



HAL
open science

Implementing a person-centered medication review process at hospital: Recommendations based on a scoping review of barriers and facilitators

Clément Wawrzyniak, Romaric Marcilly, Laura Douze, Sylvia Pelayo

► To cite this version:

Clément Wawrzyniak, Romaric Marcilly, Laura Douze, Sylvia Pelayo. Implementing a person-centered medication review process at hospital: Recommendations based on a scoping review of barriers and facilitators. *European Journal for Person Centered Healthcare*, 2020, 7 (4), pp.547-575. hal-04092945

HAL Id: hal-04092945

<https://hal.science/hal-04092945>

Submitted on 9 May 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

ARTICLE

Implementing a person-centered medication review process at hospital: Recommendations based on a scoping review of barriers and facilitators

Clément Wawrzyniak PhD^a, Romaric Marcilly PhD^b, Laura Douze^c & Sylvia Pelayo PhD^d

a Human Factor & UX Consultant, University of Lille, CHU Lille, Inserm, CIC 1403 / Evalab, ULR 2694 - METRICS: Évaluation des technologies de santé et des pratiques médicales, F-59000 Lille, France

b Researcher, Human Factors & Medical Informatics University of Lille, CHU Lille, Inserm, CIC 1403 / Evalab, ULR 2694 – METRICS: Évaluation des technologies de santé et des pratiques médicales, F-59000 Lille, France

c Human Factor Specialist, University of Lille, CHU Lille, Inserm, CIC 1403 / Evalab, ULR 2694 - METRICS: Évaluation des technologies de santé et des pratiques médicales, F-59000 Lille, France

d Associate Professor ; Deputy Director CIC-IT & Managing Director EVALAB, University of Lille, CHU Lille, Inserm, CIC 1403 / Evalab, ULR 2694 - METRICS: Évaluation des technologies de santé et des pratiques médicales, F-59000 Lille, France

Abstract

Aim: To provide a person-centered set of recommendations that will help (i) healthcare professionals to implement the medication review process at hospital and (ii) tactical stakeholders to promote medication reviews as standard practice in clinical pharmacy.

Background: Although the medication review process is highly relevant for the safety of individual patients and for economic purposes, it appears to be complex to implement and then maintain over time in hospital settings. The stakeholders who implement the medication review process may feel disempowered and often request guidance on how to overcome these problems.

Method: We first drew up the most comprehensive possible list of barriers and facilitators (i.e., factors that respectively hinder or help the medication review process at hospitals) by searching the PubMed, Web of Science, and Science Direct databases for case studies describing the implementation of medication reconciliation and medication review processes in hospital settings. Text extracts mentioning facilitators and barriers were divided into thematic units, analysed and classified hierarchically. Based on this list of influencing factors, we developed a series of person-centered recommendations.

Results: The analysis of 38 publications led to the identification of 617 factors (346 facilitators and 271 barriers) divided into 9 categories and 67 subcategories. Next, we developed a set of 71 specific recommendations for operational stakeholders on designing, implementing and performing the MRev process at hospital. The recommendations are divided into 6 main categories: *Designing the process, Participants, Training, Tools, Information and Organization*. We also elaborated a set of 20 key recommendations for local and national decision-makers on sustaining the implementation of the MRev process at hospital.

Conclusion: We identified a large number of factors that may impact the implementation of the MRev process at hospital and which therefore have the potential to impact upon person-centeredness. Based on this list, we provide a set of recommendations for operational and tactical stakeholders on supporting the local implementation and nationwide expansion of the MRev process.

Keywords

Barriers, clinical pharmacy, facilitators, human factors, medication reconciliation, medication review, patient care transitions, patient safety, person-centered healthcare, recommendations, scoping review, work system

Correspondence address

Dr. Clément Wawrzyniak, CICIT de Lille à l'Institut Cœur Poumon, 3^{ème} étage aile est, Boulevard du Pr. Jules Leclercq, CS70001, F-59037 Lille, France. E-mail: cwawrzyniak@skillsconsulting.fr

Accepted for publication: 23 September 2019

Introduction

The safety of patients admitted to health facilities is the very first consideration of person-centered care. Yet it is

broadly acknowledged that patient care transitions can trigger drug-related adverse events [1-9]. Accordingly, a number of tools have been developed with a view to significantly reducing the frequency of adverse drug reactions. These tools include medication reconciliation

(MRec) and medication review (MRev) [10]. Medication reconciliation has been defined as “a formal process that takes into account all the drugs taken and to be taken by a patient when there is a new prescription. It involves the patient and is based on information-sharing and multidisciplinary coordination between healthcare professionals. It prevents or corrects medication errors by promoting the transmission of comprehensive, accurate information on the patient’s medications between healthcare professionals at care transition points (including admission, discharge and transfers)” [11]. The MRec process has been widely deployed in North America [12-14] and in Anglo-Saxon countries [15,16] and is being actively employed across Europe [8,11,17-22]. MRev has been defined as “a structured, critical examination of a patient’s medicines; the objective is to reach agreement with the patient regarding treatment to optimize the impact of medicines, minimize the number of medication-related problems and reduce waste” [23]. MRev requires a prior, reliable, full MRec [2,3,20,23-26]. We consider that MRec is part of the MRev process and so shall use the term “MRev” in this paper conveniently to refer to both processes.

Many studies have evidenced the positive impacts (notably in clinical and economic terms) of MRev in hospital settings [6,15,27,28]. However, MRev is often considered to be difficult to deploy in care units and then difficult to maintain under conditions that are acceptable for healthcare professionals and patients themselves and which provide lasting, significant results [11,16,20,21,29]. Furthermore, a number of studies have highlighted factors that complicate the implementation or maintenance of the MRev process; these include high staff turnover [1,26], lack of motivation among the healthcare professionals involved [20,30,31], a lack of training [20,32,33], inadequate task allocation [22,34,35], a lack of support tools [36-38] and a lack of change management [7,39].

In a hospital setting, the optimal deployment and maintenance of the MRev process requires commitment from all the stakeholders (e.g., healthcare professionals, hospital managers, the hospital board, politicians, and the health authorities). However, these stakeholders may feel disempowered and often request guidance on overcoming difficulties in the MRev process [e.g., 15,21,26,31,38], as has already been done for the MRec process [e.g., 12,16,18,40,41]. More specifically, there is a need for guidance on (i) which stakeholders should be involved in MRev, (ii) when and how the stakeholders should become involved, (iii) which support tools are of value and which are not and (iv) common barriers and facilitators. Hence, the primary objective of this study was to provide sets of targeted recommendations to help operational and tactical stakeholders design, implement, develop and/or promote the MRev process at hospital. To this end, we first reviewed the literature on influencing factors (IFs) that hinder or facilitate the design, implementation and maintenance over time of the MRev process (barriers and facilitators, respectively) [20,21,42,43]. Secondly, we leveraged this comprehensive list of IFs to develop recommendations for stakeholders on avoiding barriers and enhancing the effect of facilitators during the MRev process.

