COMPARISON OF INFORMATION AVAILABLE IN THE MEDICATION PROFILE OF AN ELECTRONIC HEALTH RECORD AND THE INPATIENT BEST POSSIBLE MEDICATION HISTORY IN A MOTHER AND CHILD TEACHING HOSPITAL CENTER

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ABSTRACT

Background
Medication reconciliation (MedRec) can improve patient safety. In Canada, most provinces are implementing electronic health records (EHR). The Quebec Health Record (QHR) can theoretically be used for medication reconciliation. However, the quantity and the quality of information available in this EHR have not been studied.

Objectives
The main objective was to compare the quantity and quality of the information collected between the inpatient best possible medication history (BPMH) and the QHR.

Methods
This is a descriptive prospective study conducted at CHU Sainte-Justine, a 500-bed tertiary mother-and-child university hospital center. All inpatients from May 19-26, 2015 were considered for inclusion. Every prescription line in the BPMH and QHR were compared.

Results
The study included 344 patients and 1,039 prescription lines were analyzed. The medications' name and dosing were more often available in the QHR (95%) than in the BPMH (61%). Concordance between the medication names between QHR and BPMH was found in 48% of the prescription lines; this rate fell to 29% when also factoring daily dosage.

Conclusions
This study suggests that the QHR can provide high-quality information to support the MedRec hospital process. However, it should be used as a second source to optimize the BPMH obtained from a thorough interview with the patient and/or his or her family. More studies are required to confirm the most optimal way to integrate the QHR to the MedRec process in hospitals.

Key Words: *Medication reconciliation; medication history; electronic health records; child*

Since 2006, Accreditation Canada has identified medication reconciliation (MedRec) as a required organizational practice (ROP). Healthcare facilities have gradually implemented this ROP over the last decade and, beginning in 2018, all services and care transition points (patient's admission, transfer and discharge) will be required to have implemented MedRec.[1]

Canadian health facilities have prioritized MedRec and allocated extensive resources to ensure its success, but with varying results[2-4] that remains for the most part unpublished. At the

Sainte-Justine University Hospital Center (Centre Hospitalier Universitaire Sainte-Justine -CHUSJ), a structured MedRec program has been in place since 2008 and a number of quality improvement projects have been conducted.[5-8] Thus, in this hospital, nursing staff members are responsible for drawing up a list of all medications taken by a patient (known as a best possible medication history - BPMH) upon admission. Pharmacy students and pharmacists may also contribute to the data collection for the BPMH; but, they may not assume full responsibility for this part of the process as they are not seeing all inpatients. Pharmacy technicians are not involved. Therefore, the BPMH is faxed to the central pharmacy and a pharmacist does reconcile the information with current admission drug orders. As defined by the Institute for Safe Medication Practices Canada (ISMP Canada)[9], a MedRec is " is a formal process in which healthcare providers work together with patients, families and care providers to ensure accurate and comprehensive medication information is communicated consistently across transitions of care. Medication reconciliation requires a systematic and comprehensive review of all the medications a patient is taking (known as a BPMH) to ensure that medications being added, changed or discontinued are carefully evaluated. It is a component of medication management and will inform and enable prescribers to make the most appropriate prescribing decisions for the patient".

MedRec is widely recognized as improving patient safety not only in adults[10-20], but also in children.[21,22] In fact, although children receive relatively few medications, the risk of serious outcomes from medication errors is higher in this population.[23,24] While most hospitals rely on pharmacy technicians and pharmacists for that process in North America, others consider possible the contribution of nurses, especially in non-medicated population such as pediatrics.[25-28]

The quality of information collected in the BPMH is crucial for the whole MedRec process. The completeness of the patient's best medication history depends not only on various factors related to the patient or his family (time available for the interview, language barrier, severity of the patient's disease, cognitive status and knowledge of drugs' name and regimen) but also on factors related to hospital structure, such as the lack of time, human resources, or training to collect the patient's medication history.[29-30] To improve the BPMH, regulatory agencies such as ISMP Canada[9], Accreditation Canada[1] and the World Health Organization in its project High 5S protocol[31] recommend the use of a second source of information to complement the interview with the patient or his family. However, in a pediatric care setting, there are a number of specific obstacles to preparing a BPMH. Medications are frequently taken in a liquid form with many different concentrations that complicate the documentation process with parents often reporting a volume dose (mL) rather than a dosage (mg). Moreover, few parents bring their children's drugs or community pharmacy medication profile to the hospital, thereby making it difficult to use a second source of information to complete a BPMH.[7]

