Patients with end-stage renal disease (ESRD) are at high risk for drug-related problems (DRPs), as these individuals take numerous drugs, have multiple comorbidities, and experience frequent medication changes. Hospitalization of patients with ESRD can contribute to the risk of DRPs. Up to 40% of the total DRPs identified during a patient’s hospitalization occur at the time of admission. For the general patient population, hospital admission is a high-risk period, wherein obtaining accurate medication histories is a challenge leading to a large number of medication discrepancies. The Institute for Healthcare Improvement (IHI) reported that 50% of medication discrepancies result from poor communication. The gap in appropriate transfer of drug information is believed to play a key role in the high incidence of DRPs on hospital admission. Although patients with ESRD experience frequent DRPs, it is not fully known how these problems are related to gaps in medication information transfer.

The objectives of this study were to identify and characterize the DRPs experienced by patients with ESRD on hospital admission and investigate how these DRPs could be related to gaps in medication information transfer among patients and healthcare professionals.
Methods

This study was conducted at a 350 bed tertiary care teaching hospital affiliated with the University of Toronto, providing services to approximately 170 peritoneal dialysis and 350 in-center hemodialysis patients. Between February 9 and May 14, 2004, all consecutive patients with ESRD (hemodialysis and peritoneal dialysis) admitted to the general internal medicine and nephrology units were prospectively identified, assessed, and included in the study. This study was approved by the Institutional Research Ethics Board of the University Health Network.

There were 5 steps to the study. First, on a patient’s hospital admission, the clinical pharmacist on the general internal medicine or nephrology team used a systematic process based on the pharmaceutical care practice model to perform a comprehensive medication assessment. The steps in this process involved a collection of relevant drug, disease, and patient information through a chart review and interview with the patient and/or family members and healthcare providers, followed by an interpretation of all available information to identify the patient’s actual and potential DRPs on hospital admission. DRPs were defined as any events or circumstances involving a patient’s drug treatment that actually or potentially interferes with the achievement of an optimal outcome. Therefore, DRPs included, but were not limited to, discrepancies between admission orders and medications used prior to admission.

Second, with each drug assessment, the identified DRPs were recorded on a standardized data collection form and categorized based on prespecified headings adapted from those of Hepler and Strand. This process was completed on hospital admission, with a maximum of 72 hours after admission. The 72 hour window was used to account for any admissions that occurred during the weekend when clinical pharmacists were not on site. If a patient had multiple admissions during the study period, each admission was counted as a separate study case.

Third, each DRP was evaluated to determine whether it might have occurred because of a gap in medication information transfer. A gap in transfer of this information was defined as the absence of, incomplete, or inaccurate transfer of medication information to the healthcare providers in the hospital from either the patient/family or from healthcare providers in the community or the dialysis clinic. Comprehensive medication histories and verifications from the patient, family members, caregivers, family physicians, medical specialists, and community pharmacies were used to evaluate whether a gap in drug information transfer might have contributed to the DRP. All DRPs identified were discussed and addressed with the admitting medical team. Consultation with the medical team validated that the DRPs identified by the clinical pharmacists were unintentional. For example, a medication that was not reordered on admission was an error of omission and had not been intentionally discontinued.

Fourth, for all DRPs related to gaps in medication information transfer, the investigators attempted to identify the precise information transfer interface at which the gap might have occurred. This interface was defined as the juncture between 2 select individuals where the gap in communication might have occurred (Figure 1). This was done by determining the juncture where improved communication might have prevented the DRP. The information transfer interface was identified and assigned to each DRP.

A second pharmacist reviewed each DRP to validate the categorization of DRPs, whether the DRP was a result of gaps in medication information transfer, and the assigned information transfer interface. Any discrepancies between the 2 reviewers were discussed, and the final decision was determined by consensus. A third independent reviewer was available to provide validation if discrepancies needed further discussion.

Fifth, the DRPs were collated using Microsoft Access 97 (Microsoft, Seattle), and descriptive statistics were used to calculate the frequency of DRPs per patient and by category, percentage that was related to gaps in medication information transfer, and percentage caused by medication information transfer gaps that occurred at each of the 10 information transfer interfaces.