Methods

The first step in the present study consisted of a scoping review of literature reports on IFs in the MRev process. In compliance with current guidelines on scoping reviews [44,45], we did not appraise the studies’ methodological quality or risk of bias. However, the present report complied with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement to the greatest extent possible [46].

Information sources and search strategy

The PubMed, Web of Science, and Science Direct databases were all searched with the same keyword query: “*medication reconciliation OR medication review OR medication reviews OR med rec OR med rev OR mrec OR mrev OR medicine review OR medicines review OR medicine reconciliation OR medicines reconciliation*”. A reference management software was used to organize and store the included publications.

Eligibility criteria

Only case studies published in English or French in peer-reviewed journals (excluding conference proceedings) between January 1st, 1999, and May 7th, 2019 were examined. Letters, reviews and non-interventional studies were excluded. The case studies had to meet the following inclusion criteria: (i) reports on specific aspects of the work situation and the lessons learned from a qualitative or quantitative empirical analysis of the implemented MRev process; (ii) Studies of inpatient care (outpatient and homecare studies were excluded); (iii) Clear descriptions of barriers to and facilitators of MRev implementation and/or maintenance.

The study selection process

All the steps in selection process were over-inclusive; in the event of doubt, a publication was included for analysis in the next step. The literature search was performed by a human factors expert, in the following sequence: (i) Duplicate publications, non-original case studies and non-peer-reviewed publications were removed in an initial screening step. (ii) The titles and abstracts of the remaining publications were screened against the present study’s eligibility criteria by 2 human factors experts. In the event of initial disagreement, the 2 investigators discussed the publication in detail and then reached a consensus. (iii) Lastly, the full text of each remaining publication was screened by one of the investigators. The list of included publications was cross-checked by the second investigator. The database search was supplemented by screening the selected publications’ reference lists.

From thematic units to categories of IFs

Two types of data were extracted from each publication: (i) the study’s main characteristics (the country in which the

Table 1 Illustrative examples of how excerpts (barriers or facilitators) were categorized into IF categories and subcategories. An excerpt's positive or negative value was determined by considering the text as a whole

IF	Excerpts	IF Category	IF Subcategory
Facilitator	"Pharmacists received intensive training on the new workflow, policies, and procedures" [39]	Training	Processes & procedures
Barrier	"The number and types of health care professionals involved, (...) reflect (...) a lack of specialized training for conducting medication reconciliation." [33]		
Facilitator	"In the social context of a hospital, professionals have a competitive spirit. If a department performs medication reconciliation more effectively, other departments are likely to change their way of work to be just as, or more, effective." [31]	Teamwork	Competition
Barrier	"The introduction of more competitive market forces has made matters worse." [31]		
Facilitator	"The multidisciplinary approach used here was a decisive factor when it came to achieving satisfactory results." [49]	Organization	Multidisciplinary process
Barrier	"A major obstacle faced during the implementation of these processes was resistance from the medical staff" [39]	Participant	Motivation (Adherence)

study had been performed, the size of the hospital and the departments involved) and (ii) thematic units: the most basic text unit that reflected an idea, meaning or theme [47] explicitly describing a barrier or a facilitator. When a given publication reported a single barrier or facilitator several times, either the more detailed instance was selected for analysis or the instances were grouped together for greater precision.

Data were analysed in a collaborative, inductive, iterative manner by 2 investigators. Firstly, the extracted thematic units were classified as barriers or facilitators by one of the investigators (Table 1). The list of barriers and facilitators was cross-checked by the second investigator and the final list was established in a consensus meeting. In a second step, the 2 investigators reviewed all the thematic units and converted them into IFs by erasing their negative and/or positive values; hence, barriers and facilitators were phrased as neutral factors that can influence the MRev process in a negative or positive way, respectively (Table 1). It should be noted that some IFs were only associated with facilitators but not barriers, or *vice versa*.

The 2 investigators then classified the IFs by using open hierarchical card sorting [48]. All IFs were written down on easily handled paper cards. Firstly, the 2 investigators sorted the cards into subcategories that made sense to them, and then defined and named these subcategories in a way that they felt described the content. Next, the subcategories were grouped into categories, which were defined and labelled. This resulted in a 2-level categorization structure in which categories were mutually exclusive (i.e., none of the components could belong to more than one category) and levels were exhaustive (i.e., the levels encompassed all the identified thematic units

[47]). We chose not to count the number of mentions of each IF, because the fact that a given IF is cited more frequently than another does not mean that it is more relevant.

Elaboration of the recommendations

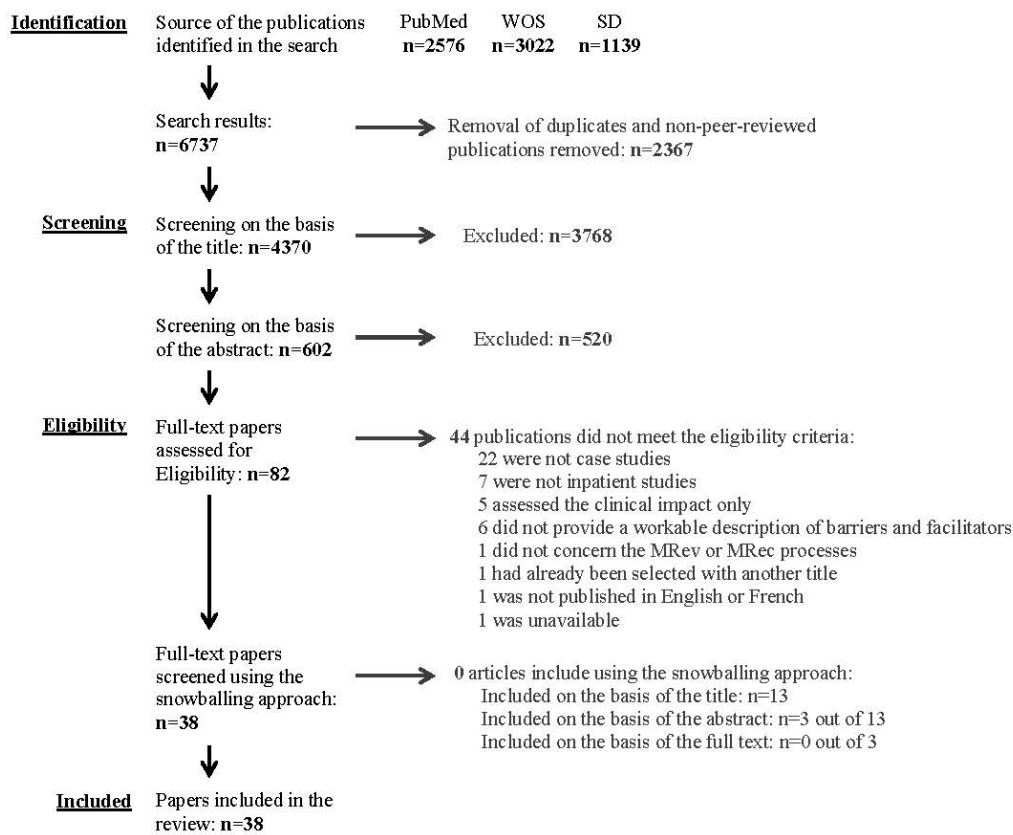
The 2 investigators consulted the definition for each IF at the subcategory level and drafted a recommendation on how to accentuate the factor's positive impact or how to avoid its negative impact. Recommendations were grouped according to the target stakeholders, that is, either operational stakeholders directly concerned by the MRev design and implementation in a hospital setting or tactical stakeholders with the requisite authority to influence local and/or national policies and promote the MRev process. Given that some IFs led to the same recommendation, the investigators sought to draft the clearest possible non-redundant recommendations. Lastly, an investigator who had not participated in the literature search or the categorization steps checked the recommendations' completeness and consistency with the initial IFs.