The Quebec Health Record (QHR) is an electronic health record (EHR) established by the government of Quebec to improve quality of care and the healthcare system's efficiency. It collects health information and stores it in a secure database while allowing authorized healthcare professionals to consult it.[32] At this moment, all people registered in Quebec's health insurance plan (Régie de l'Assurance Maladie du Québec - RAMQ) participate in the QHR, unless they have expressly refused to do so. RAMQ includes almost all of Quebec inhabitants, with some exceptions (travelers, military personnel and new immigrants to the country). Information collected currently includes prescribed medications dispensed in community pharmacies connected to the QHR, results of biological analyses and medical imaging. The medication data contained in the QHR comes from the community pharmacists. This QHR medication profile includes the prescribed medication brand name, generic name, form, dose, frequency and duration, the date of the prescription, the last date of dispensation, the quantity dispensed, the names and phone numbers of the community pharmacy and the prescribing doctor and the remaining renewals of the prescription. The following information is excluded: non-prescribed

medication, medication prescribed in healthcare facilities during admissions, vaccinations received and medication used in clinical trials. As of May 15, 2015, 82% of the province's pharmacies (1,524/1,865) share data with the QHR[29,33] and less than 1% of patients have refused to have their data accessed. To gain access rights to the QHR, every authorized professional must submit a request to the RAMQ. After verification, the professional receives access rights according to its professional status and a security access device (USB key). To access the QHR, one must use this security device and a password. Authorized professionals with full or partial QHR access are, at this time, physicians, pharmacists, and medical and pharmacy residents and interns as well as their technical support staff.[32]

Given the QHR's recent large-scale deployment, we evaluated the added value of its potential systematic use as a complementary information source to the BPMH process.

METHODS

Objectives

This was a descriptive and prospective study. The main objective was to compare the quantity and quality of the information collected between the BPMH available in inpatient records and their medication profile in the QHR.

Study Population

The study was conducted at the CHUSJ, a 500-bed tertiary mother-and-child university hospital center. The study focused on the patients admitted to the hospital's pediatrics, obstetrics and surgery units, whether they were children or adults (9 pediatric units and 5 adult units). Patients from the emergency, hemato-oncology, intensive care and neonatology units as well as outpatient clinics and day centers were excluded.

A convenience sample was created with all patients hospitalized from May 19 to 26, 2015, on the predetermined units.

Data Extraction

We identified eligible patients daily using the hospital's electronic medication record (GespharRx®, CGSI TI, Quebec City, QC, Canada). Within 24 hours of identifying a study subject, we extracted his or her medication profile from the QHR. After the patient's discharge, we consulted the most recent version of the BPMH in the patient's digital record (Chartmaxx®, Mediplus - Montréal, QC, Canada).

We collected all data on the active medications recorded on the BPMH and QHR in a spreadsheet (MS Excel, Seattle, WA, USA). The term "medication" includes all prescription and over-the-counter drugs, natural health products and baby formulas. Medical supplies and devices (e.g., glycemia strips) were excluded.

At our hospital center, professionals are asked to enumerate on the BPMH any regular or as needed medication taken up to 14 days prior to admission. In the case of the QHR, a medication taken regularly was deemed "active" if it's dispensing period (dispensing date + duration of supply) fell within 14 days before the admission; whereas, any medication taken on an as needed basis was deemed "active", irrespective of its dispensing date.

Data Analysis

Every prescription line in the BPMH and QHR was then analyzed in terms of completeness (presence of the medication's name and dosage [dose + frequency]), type of medication (including natural health and baby formula products), and interval of use (regular medication or as needed).

Concordance between the medications' list in the BPMH and QHR was then verified by counting the number of prescription lines in the BPMH and QHR that matched correctly (identical medication's name ± daily dosage) for each patient. For instance, a brand name in a BPMH and a generic name in another QHR were considered concordant if it was the same chemical entity. However, the mention of a therapeutic class (e.g. insulin) in BPMH was considered insufficient to match a prescription line in BPMH for a specific insulin (e.g. insulin glargine). At the same time, BPMH quality was also assessed in terms of the number of sources consulted to fill it, the use of the QHR as a consulted source, the presence of the signature of the nurse and/or pharmacist who filled out the form and the signature of the physician to confirm that the

BPMH had been consulted on admission and when transferring the patient.