Results

During the 12 week data collection period, a total of 199 DRPs were identified in 47 patients with ESRD (16 females, 31 males) during 52 individual hospital admissions. Study patients were on the following dialysis modalities: 27 hemodialysis, 14 peritoneal dialysis, and 9 admitted to initiate dialysis. The average age of patients was 68.1 ± 12.4 years. The patients were on a mean of 11.7 ± 5.1 drugs.

CHARACTERIZATION OF DRPS

Ninety-two percent of the patients had at least one DRP identified on admission. The average number of DRPs per patient identified at that time was 4.2 ± 2.2. The characteristics of DRPs on hospital admission and their relationships to gaps in medication information transfer are provided in Table 1. The most common type of DRP identified on hospital admission was Indication for Drug Therapy (patient requires a drug but is not receiving it). For example, DRPs classified under this designation included a home medication prescribed by an outpatient physician, which was not ordered by the admitting physician. Another example of this category included an appropriate clinical indication for a drug, but the patient was not receiving the drug at home, nor was it prescribed on admission. Other common DRPs were related to inappropriate adjustment of drug doses for ESRD and/or dialysis modality, specifically, patients having too much or too little of the right drug.

![Figure 1. Information transfer interfaces identified in the medication information transfer process. Comm = community; MD = admitting physician; Phm = pharmacist.](image-url)
Relationship of DRPs to Information Transfer

Of the total 199 DRPs identified, 130 (65%) were linked to a gap in medication information transfer (Table 1). A total of 41 (78.8%) of 52 admissions had at least one DRP caused by a gap in medication information transfer. For all DRPs related to those gaps (n = 130), the investigators were able to determine in 69 where the exact gap in the communication process was located. Of the DRPs related to a gap in medication information transfer, 21.5% occurred as a result of inadequate information transfer from the ambulatory dialysis clinic pharmacist to the inpatient hospital pharmacist. The second most common gap in information transfer occurred from the patient to the admitting physician (17.7%). Table 2 provides the incidence of DRPs according to the medication transfer interface as well as some examples of DRPs identified.

There were 10 cases where the reviewers encountered differences in assigning either the category of the DRPs or the medication transfer category. Through discussion, the reviewers were able to reach a consensus on the discrepancies and did not require the involvement of a third assessor.

Discussion

This study demonstrates that a majority of DRPs experienced by patients with ESRD on hospital admission are related to gaps in medication information transfer among healthcare professionals and between patients and their healthcare providers. On admission, our ESRD population experienced an average of 4 DRPs/patient; more than half of these could be linked to a gap in medication information transfer. The most common breakdowns in information transfer were between the dialysis clinic pharmacist and the hospital pharmacist and the patient and the admitting physician.

To the best of our knowledge, this is the first study that prospectively assessed DRPs on hospital admission and related these DRPs to gaps in the medication information transfer process with an attempt to also isolate where the breakdown in communication might have occurred. Previous studies evaluating DRPs experienced by patients with ESRD identified and characterized the specific types of DRPs, but did not relate these to gaps in the communication process.1,2

Our study confirms and supports previous findings that high rates of DRPs in patients with ESRD occur on hospital admission.3 The results are also consistent with those of recent studies that investigated medication discrepancies.4,5 In particular, one study performed reconciliation of discrepancies between medication histories and admission orders of newly hospitalized patients.4 The investigation quantified and characterized the endpoint of medication discrepancies, whereas we identified and characterized DRPs on admission. Our study included discrepancies between admission medication history and admission orders, but went beyond that process to identify other categories of DRPs, the relationship of the DRP to information transfer and to potential information transfer interfaces. Our major findings were also consistent with those of Cornish et al.4 and Gleason et al.5 wherein the top discrepancy and DRP category were similar (omission of medications or patient required a drug but was not receiving it). Both of the previous studies revealed that more than half of the patients on admission had at least one discrepancy or DRP.

Our study builds on the work of other researchers and adds to the literature by providing a link between DRPs on hospital admission and the role of medication information transfer as a cause of these DRPs. The results provide some insight into how and where pharmacists can reduce gaps in medication information transfer and subsequently improve patient safety. It helps clinicians begin to understand the possible factors that contribute to DRPs on hospital admission and therefore provide focus for targeted tools or strategies that need to be put into place to address these causes.