Results

Study selection

The database search yielded a total of 6737 publications (Figure 1). After screening 82 potentially relevant full-text publications, 38 were included in the scoping review. Screening the 38 publications' reference lists did not lead to the inclusion of any new publication.

Figure 1 The article selection flow chart



Study characteristics

The 38 case studies had been published between 2006 and 2018 (Table 2) and 17 of them had been performed in the USA. Twenty of the 38 studies did not specify the hospital size; in the 18 remaining studies, the hospital size ranged from 120 to 3500 beds. The MRev process had been implemented in various types of department (surgical units, emergency rooms, geriatric units, cardiology departments, etc.).

Influencing factors in the MRev Process

A total of 617 thematic units (346 facilitators and 271 barriers corresponding to IFs) were extracted from the 38 studies and then classified into 9 categories and 67 subcategories (Table 3). The level of descriptive detail varied from one thematic unit to another as a function of the elements reported in the studies. The distribution of IF categories across the 38 studies is detailed in Appendices 1a and 1b and the definitions of IF categories and subcategories and the corresponding excerpts are presented in Appendix 2.

Table 2 Main characteristics of the selected studies

Study characteristics	Number of studies
Country	
USA	17
France	7
Canada	3
Denmark; Australia	2
Belgium; Croatia; Ireland; Jordan; Netherlands; Spain; Sweden	1
Hospital size (number of beds)*	
Not specified	23
100-1000	15
1000-2000	1
> 2000	1
Departments*	
Not specified	13
The whole hospital	6
Internal medicine departments	6
Surgical units	4
Emergency & geriatric units	3
Intensive and acute care units	2
Paediatric and psychiatric wards	1

* The total exceeds 38 because some studies included several hospitals and/or departments

Table 3 The 9 categories of IFs: brief descriptions and the associated subcategories

(Re)Designing the process

Elements related to the importance of (i) adopting strategies for the implementation phase (i.e., before or during MRev implementation), (ii) evaluating performance after implementation and (iii) leveraging feedback from the stakeholders.

Subcategories: Design; Implementation; Evaluation; Leveraging feedback

Organisation

Elements related to the organization of the MRev process. These mainly concern resource management, the relevance with regard to objectives, and local barriers/facilitators.

Subcategories: tasks/responsibility allocation; the match between resources/constraints and objectives; the presence of supervisors; the presence of a leader; the type of process; the MRev team's working hours; patient identification; patient involvement; integration of MRev into existing procedures; the community-hospital link; the location of equipment and facilities; the moment at which MRev is performed; multidisciplinary MRev; the presence of a pharmacist in the service; processes; face-to-face meetings; human resources.

Task

Elements that explicitly characterize specific MRev tasks.

Subcategories: complexity; cross-checking sources; patient education on discharge; familiarity with the task/process; performance cost/benefit ratio; rigorousness; compliance with a validated procedure; anticipation of the patient's discharge; checking the MRec; the time required to perform tasks.

Participants

Elements related to the characteristics of the healthcare professionals (e.g. skills, knowledge, motivation, training, and interests) and the patients (e.g. ability to communicate, compliance, knowledge about their medications, involvement, and carers).

Subcategories: motivation; perception; skills & knowledge; patients.

Training

Elements explicitly related to training MRev stakeholders.

Subcategories: evaluation of skills at the end of the training period; the trainer's expertise in the MRev process; continuing education; integration into initial training; certified bodies; progressive independence; processes and associated policies; training material; shared learning; use of the MRev tool.

Teamwork

Elements related to group working within the MRev team.

Subcategories: effective communication; competition; understanding the partner's actions; interpersonal trust; coordination; experience of working together; participation in key group meetings and information sessions on patient management; face-to-face meetings.

Tools

Elements directly related to specific tools/media and the latter's usage or usability.

Subcategories: task automation; dedicated tools; computerization; interoperability; usability.

Information

Elements related to data management during the MRev process.

Subcategories: centralization in a single repository; availability; exhaustiveness; reliability; security.

Institutional support

Elements related to support from the authorities at the local, regional, national and/or international levels.

Subcategories: MRev as a high priority; regulatory obligations; perceived interest; human resources.

Recommendations for operational staff

This set contained the majority of our recommendations, and comprises 6 of the 9 main categories used to classify the IFs (Table 4). The recommendations based on IFs from the *Organization*, *Task* and *Teamwork* categories were grouped into the *Organization* category to make the document easier to read and to avoid repetition (some IFs led to similar recommendations). The readers should interpret these recommendations in the following manner: "What should I consider with regard to [Category/Subcategory] if I want to implement the MRev process at hospital?" The first category (*(Re)Designing the process*) relates to the general recommendations the stakeholders must consider before, during and after the MRev implementation, in the following 5 thematic categories.

Recommendations for decision-makers

This set of recommendations is intended for decision-makers with the power or influence to facilitate the implementation and promotion of the MRev process (Table 5). The recommendations are divided into 2 categories: those addressing hospital-level issues that concern the local authorities (e.g., the project team, the hospital board and the unit head); and those addressing legislative and governmental issues that concern national and international authorities (e.g., politicians, health authorities and national health associations).

