMS following clinical pharmacist intervention.

Table 3: *Clinical Pharmacist Intervention Analyses.*

KDCPMS medication lists requiring modification	**(n=35)**		
Clinical Pharmacist Modification of Electronic Medication Lists Post Intervention		**Median**	**IQR**
Additions made to KDCPMS medication list	101	2	2
Amendments made to existing KDCPMS medication list	109	3	2
Deletions made to KDCPMS medication lists	46	1	2
Number of medicines recorded Pre- and Post- Pharmacist Intervention	**(n=36)**	**Median**	**IQR**
Pre Pharmacist Intervention			
Medicines recorded in KDCPMS	565	14	6.25
Medicines recorded in GS-PAML	615	16	5.25
Post Pharmacist Intervention			
Medicines recorded in final updated medication list on KDCPMS and GS-PAML	612	17	5
Clinical Pharmacist Intervention Time Analysis (mins)		**Median**	**IQR**
Completion of Medicine Reconciliation		60	25
Completion of Medication review		85	32.5
From pharmacist recommendations to resolution of DRPs		244	323.25
Total time to KDCPMS update		408	318

Discussion

KDCPMS contains inaccuracies which could result in error or possible harm. It reflects a critical risk in patient care when information is recorded multiple locations without regular data reconciliation reviews. In this setting, it highlights a weakness of KDCPMS when it is not used as the primary record for HD patients.

Concurrent use of paper and electronic platforms across a variety of healthcare settings contributes to discrepancy and DRP rates seen here. This is supported by a recent study demonstrating discharge discrepancies when paper and electronic systems are used simultaneously.[10]

The demand for maintenance HD is increasing. In Ireland over 310,000 in-centre haemodialysis treatments were delivered in 2020, increasing by over 30% in the past decade.[1] Maintenance HD results in a fragmented care delivery to multi-morbid patients with significant polypharmacy, contributing to a high risk of error and potential harm in the HD outpatient setting. The unintentional discrepancy rate of 8.8 per patient here is higher than those reported elsewhere.[3,11] Infrequent and unassigned responsibility for updating of KDCPMS may contribute to this higher rate.

KDCPMS was developed to improve care for CKD patients attending specialist secondary care and to facilitate transitions of care between dialysis and transplant centres[2]. Currently, restricting KCDPMS access to specialist teams alongside disjointed communication between primary and secondary care culminates in impractical and additional workloads in ESKD care, with Nephrologists becoming *de-facto* primary care providers for HD patients. Previous studies acknowledge that Nephrologists should not have responsibility for primary care but in reality, HD patients rely on their HD unit for referrals, preventative care and symptom management.[12] Challenges such as barriers in sharing electronic information between healthcare settings, and more frequent HD unit attendances compared to primary care may compound this issue.[13]

However, the National eHealth Ireland Strategy, which includes KDCPMS, aims to ensure that information and technology (IT) support health care efficiently and effectively across the whole health service.[2] To realise this vision, IT infrastructures across primary and secondary care must be enhanced in terms of software platforms, integration and functionality to support the consistent use of KDCPMS at all interfaces and transitions of care for CKD patients.

Supporting the development of KDCPMS to become the primary reference source, including permitting multi-speciality access, may facilitate national delivery of integrated care for chronic disease.[14] This could reduce co-morbidity related discrepancies and DRPs, reducing the risk of error or potential harm in all aspects of kidney patient care.

Robust clinical oversight including policy development, integrated care models and assigned clinical governance, is essential for ensuring consistent, accurate information within KDCPMS. Policy must include defined criteria for providing complete medication lists, and documentation of co-morbidities, allergies and adverse reactions, within a specified timeframe following medication changes, hospitalisation or care transitions. This is recommended at a national level by the Health Information & Quality Authority (HIQA) for electronic patient summaries.[15] Such provisions reduces discrepancy and errors when applied consistently as part of clinical governance structures.

Systematic error risks as a result of electronic record discrepancies is not limited to ESKD patients. Factors identified here are applicable to other patient groups across all care settings. Issues highlighted by this study should factor into national EPR development under Slaintécare.[16]

Clinical oversight must include specialist clinical pharmacists within KDCPMS governance and accountability structures alongside enhanced clinical pharmacy service provision within the renal MDT. As medication experts, pharmacist involvement in EPR governance reduces discrepancy and error in electronic records of HD outpatients.[17]

The positive impact of clinical pharmacists within the renal MDT is evident by this study. The proportion of HD outpatients with DRPs, and the rate of DRP exposure, were in line with studies which support enhanced clinical pharmacy services to HD outpatients.[7] Pharmacist recommendations to resolve DRPs were accepted for 65% of interventions. The collaborative approach of this study to resolve DRPs, in which a further 8.4% of recommendations were resolved via MDT, increases overall DRP resolution to 73.4%. This is greater than the 67.6% acceptance rate reported in comparable collaborative care model studies,[18] which operate similarly to the PACT model-of-care for inpatients at this study.[19]

De-prescribing of at least one medicine occurred in 44.4% of patients following clinical pharmacist intervention. This is lower than other studies where specific de-prescribing tools reduced polypharmacy in 57% of HD patients.[20] Further data analysis using prescribing quality indices and comparing to previous studies[21] is required to target de-prescribing practices in ESKD here.

Pharmacy practice standards developed internationally are well-defined and demonstrate a broad range of services that should be provided alongside HD outpatient services such as pharmacist-led CKD clinics and pharmaceutical care services to peritoneal and home haemodialysis.[22,23] Patient care improvements such as reduced hospitalisations were observed elsewhere when enhanced clinical pharmacy services were introduced[24] and should form part of national policy and care models within the Irish setting. Equally, enhanced pharmacy services within the wider population, empowers primary care and allows more community care delivery in line with Slaintécare, reducing costs and must form part of national policy.[17]

This study has many strengths. It demonstrates clinical pharmacist impact in improving KDCPMS accuracy and potential harm reduction for HD outpatients. The results seen here with discrepancies, DRPs and pharmacist interventions supports current literature and acts as a benchmark to international practices for both renal and other comorbid patients. This study demonstrates the challenges surrounding effective use of EPR at this setting and is the first (to our knowledge) assessing KDCPMS use and accuracy in Irish practice.

In terms of limitations, maintenance of KDCPMS accuracy was not assessed given the single-intervention nature of the methodology. Prospective audit is required to determine frequency of intervention to maintain accuracy. The results outlined in Table 3 may serve as key performance indicators to establish, maintain and enhance clinical pharmacy service allocation for HD outpatients locally and nationally as part of an integrated model of care.

This study suggests that regular prospective audits of routine MedRec is warranted in dialysis services, supported by specialist or advanced practitioner pharmacists to improve medication safety, patient adherence, and polypharmacy. This includes pharmacist interventions at initiation of HD and at transitions of care including hospitalisations, clinic visits and GP visits. Our findings are supported by a recent study that also demonstrated that integration of a pharmacist into a HD unit significantly reduced medication discrepancies and medication related problems.[25]

In conclusion, KDCPMS inaccuracies may lead to systemic error. Robust clinical governance supported by national policy is required to improve accuracy within KDCPMS and support its use as the primary platform for renal patients. Enhanced pharmacy services by specialist pharmacists within the renal MDT supported by national models of care policy can reduce discrepancies, improve KDCPMS accuracy and resolve DRPs.

Declaration of Conflicts of Interest:
Professor Mellotte receives consultancy fees from Baxter Healthcare for participation in an Advisory Board for Peritoneal Dialysis.

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