A comparison of the quantity and quality of the information present in the QHR and BPMH for all populations studied was performed using a Chi2 for proportions and Student T Test for averages. A p value inferior to 0.05 was considered to be statistically significant.

RESULTS

The study included 344 patients, 58% of which were children. Details on the population characteristics are shown in Table 1. Almost all subjects (99%) had an active QHR profile and 94% of them had a BPMH form in their hospital record. Most adults (82%) and children (72%) had at least one active medication in the QHR and/or BPMH during the targeted period.

We collected and analyzed 1,039 prescription lines for the study population. Most of the data (57%) came from the BPMH forms. Only 11% of the BPMHs (37/325) indicated that more than one source was used to complete the form. Table 2 presents more information on the BPMH forms' content and quality.

Concordance between the names of medications mentioned in the QHR and BPMH was only found in 48% of the prescription lines (500/1,039). This rate fell to 29% (306/1,039) when also factoring for daily dosage. In total, 65% of the QHR prescription lines (290/443) were not accurately reported in the BPMH, whereas 75% of the BPMH lines (445/596) were absent from the QHR. When analyzing discrepancies, 29% of the QHR lines that did not match (85/290) referred to as needed medications and 20% of the BPMH unmatched lines (89/443) referred to natural health products.

TABLE 1 Study population's characteristics

	Pediatrics	**Obstetrics/gynecology**
Patients, n (%)	198 (58%)	146 (42%)
Sex, n (%)		
Males	114 (58%)	NA
Females	84 (42%)	146 (100%)
Median age, n years [range]	4 [0;20]	32 [19;54]
Care units, n (%)		
Pediatrics	113 (57%)	NA
Surgery	85 (43%)	0 (0%)
Obstetrics	0 (0%)	146 (100%)

Legend: NA: not applicable

TABLE 2 Profile of BPMH content on patients' admission

Variables	n (%)
Number of patients	344 (100%)
Number of hospital records with at least one BPMH	325 (94%)
Number of consulted sources to fill out the BPMH	
- One	210 (65%)
- Two	33 (10%)
- Three	4 (1%)
- Not reported	78 (24%)
Use of QHR as a consulted source	24 (7%)
BPMH filled out by	
- Nurse only	273 (84%)
- Pharmacist only	6 (2%)
- Nurse and pharmacist	29 (9%)
- Not reported	17 (5%)
BPMH faxed to Pharmacy Department to be archived in the hospital's electronic medication record	270 (78%)
Presence of signature	
- Nurse/pharmacist who filled out the form	308 (90%)
- Physician to confirm the consultation of BPMH on admission	27 (8%)
- Physician to confirm the consultation of BPMH when transferring the patient	1 (0.3%)

Legend: BPMH: Best Possible Medication History; QHR: Quebec Health Record

When compared to the BPMH, data contained in the QHR were more complete: the name of the medications and their dosage were clearly indicated in 95% of the lines in the QHR (421/443), whereas only 61% of the lines in the BPMH (365/598) were fully completed. This trend was observed in both adult and pediatric populations. However, fewer medications were reported in the QHR than in the BPMH, with averages of 1.30 vs. 1.84 medications per patient, respectively. Finally, Table 3 presents a comparison of the quantity and quality of the information available in the QHR and BPMH in the pediatric and adult populations. We found some differences between the data collected for these two populations. We report that, for pregnant women, as needed drugs were much more commonly reported in the QHR when compared to the BPMH, whereas such a situation was not observed in children. The absolute rate of use of natural health products was higher in the adult population.