Table 4 Recommendations for operational stakeholders (e.g., healthcare professionals) on designing, implementing and performing the MRev process at hospital. Studies having made similar recommendations are cited

1. (Re)Designing the process. These recommendations are based on IFs related to elements that must be considered by the *project team* (see below) before, during or after process implementation.

A. Before the implementation:

- 1) Create a multidisciplinary project team of operational and tactical stakeholders representing (i) the professions and care units concerned, (ii) relevant decision-makers (e.g., the team leader, the head of unit or department, and the hospital board members), (iii) stakeholders with expertise in MRev and (iv) community care stakeholders (e.g., community pharmacists and general practitioners). Involving decision-makers provides the substance to underpin process implementation [1,20].
- 2) Define a general methodology for planning the implementation of the work process [20].
- 3) Consult the guidelines (if they exist) and/or lessons learned at other sites.
- 4) Estimate the financial, human, technical, logistic and organizational resources that will be required and those that are available.
- 5) Ensure that the MRev process is compatible with the general care process.
- 6) Adapt the process to match a unit's specific features. Do not try to apply exactly the same process to units that have different characteristics [5].
- 7) Define:
 - a. The target population (e.g., geriatric patients, patients in the emergency department, *etc.*), a potential inclusion process, and clear eligibility criteria.
 - b. The units/departments in which MRev will be implemented.
 - c. The input/output for each step in the implementation process.
- 8) Elaborate together a reference information resource for describing the MRev process and its phases. Each phase must mention the stakeholders concerned, the stakeholders' objectives, the procedures, the information that the stakeholders must collect or supply, the tools and/or media to be used, the expected results, the potential contact persons, the time interval, the expected duration of each task, the person(s) responsible for data validation, the potential location and the potential barriers/limitations that might complicate the work. The tools and the process must be adapted to match the characteristics of the unit in which the MRev process is to be implemented [1].
- 9) Appoint a leader to supervise the process and to ensure that stakeholders meet their deadlines, collect and/or supply data, and achieve their objectives.
- 10) Define performance indicators for the MRev process. These indicators must be chosen so that performance is not maximal at the start of process implementation. Ideally, the indicators should be automatically retrieved and updated.
- 11) Plan to provide:
 - a. communication channels (e.g., tools and meetings) with and between the MRev stakeholders, so that the latter can provide feedback about their performance, needs, difficulties, and ways of improving the process, *etc.*
 - b. a tool for collecting, storing and exploiting information about patients, and for managing the patient care process. (see Section 4, Tools)
 - c. ways (e.g., telephone calls and additional discharge letters) of informing the patients' general practitioners (GPs) and community pharmacists of the conclusions of the MRev after discharge.
 - d. a training process (which eventually might become an evaluation process) and the related tools (see Section 3, Training)
 - e. institutional and technical links between hospital- and community-based stakeholders (e.g., financial compensation for community pharmacies, ways of exchanging information and a time slot for telephone calls). (see Section 6, Organization)
 - f. All the equipment required for the MRev tasks: computers, network connections, projectors, furniture, media, *etc.* (see Section 4, Tools)
- 12) Encourage communication between leaders and MRev stakeholders, in order to facilitate the maintenance/development of the MRev process.
- 13) Designate a management committee that supervises and optimizes the process during its implementation. Preferably, the committee should include the MRev leaders and stakeholders from the initial multidisciplinary team.

B. During/after effective implementation:

- 1) Monitor objectives during the first few months after implementation, to check that the MRev team is fully operational.
- 2) Train the MRev stakeholders (see Section 3, Training).
- 3) Evaluate the MRev process with regard to the indicators defined by the project team.
- 4) Provide feedback to the MRev stakeholders about:
 - a. The results (e.g., a conventional display panel for showing electronic medical records).
 - b. Progress through the MRev process for each patient, the steps that have been completed, the remaining steps, *etc.*
- 5) Enable the MRev stakeholders to communicate with the MRev management committee about limitations, optimization and remarks (see Section 1, A.13).
- 6) Be aware of stakeholders' motivations and potential resistance to change.
- 7) Inform indirect stakeholders (e.g., community partners and other hospital units) about the MRev results
- 8) Provide facilities (e.g., rooms) in which the MRev tasks can be performed. This is especially recommended for the MRev meetings and possibly for the telephone calls needed to establish the best possible medication history.
- 9) Provide equipment for the performance of the MRev tasks (e.g., dedicated computers, projectors, a Wi-Fi network connection, *etc.*). (see Section 4, Tools)

2. Participants. These recommendations are based on IFs related to the participants involved in MRev (i.e., hospital- or community-based healthcare professionals and patients/carers) and concern the stakeholders' skills/knowledge, task allocation, motivation, and characteristics.

A. Task allocation:

- 1) Ensure that dedicated staff are assigned to the MRev [34].
- 2) Allocate tasks clearly among the MRev stakeholders, and make sure that each stakeholder knows which tasks have been allocated to him/her [9,35,52].
- 3) Ensure that tasks are consistent with the stakeholders' occupations (e.g., do not assign a prescription task to a non-prescribing stakeholder; it is preferable to target specialists who are strongly concerned about medication risks, such as geriatricians and cardiologists [23,40]) and seniority (e.g., ensure that senior staff are given tasks that require their level of authority or responsibility).
- 4) Use students to perform time-consuming tasks and tasks that do not require medical responsibility [1,26,53]. However, stakeholders must be careful when students are involved in the process because of the high level of turnover, the resulting loss of expertise and thus the need to train new staff.
- 5) Ensure that MRev does not rely only on one or two stakeholders, the departure of whom would stop the process [26].
- 6) Involve both pharmacist stakeholders (pharmacists, pharmacy technicians and pharmacy students) and medical stakeholders (e.g., physicians and residents) in the MRev process. The MRev process (especially the MRev meeting) has to be multidisciplinary [26,34].
- 7) Involve managers and team leaders as much as possible; they will naturally take on the role of an MRev leader [1].
- 8) Leaders must ensure that objectives are achieved on time and in the right format, and must fix problems when they occur [26].
- 9) All stakeholders must know who the MRev leaders are.

B. Evaluation:

- 1) Evaluate the stakeholders, and validate their training or recruitment.
- 2) New MRev stakeholders must be monitored by a healthcare professional with experience of MRev.

C. Motivation/Perception:

- 1) Be aware of stakeholders' motivations and potential resistance to change. For example, the MRev stakeholders should be told about the benefits of MRev for the patients and that MRev-related tasks are add-ons to the usual care process.