How could we prevent DRPs that are related to gaps in medication information transfer? First, for a population such as patients with ESRD, we need an integrated information system, such as a centralized medication database, that allows sharing of drug information between healthcare settings. It is proposed that the information should also be easily transmittable to provide patients’ medication information (electronic file or fax) to institutions that cannot access the central database system.

Second, patients need to be provided with tools to build their knowledge about their medications and help them communicate their current drug therapy to their healthcare providers. This is illustrated by the high rates of drug nonadherence that were seen among our ESRD population (102 (51.3%)). Our study and others have shown that medication errors are often due to patients’ lack of knowledge about their medications and their instructions. This is consistent with the results of this study, where 17 of 21 patients (81%) whose DRPs were related to drug nonadherence were able to recall at least part of the medication instructions on admission. Thus, it is important to ensure that patients are provided with clear and concise information about their medications to help prevent medication errors. This is reflected in the high rates of drug nonadherence reported in this study (102 (51.3%)).

Table 1. Characterization of Drug-Related Problems on Hospital Admission

<table>
<thead>
<tr>
<th>Drug-Related Problem Category</th>
<th>Frequency of DRPs on Admission, n (%)</th>
<th>DRPs on Admission Related to Gaps in Information Transfer, n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug use without indication</td>
<td>11 (5.5)</td>
<td>5</td>
</tr>
<tr>
<td>Improper drug selection</td>
<td>2 (1.0)</td>
<td>1</td>
</tr>
<tr>
<td>Overdosage</td>
<td>27 (13.6)</td>
<td>16</td>
</tr>
<tr>
<td>Subtherapeutic dosage</td>
<td>27 (13.6)</td>
<td>17</td>
</tr>
<tr>
<td>Drug interaction</td>
<td>1 (0.5)</td>
<td>0</td>
</tr>
<tr>
<td>Adverse drug reaction</td>
<td>13 (6.5)</td>
<td>7</td>
</tr>
<tr>
<td>Indication for drug therapy</td>
<td>102 (51.3)</td>
<td>69</td>
</tr>
<tr>
<td>Failure to receive drug (ie,</td>
<td>16 (8.0)</td>
<td>15</td>
</tr>
<tr>
<td>pt. nonadherence, gap in pt.’s knowledge)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>199 (100)</td>
<td>130</td>
</tr>
</tbody>
</table>

DRPs = drug-related problems.
providers who do not have access to a central database. As illustrated in this study, the information transfer gap identified between physicians and patients is also a major factor contributing to DRPs on admission. In the absence of a system that makes medication information readily available to the admitting hospital physician, the patient and/or the family is usually the primary source of information about the patient’s drugs. Patients need to be empowered to play an active role in updating medication lists or keeping emergency contact information readily available for healthcare providers to access. As recommended by the 100,000 Lives campaign, patients are key players in the success of this process.6

Currently, there is a major initiative to incorporate medication reconciliation at the time of admission and discharge, as such interventions have been shown to reduce medication errors and potentially prevent adverse drug events.6,10,11 However, as conceptualized in this study, medication reconciliation may only be the first step in addressing this complex issue. Some examples of DRPs experienced by our study population were unrelated to medication discrepancies and thus may be undetected through medication reconciliation alone. Even if drug lists are available on admission, healthcare providers may still not have the complete medication information required about previous treatments, pertinent laboratory results, recent dosage changes, or patient-specific goals of therapy to provide comprehensive drug therapy.12 Patients may be continued on therapies with no valid indication or be started on therapy on hospital admission that was unsuccessful or not tolerated in the past.12,13 To provide comprehensive drug treatment, complete medication information is needed by the healthcare provider.