TABLE 3 Comparison of the quantity and quality of the information present in the QHR and BPMH in the pediatric and obstetrics/gynecology population

	Pediatric population n (%)		**Obstetrics/gynecology n (%)**		**All populations n (%)**	
Medication list	**QHR**	**BPMH**	**QHR**	**BPMH**	**QHR**	**BPMH**
Patients with medication list, n (%)	196 (99%)	189 (95%)	143 (98%)	136 (93%)	339 (99%)	325 (94%) [a]
Refusal, n (%)	NA	NA	1 (0.7%)	0 (0%)	1 (0.3%)	0 (0%) [b]
Prescription lines						
Total number, n (%)	251 (100%)	350 (100%)	192 (100%)	246 (100%)	443 (100%)	596 (100%) [c]
Complete lines, n (%)	233 (93%)	206 (59%)	188 (98%)	159 (65%)	421 (95%)	365 (61%) [d]
Matched lines, n (%)	92 (37%)	92 (26%)	61 (32%)	61 (25%)	153 (34%)	153 (26%) [e]
Average number of prescription lines per patient	1.28	1.85	1.34	1.81	1.31 ± 2,00	1.79 ± 2,38[f]
As needed medications lines, n (%)	36 (14%)	51 (15%)	55 (29%)	15 (6%)	91 (20%)	66 (11%) [g]
Natural health products lines, n (%)	8 (3%)	35 (10%)	11 (6%)	69 (28%)	19 (4%)	104 (17%) [h]
Infant formulas lines, n (%)	12 (5%)	1 (0.3%)	0 (0%)	0 (0%)	12 (3%)	1 (0.2%) [i]
Top five most reported medications	Salbutamol Vitamin D Amoxicillin/ clavulanic acid Lansoprazole Methylphenidate	Acetaminophen Vitamin D Salbutamol Ibuprofen Lansoprazole	Ranitidine Levothyroxine Doxylamine/ vitamin B6 Multivitamins Iron	Multivitamins Iron Ranitidine Levothyroxine Folic Acid	NA	NA

Legend: BPMH: Best Possible Medication History; NA: not applicable; QHR: Quebec Health Record
Statistical analyses – Chi2 for differences of proportion; Student T test for differences for averages - [a] p = 0,058, [b] NS, [c] NS, [d] p < 0,0001, [e] p = 0,002, [f] p = 0,0017, [g] p = 0,02, [h] p < 0,001, [i] p < 0,0001.

DISCUSSION

This study compared the quantity and quality of information collected between the BPMH available in the patient's record and their QHR medication profile. To the best of our knowledge, this is the first study analyzing the QHR for this purpose. However, similar studies using different EHRs have been conducted in other Canadian provinces.[24,34,35]

We found that the QHR is a source of high-quality information. The drugs' dosing in the QHR was more often complete than those available in the BPMH. However, in our study, only 29% of the prescriptions found in the QHR and BPMH could be matched on the basis of the medication's name and dosage. Such low rates of concordance have been reported in similar studies, with concordance rates ranging from 16% to 49%.[34-38] A significant part of this lack of concordance between the QHR and BPMH was related to the poor dosage information collected in the BPMH. Also, several as needed medications recorded in the QHR and therefore deemed "active" were not necessarily used by the patient in the weeks leading up to admission. This low rate of concordance between the two sources of data related to the patient's medication record shows the importance of using more than one source of information in the MedRec process.

However, it should be noted that almost all of the study subjects (in both pediatric and adult populations) had an active QHR medication profile. In addition, the large scale deployment of the QHR allows for easy access to this information, as many of our facility's healthcare professionals have been granted QHR access. The QHR therefore appears to be a useful second source of information when preparing a patient's BPMH on admission, in addition to the interview with the patient or his parents.

The QHR alone cannot be the only source of information used to obtain an exhaustive BPMH at the time of a patient's arrival to hospital. Tulloch et al. underlined the fact that EHRs underestimate the number of medications actually taken by a patient.[36] Our study also identified that the QHR listed 30% less medications than the BPMH. This underestimation can be attributed to a number of factors. The QHR only displays the dispensed prescribed medications. The information not displayed in the QHR includes most over-the-counter medications and natural health products dispensed without a prescription and even prescription drugs recorded in the patient's community pharmacy file but not yet dispensed to the patient. A number of studies conducted in North America and Europe have mentioned the lack of accuracy of the information available in this type of prescription databases[24,34-37,39,40], especially when the medications are taken intermittently or not prescribed on a regular basis.[40] Since they rely on dispensing data, those databases do not take into account any recent treatment modifications, whether they are at the patient's or physician's initiative, such as a dosage reduction or the discontinuation of a medication after an adverse event. A number of these modifications can be made verbally between a healthcare professional and the patient without the changes being recorded in the QHR. Glintborg et al. suggested a better predictive value for the use of EHRs when only accounting for the medications that were dispensed in the week before admission to hospital.[40] Nevertheless, this study showed that fewer than 50% of the medications taken by patients were dispensed in the month before admission.