D. About the patient:

- 1) Involve the patient as much as possible in the MRev process and ensure her/his compliance [22,36,50,53,54].
- 2) Involve a patient's care givers if the patient does not provide complete or reliable information.
- 3) Raise the patients' awareness about the importance of providing an accurate, complete, up-to-date list of medications [20,52].
- 4) Prioritize patients, if necessary [23].

3. Training. These recommendations are based on IFs related to the training of MRev stakeholders.

- 1) Train the MRev stakeholders. Training must address the benefits of the MRev (e.g., financial, health-related, pharmaceutical and medical benefits), its objectives, the related knowledge required, the use of tools and media, and the expected input/output for each phase. Training must be underpinned by practice and evaluation sessions monitored by an experienced stakeholder [1,20,22,26,34,50,55].
- 2) Training must address the value of the MRev, the objectives, necessary knowledge, use of tools and media, the expected input/output for each phase and the stakeholders' roles and responsibilities.
- 3) Elaborate documents to support the training. The documents must be of practical value in performing the MRev process.
- 4) Ensure that training and practice are validated and supervised by an experienced pharmacist or physician [53].
- 5) Train and/or evaluate new staff with regard to MRev, with a focus on their specific tasks. Do not involve stakeholders with non-validated skills/knowledge (see Section 2.B).
- 6) Enable MRev stakeholders to become autonomous progressively, rather requiring optimal performance immediately (see Section 1B1).
- 7) Encourage knowledge transfer meetings between new staff and departing staff.

4. Tools. These recommendations are based on IFs related to the tools used to perform the MRev tasks.

- 1) Develop or purchase a dedicated paper- or computer-based tool for collecting, storing and exploiting the MRev data.
- 2) Ensure that the tools disseminate all the MRev information to the MRev stakeholders; use automatic data retrieval [20,22,26,36].
- 3) Adapt tools to match the stakeholders' roles, skill/knowledge levels, and technical language.
- 4) Ensure that the tools' goals are defined and known to the MRev stakeholders [5].
- 5) Ensure interoperability between the MRev tools and the hospital information systems and between the latter and the information system used in community practices [1,20,37,56].
- 6) Ensure that MRev tools have a good level of usability [5,9,20,22,37,56].
- 7) Adapt the tool's format (e.g., paper-based or digital) to match local resources.
- 8) Facilitate data collection by automatically retrieving information from electronic medical records.
- 9) Computerize documents only when this adds value.
- 10) Use documents dedicated to sustaining medication prescriptions (e.g., the Laroche list, the START/STOPP criterion, the Medication appropriateness index, the Ghent Older People's Prescriptions Community Pharmacy Screening tool).

5. Information. These recommendations are based on IFs related to information management (e.g., information flow and reliability) in the MRev process.

- 1) Include all the MRev-related information in a single document and make it available to all stakeholders. Avoid fragmenting information across several media and sources [5,20,37,52,56].
- 2) Cross-check the sources when collecting data about the patient, to maximize reliability [34].
- 3) Inform stakeholders when information is incomplete or not reliable.
- 4) Secure the data collection/storage/transmission processes within the hospital and those between hospital and community stakeholders [22,36].
- 5) Make sure that the future care team (especially the GP) receives all the information (in an appropriate format) after the patient's discharge [20,22].
- 6) Provide the future care team, patients and carers with MRev documents signed by both physicians and pharmacists [22,34].

6. Organization. These recommendations are based on IFs that shape the MRev process and the work organization. They concern time lines, durations, objectives, stakeholders, teamwork, hospital-community links, tools and the environment.

A. Timelines:

- 1) Ensure that deadlines are met for each task. Leaders must take account of the workload, changes in the patient's location, the team composition, complex cases, and logistic/technical barriers [36,40].
- 2) Provide dedicated time slots for the performance of MRev tasks [36,40,50].
- 3) Initiate the MRev process as early as possible in the care process. [1]. For instance, initiate data collection during the consultation with the anaesthetist for patients due to undergo surgery [49].

B. Teamwork:

- 4) Promote collaboration among MRev stakeholders [20,21].
- 5) Build confidence between MRev stakeholders.
- 6) Enable communication between MRev stakeholders. Let the stakeholders define the best communication practices [5,52].
- 7) Prefer face-to-face meetings to remote communication [20].

C. Links between hospital stakeholders and community stakeholders:

- 8) Maintain and develop relationships between hospital- and community-based stakeholders.
- 9) Ensure that discharge documents are clear and synthetic.
- 10) Explain and justify all the changes made to the initial treatment, in order to (i) make it easier for the community pharmacist to explain the new treatment to the patient, and (ii) maximize the GP's compliance with the MRev's conclusions.

Table 5 Recommendations for decision-makers on sustaining the implementation and expansion of the MRev process at hospital. Studies having made similar recommendations are cited

Recommendations specifically targeted at hospital-based decision-makers:

- 1) Proactively encourage MRev initiatives [20,22].
- 2) Promote the MRev as a local priority, with a view to decreasing adverse drug reactions and medication consumption [22].
- 3) Add the MRev to local standards, potentially targeting a specific population (e.g., geriatric patients).
- 4) Support MRev initiatives by providing the necessary resources:
 - a. Provide dedicated time for senior physicians and pharmacists to perform their MRev tasks (including the training of new staff): for instance, include these tasks in their job description and performance indicators.
 - b. Provide specific tools for the performance of MRev. Ensure an acceptable usability level and good compatibility/interoperability with existing hospital and community care tools. Involve the MRev stakeholders in the tool's procurement or design process (see Table 4, 4. Tools).
 - c. Consider technical and logistic aspects (e.g., premises, computers, network connections).
 - d. Allow the MRev team to delegate some tasks to students.
 - e. Make training mandatory for the performance of MRev tasks.
- 5) Sign a collaboration agreement with community-based stakeholders, in order to facilitate the MRev process.
- 6) Participate in the MRev process design (see section Table 4, section 1 (Re)Designing the process. A1).
- 7) Promote MRev initiatives to the unit heads [20].
- 8) Design and disseminate guidelines so that stakeholders can implement the MRev process in accordance with their local resources and constraints.
- 9) Adapt the process according to a unit's specific features. Do not try to apply exactly the same process to units that have different characteristics [5] (see Table 4, section 1. (Re)Designing the process. A1).
- 10) Ensure that the MRev process is well integrated into the routine overall care workflow [5] (see Table 4, Section 1. (Re)Designing the process. A1).
- 11) Integrate clinical pharmacists into hospital units [1,20,26].
- 12) Promote physician-pharmacist collaboration within the hospital [21].