The appropriate transfer of medication information needs to move beyond medication discrepancies and the reconciliation process. Up-to-date lists of drugs at transfer

<table>
<thead>
<tr>
<th>Information Transfer Interface</th>
<th>DRPs (n)</th>
<th>Examples of DRPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital pharmacist and community pharmacist</td>
<td>1</td>
<td>Patient was admitted to hospital on warfarin for past history of cardioembolic stroke; however, the dose was unknown. The community pharmacist was unable to provide the dose since the directions were noted on the computer profile as “take as directed.”</td>
</tr>
<tr>
<td>Hospital pharmacist and clinic pharmacist</td>
<td>28</td>
<td>Patient has valid indication for ACE inhibitor therapy; however, this medication was not started as an outpatient. There was no reason or rationale for the omission available from the clinic. The patient later reported that the drug was held due to high potassium levels but never restarted. Patient experiences high phosphate levels; however, there were no phosphate binders ordered on admission. The clinic medication record indicates phosphate binders were put on hold, but no rationale was given.</td>
</tr>
<tr>
<td>Community pharmacist and clinic pharmacist</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Community pharmacist and patient</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Hospital pharmacist and patient</td>
<td>4</td>
<td>Patient is on cyclical therapy of bisphosphonates. The drug was restarted on hospital admission on the wrong day, as the patient failed to report the proper schedule to the hospital pharmacist.</td>
</tr>
<tr>
<td>Clinic pharmacist and patient</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Admitting physician and hospital pharmacist</td>
<td>2</td>
<td>Patient has a history of diabetes with increased lipid levels found on admission. The admitting physician discontinued atorvastatin for an unknown reason. Laboratory values show normal LFT results and CK, and the patient does not complain of muscle pains. The hospital pharmacist needed to clarify why this drug was discontinued.</td>
</tr>
<tr>
<td>Admitting physician and clinic</td>
<td>8</td>
<td>Patient has a history of CAD and MI and is not on ACE inhibitor therapy on admission. The physician ordered an ACE inhibitor, not realizing the patient had received it in the past but had developed an intolerable cough and therefore discontinued it.</td>
</tr>
<tr>
<td>Admitting physician and patient</td>
<td>23</td>
<td>Patient was on a drug prior to admission for a valid indication, but it was not reordered by the admitting physician because the patient failed to report its use.</td>
</tr>
<tr>
<td>Admitting physician and community pharmacist</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Institution and institution</td>
<td>3</td>
<td>Patient was transferred from another hospital and was on an antibiotic. Cultures and sensitivities were not available from the other institution. Also, the start date of the antibiotic was not provided to determine the length of therapy.</td>
</tr>
<tr>
<td>Unable to identify exact interface</td>
<td>61</td>
<td>Patient was continued on long- and short-acting morphine on admission as taken prior to admission even though the patient was experiencing increased confusion due to a high daily dose. In family interview, it was determined that the patient received different morphine formulations from 2 prescribers who were unaware that the patient was already on morphine.</td>
</tr>
</tbody>
</table>

ACE = angiotensin-converting enzyme; CAD = coronary artery disease; CK = creatine kinase; DRPs = drug-related problems; LFT = liver function test; MI = myocardial infarction.
points need to be accompanied by complete care plans and follow-up issues. Without the latter components, DRPs may still arise. Focus of future research will need to be aimed at not only developing tools for reconciling medication lists, but also developing strategies to transfer complete drug information to the next practitioner receiving responsibility for the patient’s care.

**Limitations**

In this study, only 53% of the DRPs related to gaps in medication information transfer could be narrowed down to a single interface in the information transfer process. Prospective analysis of these patients and validation by a second pharmacist revealed that it can be challenging to define the precise interfaces. It was found that many DRPs could have arisen from a combination of several communication gaps. In addition, our study characterized DRPs and their relationship to information transfer from the perspective of the institutional inpatient pharmacist on hospital admission. DRPs and relationship to information transfer would likely be very different from a community pharmacist perspective. Furthermore, our study did not explicitly evaluate other healthcare providers, such as family physicians and nurses, and was not designed to determine patient outcomes, such as prolonged hospitalization or patient harm resulting from the DRPs observed on admission.

Further research could include other healthcare providers, refine the process for identifying locations of breakdowns in communication gaps across the entire system, and evaluate resultant patient outcomes. Although our evaluation focused on the ESRD population, our findings may be applied to other patient populations with numerous co-morbidities, high medication use, and those who frequently move between hospitals and ambulatory care clinics.

**Conclusions**

Patients with ESRD are at high risk for DRPs at the time surrounding hospital admission. The majority of these DRPs are related to gaps in appropriate transfer of medication information among healthcare professionals and also between healthcare providers and the patient. Tools and a system targeted at promoting appropriate, efficient, and accurate transfer of medication information might serve to minimize and prevent DRPs on admission in high-risk patient populations.