In our study, the QHR and BPMH medications that most often matched were related to chronic treatments where the medications were taken every day (e.g. levothyroxine). On the other hand, QHR and BPMH medications with the fewest match rates were medications taken when necessary (e.g. salbutamol), non-prescription medications (e.g. acetaminophen) and natural health products (e.g. multivitamins, vitamin D). These findings are similar to those reported in the literature. Warholak et al. and Grimes et al., respectively observed that 50% and 33% of the medications that went unrecorded in prescription databases were over-the-counter medications.[37,39] In addition, according to Glintborg et al., the medications that patients reported most often were those they were taking on a chronic basis.[40]

Studies focusing on prescription database's use in a pediatric population are

scarce.[29] Even though we found some significant differences between the quality and quantity of information on the QHR and BPMH, further studies will be required to assess the strength of these associations.

Our study results demonstrate that obtaining an accurate medical history of a patient is a difficult task. Accreditation Canada's Medication Management Standards require the use of at least two sources of information within the MedRec framework.[1] Given its widespread availability and our wish for better coordination with community pharmacists, it appears essential that the QHR be used as a second source of information in our hospital setting. However, systematic use of this second source of information should be done in an optimal way. Based on this study and a management consensus, we selected a scenario whereby a hospital admissions clerk extracts the medication list from the QHR upon each elective or emergency admission. Using non-professionals in such scenario creates administrative hurdles, as QHR access is mostly limited to healthcare professionals belonging to a professional order. Meeting these challenges is possible with a management team aware of what is at stake in terms of the security of information assets, including confidentiality. In addition to this systematic extraction on admission, all our Pharmacy Department pharmacists have now been trained and granted access to the QHR, to complement the basic process.

Other issues could arise from the systematic printing of electronic medication profiles. Some clinicians may simply append the QHR print to the BPMH. Others may only recopy EHR information without a proper patient interview. Accreditation Canada's ROP with regard to MedRec emphasizes that it is a strategic priority for which the organization must demonstrate that it "has a strategy to combine its forces with those of the users in order to collect accurate and complete information on the users' medications and use this information at care transition points".[1] Proper personnel training will be crucial to achieve such a strategy.

Our study is the first study to compare QHRs and BPMHs. It will be useful for initiatives and efforts at other Canadian healthcare facilities. However, this study has limitations. The quality of BPMH collected by nurses or other healthcare professionals was compared to QHR data but it was not evaluated by another independent person considering the retrospective design of the study. Therefore, the quality of BPMH is unknown but does reflect the current practice. In the literature, discrepancies between admission and discharge orders are often associated with incomplete BMPH rather than reconciliation errors.[17,25] As per our retrospective design, we did not conduct an interview with patients/parents. Therefore, it is not possible to assess whether the absence of a medication profile in the QHR is associated to the absence of active drug orders or to the fact the pharmacy was not yet connected to the QHR at that time. Also, we did not evaluate the compliance and the adherence of patients.

In our study, most BPMH were filled out by nurses as reported by others.[41,42] In the literature, most BPMH are collected by pharmacy technicians and pharmacists.[43-49] While pharmacy technicians and pharmacists are certainly the most trained professionals to collect BMPH, it may be more cost-effective to let the nurses do so. However, the MedRec process itself should be managed by pharmacists in any case. Our study was not designed to compare the quality of BMPH collected by nurses or other professionals. Moreover, our study was not designed to compare the time taken by nurses or other professionals to collect the BPMH. Such activity may be time consuming. However, we believe the use of QHR might contribute to reduce the time needed to complete a BPMH.

In our study, some patient groups were excluded (e.g. patients admitted to the intensive care units or only to the emergency). Consequently, our results may represent only a subset of the intended populations.

Finally, we did not evaluate the gravity associated with discrepancies. Up to 20% of unintentional discrepancies can cause patients' harm.[50-51]

CONCLUSION

This study suggests that the QHR can provide high-quality information to support the MedRec hospital process. However, it should be used as a second source to optimize the BPMH obtained from a thorough interview with the patient and/or his family. More studies are required to confirm the most optimal way to integrate the QHR to the Med Rec process in hospitals.

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