Recommendations specifically targeted at national-level decision-makers:

- 1) Encourage hospitals to implement the MRev process (e.g. through financial support) [20].
- 2) Include MRev in the list of criteria for hospital accreditation [21,22].
- 3) Promote the MRev process to hospitals [22].
- 4) Promote medication management to the public and to community healthcare professionals [22].
- 5) Incorporate MRev initiation or training into pharmacy and medical degree courses [20].
- 6) Design and disseminate guidelines (containing descriptions of common barriers and facilitators) so that stakeholders can implement the MRev at hospital. These guidelines should be (i) designed by a panel of experts, (ii) based on their experiences, feedback, and the scientific literature and (iii) concern [21]:
 - a. A process description, with precise descriptions of the various phases and the corresponding tasks.
 - b. Ideal stakeholders, with a description of their roles, task allocations and responsibilities.
 - c. The input and output for each task.
 - d. Templates for media, tools and MRev letters sent to community-based stakeholders.
 - e. Training content and the supporting documentation.
- 7) Facilitate the collection of patient data from the national health database [20,32].
- 8) Provide tools and communication networks that improve communication between hospital- and community-based stakeholders. Data exchange and storage must be secure [20].

Discussion

The objectives of the present review were to (i) establish the broadest possible list of factors that influence the deployment and maintenance of the MRev process in hospital and then (ii) provide operational and tactical stakeholders with targeted sets of person-centered recommendations on designing, implementing and developing this process at hospital.

A rigorous analysis of 38 case studies enabled us to list 617 IFs and then categorize them into 9 categories and 67 subcategories. The large number of subcategories testifies to the diversity of the IFs. Although more than half of the studies (20 out of 38) had been performed in North America, several countries were represented in our analysis. However, the studies performed in North America and those performed elsewhere typically covered the same types of IF. The convergence of our results reinforces the validity of these IFs; regardless of the local resources, stakeholders are faced with similar problems and opportunities when implementing the MRec or MRev process.

Although our 9 IF categories are in line with most of those described in sociotechnical studies of work environments [57,58], this initial categorization step was nevertheless required for the precise definition of the characteristics of MRev at hospital and for the provision of relevant recommendations. Most of the IFs reported in the literature will prompt operational stakeholders to plan and supervise MRev implementation by considering specific local resources and limitations and thus to avoid preventable problems. For example, a number of researchers have emphasized the importance of the clear, relevant allocation of tasks among the operational stakeholders, the need to train the different stakeholders, the need to provide stakeholders with appropriate data management tools and work organization factors (e.g., deadlines, community/hospital links and human resources). The IFs also show that MRev deployment will not be optimal if only operational stakeholders are assisted; it is important to involve stakeholders at more tactical levels (i.e., local hospital boards and national politicians) to promote the MRev process and integrate it into the common practice in clinical pharmacy.

This list of IFs (based on reports by stakeholders directly concerned by MRev implementation) enabled us to provide a set of recommendations on designing, implementing, maintaining or evaluating an MRev process in a hospital setting. Firstly, we grouped our recommendations for operational stakeholders (e.g., healthcare professionals) into six main categories.

(Re)Designing the process

This category comprises recommendations on the implementation phase and is divided into two subcategories. The first subcategory concerns all the elements that stakeholders must be aware of before the implementation becomes effective. Indeed, many studies have reported that implementation is easier when it is

planned than when it is done “on the job”. Ideally, the first step involves setting up a multidisciplinary project team comprising all the stakeholders (or their representatives) concerned by the MRev performance. The team then defines a framework for designing, implementing and maintaining the MRev process in hospital. Several key questions have to be answered. Who are the MRev stakeholders? Which phases/tasks constitute the MRev process? Do these tasks need paper-based or computer-based tools and media? Should MRev documentation be bought or created? Where are the MRev tasks performed? Do the stakeholders need practice or training? How is the stakeholders’ performance to be evaluated? What are the stakeholders’ objectives? How much time do the stakeholders need? How can secure data access and storage be provided? Do hospital-based stakeholders need dedicated ways of communicating with community-based stakeholders? More generally, the project team must define objectives and performance indicators, model the process, identify local barriers and facilitators and allocate resources as well as possible. A pre-implementation simulation phase can help the project team to redesign the process until an acceptable result is achieved. The second subcategory concerns aspects to be considered once the process has been effectively implemented. As mentioned above, we recommend designating a management committee to supervise the MRev process, ensure that objectives are achieved, provide feedback about performance to the MRev stakeholders and collate the stakeholders’ remarks and needs. The main recommendations concern the stakeholders’ training and evaluation (so that they have the appropriate skills and knowledge), ways of ensuring a high level of motivation and the maintenance of two-way communication between the MRev stakeholders and the management committee.

Participants

This section comprises recommendations about stakeholders involved in MRev (i.e., hospital-based healthcare professionals and patients/carers). Most of the recommendations for hospital-based MRev stakeholders concern task allocation. Indeed, two-thirds of the analysed studies reported that task allocation was a major success/failure factor in the MRev process. All the stakeholders have to be clear on their objectives, roles, expected level of performance, report formats, use of task-related tools and media and the resource stakeholders to be contacted if necessary. The management committee has to ensure that relevant tasks are allocated to designated stakeholders; for example, a student cannot be expected to perform the MRev on his/her own and a cardiologist or a geriatrician is likely to be more comfortable with medication management than a surgeon. Another main group of recommendations concerns the stakeholders’ training and evaluation. The recommendations help MRev stakeholders to (i) achieve their objectives by following the planned processes and (ii) stay motivated and thus avoid a loss of enthusiasm due to misunderstandings about the value of MRev (i.e., clinical, financial, pharmaceutical, social and training-related benefits). We note that a lack of

enthusiasm/motivation/understanding mainly concerns the physician population. With regard to the individual patient, our recommendations invite MRev stakeholders to involve him/her in the process as much as possible - especially during the data collection step and when informing the patient about his/her new treatment. This involvement, integral to person-centered healthcare, seems to maximize both patient compliance and the GP's commitment to the new prescription because the patient can explain the reason for the hospital-prescribed changes in the initial treatment. We recommend always involving the patient's carer when the MRev concerns a geriatric patient.

Training

This category is linked to the previous one. As explained above, the MRev stakeholders' training and evaluation appear to be key factors in the MRev process. Training must consider the skills and knowledge required to perform the MRev, the benefits of the MRev (e.g., financial, health-related, pharmaceutical and medical benefits), the objectives, the knowledge required, the use of tools and media, the expected input/output for each phase, the different types of stakeholders and the stakeholders' roles and responsibilities. This training must be endorsed by experienced stakeholders and followed by an evaluation to ensure that the trainees are able to meet their objectives.