**References**


**Extracto**

Los pacientes con enfermedad renal terminal (ERT) tienen riesgo de padecer problemas relacionados con medicamentos (PRM), especialmente en el momento del ingreso en el hospital.

**Objetivo**: Los objetivos de este estudio fueron identificar y caracterizar los PRM en pacientes con ERT en el momento del ingreso hospitalario e investigar cómo estos PRM se pueden relacionar con fallos en la transferencia de información sobre los medicamentos.

**Métodos**: Se identificaron de manera prospectiva los pacientes con ERT admitidos en el hospital, y un farmacéutico los evaluó clínicamente para identificar y clasificar los PRM en el momento del ingreso. Se analizó cada PRM para determinar si pudo ser causado por un fallo en la transferencia de información sobre medicamentos. Para los PRM...
causados por fallos en la transferencia de información sobre medicamentos, se determinó la interfase en el proceso de transferencia de información donde pudo ocurrir el fallo.

RESULTADOS: Se identificaron un total de 199 PRM en 47 pacientes con ERT en un período de 12 semanas. El 92% de los pacientes tenía por lo menos un PRM en el momento del ingreso, con un promedio de 4.2 ± 2.2 PRM por paciente. El PRM más común fue indicación para farmacoterapia—el paciente requiere un fármaco y no lo está recibiendo (51.3%). Del total de PRM, 130 (65%) estaban relacionados a fallos en la transferencia de información sobre medicamentos; un 21.5% de los cuales ocurrió entre los farmacéuticos del área de pacientes encamados y los de las clínicas ambulatorias y el 17.7% entre el médico que ingresa y el paciente.

CONCLUSIONES: Los resultados demuestran que, en pacientes con ERT, los PRM en el momento del ingreso están frecuentemente relacionados con fallos en la transferencia de información sobre medicamentos entre los profesionales de la salud y también entre los profesionales de salud y los pacientes. Se requiere mejorar la comunicación en las interfases de transferencia de información sobre medicamentos para prevenir estos PRM.

Giselle Rivera-Miranda

RÉSUMÉ

OBJECTIF: Les patients souffrant d’insuffisance rénale terminale sont à risque de développer des problèmes reliés aux médicaments (PRP). L’objectif de cette étude était d’identifier et de caractériser les PRP chez une population de patients insuffisants rénaux et de déterminer la relation possible entre le développement des PRP et un manque dans la continuité des soins lors du transfert d’informations médicamenteuses à l’admission des patients à l’hôpital.

MÉTHODOLOGIE: Tous les patients insuffisants rénaux admis consécutivement à un établissement hospitalier universitaire sur une période de 12 semaines étaient identifiés de façon prospective. Afin de déterminer l’existence de PRP, un pharmacien clinicien procédait à une évaluation complète de chaque dossier médical et à un entretien avec le patient, les membres de sa famille, et les différents professionnels de la santé garants des soins médicaux et pharmaceutiques. Dans l’éventualité où un ou plusieurs PRP étaient identifiés, une évaluation plus approfondie était faite afin de déterminer la relation possible entre la présence des PRP et le manque de continuité des soins entre les milieux ambulatoire et hospitalier.

RÉSULTATS: Un total de 199 PRP ont été identifiés chez les 47 patients insuffisants rénaux de l’étude. Près de 92% des patients avaient au moins un PRP à l’admission avec une moyenne de 4,2 ± 2,2 PRP par patient. Le PRP le plus fréquemment rencontré (51.3%) était indication pour la thérapie—le patient requiert un médicament mais ne le reçoit pas. Des 199 PRP identifiés, 130 (65%) étaient dus à un manque de transfert d’informations médicamenteuses, les 2 causes principales étant dues soit à un manque de communications entre le pharmacien communautaire et le pharmacien d’hôpital (21.5%) ou soit entre le patient et le médecin responsable de l’admission (17.7%).

CONCLUSIONS: Les résultats de cette étude démontrent bien l’importance d’une communication efficace entre le patient et les différents professionnels de la santé ainsi qu’entre les professionnels eux-mêmes. L’impact d’une telle communication permettrait l’optimisation de la continuité des soins et la minimisation du nombre de PRP.

Sylvie Robert