Tools

These recommendations are related to the tools and media used during MRev tasks. Many studies report that the tools' suitability is a key IF in data management - the crux of the decision-making processes. The first choice relates to whether to create or adopt a new tool/medium. Stakeholders must consider local resources and limitations. On one hand, creating a new document is fastidious, but ensures that the result is well suited to the local context. On the other, adapting and adopting an existing tool can save time and many tools/media are already available in the scientific literature. Another important choice concerns paper- vs. computer-based tools. We recommend the second option only when secure access and storage, interoperability with hospital- or community-based IT systems and a high level of usability can be guaranteed. Whichever tools/media are chosen, they must match local resources and limitations; this helps to avoid unexpected negative outcomes and saves time and energy. The tool has to be an asset, rather than a burden.

Information

This category is similar to the "tools" category but focuses on data management. The recommendations mainly invite stakeholders to ensure the comprehensive storage of relevant information that can be securely accessed by the MRev stakeholders at any time. The data system should provide an overview of the patient's status and his/her progress through the MRev.

Organization

This category comprises recommendations that enable stakeholders to optimize the work plan. The initial recommendations concern the definition and allocation of clear, relevant objectives, as mentioned above. A second group concerns the time slots and durations of MRev tasks. Indeed, the duration of a given task depends on the complexity and variability of cases and the ongoing care activities. We recommend the definition of dedicated but adjustable time slots for MRev tasks. A third group of recommendations concerns the stakeholders themselves. The MRev process should not rely entirely on one or two stakeholders whose departure would cause the process to fail. We also emphasize the need to involve both pharmacists and physicians in the process and not just one group or the other. Indeed, collaboration between pharmacists and physicians adds value to the MRev process. We insist on the importance of designating one or more leaders to supervise the process *in situ* and to ensure that the objectives are achieved as expected. This role should be endorsed by the team leader or unit head once he/she has committed to the MRev process. Stakeholders should also be aware of (and thus plan for) the negative effects of student turnover, which leads to a frequent loss of expertise and a renewed need for training. A related group of recommendations focuses on group working, by promoting (for example) communication and face-to-face meetings. Another group of recommendations concerns tools and environments; stakeholders are invited to provide dedicated, appropriate facilities and equipment for the performance of the MRev tasks. A last set of recommendations invite hospital-based MRev stakeholders to work with community-based stakeholders on political, technical and logistic aspects that facilitate communication and collaboration.

Our identification of IFs also enabled us to draw up recommendations for tactical stakeholders. Indeed, some studies noted that certain issues can only be resolved by decision-makers on the hospital board or national/international authorities and associations. At the local level, our recommendations encourage stakeholders to (i) promote MRev initiatives by including them in the local standards, (ii) provide financial, human, material and organizational resources and (iii) collaborate with community-based stakeholders - thus making it easier for hospital-based stakeholders to implement the MRev in the local context. On the national and international levels, our recommendations mainly cover the need to support MRev implementation in the hospital environment by (for example) incorporating MRev activities into the criteria for hospital accreditation, providing dedicated guidelines (with defined phases, objectives, stakeholders, tools, inputs/outputs, time lines, *etc.*) designed and endorsed by a panel of experts, promoting MRev initiatives and facilitating communication between hospital-based stakeholders and community-based stakeholders.

Several publications based on expert opinions have already highlighted the importance of supporting healthcare professionals and stakeholders in medication management, although most concerned the MRec itself [e.g., 11-13,18,19]. In contrast, we focused on the whole

MRev process; when compared with previous work, the present study is the first to have added value by incorporating a rigorous analysis of field experiences of MRev. By converting IFs into empirical evidence, our study confers representativeness and exhaustiveness to the IFs classification. Our work also adds value because it is based on feedback from people directly concerned by MRev implementation and who are keen to have guidelines on how to optimize their involvement, avoid unforeseen problems and not waste time and energy. Our recommendations list the factors that should be considered by healthcare professionals and/or stakeholders when designing, implementing, performing or promoting the MRev process at hospital. Furthermore, the MRev process is implemented with a health system whose organizational and technical aspects are constantly evolving; hence, we invite healthcare professionals and stakeholders to comment on, complete and improve this checklist on the basis of their own experiences and environments.

In the future, we intend to (i) ask representative stakeholders to criticize, optimize and validate our recommendations and (ii) model and describe the MRev process as a whole and the associated tasks, objectives, stakeholders and inputs/outputs. These steps should help operational stakeholders to implement the process and help tactical stakeholders to promote MRev and provide a framework. The modelling work has already been initiated as part of a PhD project [59].

Conclusion

In the present study, we generated a list of person-centered recommendations that may help stakeholders and healthcare professionals to understand and optimize the MRev process at hospital. The list provides stakeholders with a detailed, evidence-based list of factors that influence the efficiency and effectiveness of the MRev process in hospital settings. Taking account of these factors should help healthcare professionals and other stakeholders to design, implement and maintain the MRev process and therefore increase its value and quality. Ultimately, this list of recommendations should help to improve medication management and increase patient safety, surely the very first concern of a properly person-centered system, during care transitions.

Acknowledgements and Conflicts of Interest

The authors thank Marie-Catherine Beuscart-Zephir for her support for the present study. The authors declare no conflicts of interest.

Box 1 List of acronyms (Text & Appendixes)

AGU = acute geriatric unit
AO = administration order
BPMH = best possible medication history
CP = clinical pharmacist
ED = emergency department
EHR = electronic medical record
GP = general practitioner
HF = human factor
ICU = intensive care unit
IF = influencing factor
MAR = medication administration record
Med Rec = medication reconciliation
MR = medication reconciliation
MRec = medication reconciliation
MRev = medication review
PR = pharmacy resident
PTMR = pharmacy technician-centered medication reconciliation
SD = science direct
SPFC = société française de pharmacie clinique
VTE = venous thromboembolism prophylaxis
WHO = world health organization
WOS = web of science

References

- [1] Coffey, M., Cornish, P., Koonthanam, T., Etschells, E. & Matlow, A. (2009). Implementation of admission medication reconciliation at two academic health sciences centres: challenges and success factors. *Healthcare Quarterly* 12 (Special No Patient) 102-109.
- [2] Curatolo, N., Gutermann, L., Devaquet, N., Roy, S. & Rieutord, A. (2014). Reducing medication errors at admission: 3 cycles to implement, improve and sustain medication reconciliation. *International Journal of Clinical Pharmacy* 37 (1) 113-120.
- [3] Hammad, E.A., Wright, D.J., Walton, C., Nunney, I. & Bhattacharya, D. (2014). Adherence to UK national guidance for discharge information: an audit in primary care. *British Journal of Clinical Pharmacology* 78 (6) 1453-1464.
- [4] Lavan, A.H., Gallagher, P.F. & O'Mahony, D. (2016). Methods to reduce prescribing errors in elderly patients with multimorbidity. *Clinical Interventions in Aging* 11, 857-866.
- [5] Poon, E.G., Blumenfeld, B., Hamann, C., Turchin, A., Graydon-Baker, E., McCarthy, P.C., Poikonen, J., Mar, P., Schnipper, J.L., Hallisey, R.K., Smith, S., McCormack, C., Paterno, M., Coley, C.M., Karson, A., Chueh, H.C., Van Putten, C., Millar, S.G., Clapp, M., Bhan, I., Meyer, G.S., Gandhi, T.K. & Broverman, C.A. (2006). Design and implementation of an application and associated services to support interdisciplinary medication reconciliation efforts at an integrated healthcare delivery network. *Journal of the American Medical Informatics Association* 13 (6) 581-592.
- [6] Rhalimi, F., Rhalimi, M. & Rauss, A. (2017). Pharmacist's Comprehensive Geriatric Assessment:

- Introduction and Evaluation at Elderly Patient Admission. *Drugs - Real World Outcomes* 4 (1) 43-51.
- [7] Schwarz, M. & Wyskiel, R. (2006). Medication reconciliation: developing and implementing a program. *Critical Care Nursing Clinics of North America* 18 (4) 503-507.
- [8] SFPC, Fiche memo : La conciliation médicamenteuse, Société Française de Pharmacie Clinique, 2015. Available at: <http://sfpc.eu/fr/item1/finish/34-documents-sfpc-public/1492-sfpc-memo-conciliation-maj-juillet-2015/0.html> (accessed September 6, 2017).
- [9] Vogelsmeier, A., Pepper, G.A., Oderda, L. & Weir, C. (2013). Medication reconciliation: A qualitative analysis of clinicians' perceptions. *Research in Social & Administrative Pharmacy* 9 (4) 419-430.
- [10] Seidling, H.M., Stützle, M., Hoppe-Tichy, T., Allenet, B., Bedouch, P., Bonnabry, P., Coleman, J.J., Fernandez-Llimos, F., Lovis, C., Rei, M.J., Störzinger, D., Taylor, L.A., Pontefract, S.K., van den Bemt, P.M.L.A., van der Sijs, H. & Haefeli, W.E. (2016). Best practice strategies to safeguard drug prescribing and drug administration: an anthology of expert views and opinions. *International Journal of Clinical Pharmacy*. 38 (2) 362-373.
- [11] HAS, Initiative des High 5s. Medication Reconciliation. Rapport d'expérimentation sur la mise en œuvre de la conciliation des traitements médicamenteux par neuf établissements de santé français, Haute Autorité de Santé, 2015. Available at: www.has-sante.fr/portail/jcms/c_2575563/en/decision-n-2015-0195/dc/msp-du-2-septembre-2015-du-college-de-la-haute-autorite-de-sante-adoptant-le-document-intitule-initiative-des-high-5s-medication-reconciliation-rapport-d-experimentation-sur-la-mise-en-oeuvre-de-la-conciliation-des-traitements-medicamenteux-par-neuf-etablissements-de-sante-francais (accessed July 19, 2017).
- [12] Accreditation Canada & Al., Medication Reconciliation in Canada: Raising The Bar - Progress to date and the course ahead, Accreditation Canada, the Canadian Institute for Health Information, the Canadian Patient Safety Institute, and the Institute for Safe Medication Practices Canada, Ottawa, 2012. Available at: <https://accreditation.ca/sites/default/files/med-rec-en.pdf> (accessed August 15, 2017).
- [13] Hospital National Patient Safety Goal #8, Joint Commission, n.d. Available at: <http://www.jointcommission.org/AccreditationPrograms/Hospitals/NPSG/> (accessed August 14, 2017).
- [14] Rogers, G., Alper, E., Brunelle, D., Federico, F., Fenn, C.A., Leape, L.L., Kirle, L., Ridley, N., Clarridge, B.R., Bolcic-Jankovic, D. *et al.* (2006). Reconciling medications at admission: safe practice recommendations and implementation strategies. *Joint Commission Journal on Quality and Patient Safety* 32 (1) 37-50.
- [15] Lehnbohm, E.C., Stewart, M.J., Manias, E. & Westbrook, J.I. (2014). Do medication reconciliation and review improve health outcomes? A review of the evidence and implications for the impact of the Personally Controlled Electronic Health Record (PCEHR). Melbourne: University of New South Wales.
- [16] The high 5s project: interim report., WHO, 2014. Available at: http://www.who.int/patientsafety/implementation/solutions/high5s/High5_InterimReport.pdf?ua=1 (accessed July 7, 2017).
- [17] Gleason, K.M., McDaniel, M.R., Feinglass, J., Baker, D.W., Lindquist, L., Liss, D. & Noskin, G.A. (2010). Results of the Medications at Transitions and Clinical Handoffs (MATCH) study: an analysis of medication reconciliation errors and risk factors at hospital admission., *Journal of General Internal Medicine* 25 (5) 441-447.
- [18] SFPC, Fiche mémo : Préconisations pour la pratique de conciliation des traitements médicamenteux, Société Française de Pharmacie Clinique, 2015. Available at: <http://sfpc.eu/fr/item1/finish/34-documents-sfpc-public/1608-sfpc-memo-conciliation-v2016/0.html> (accessed September 6, 2017).
- [19] Messerli, M., Griese, N. & Hersberger, K.E. (2014). Development of the PCNE standards for medication reviews. *International Journal of Clinical Pharmacy* 36 (4) 856-857.
- [20] De Bock, L., Tommelein, E., Baekelandt, H., Maes, W., Boussery, K. & Somers, A. (2018). The Introduction of a Full Medication Review Process in a Local Hospital: Successes and Barriers of a Pilot Project in the Geriatric Ward. *Pharmacy* 6 (1) pii: E21.
- [21] Kempen, T.G.H., Gillespie, U., Färdborg, M., McIntosh, J., Mair, A. & Stewart, D. (2018). A case study of the implementation and sustainability of medication reviews in older patients by clinical pharmacists. *Research in Social and Administrative Pharmacy* 15 (11) 1309-1316.
- [22] Alix, L., Dumay, M., Cador-Rousseau, B., Gilardi, H., Hue, B., Somme, D. & Jego, P. (2018). Conciliation médicamenteuse avec remise d'une fiche de conciliation de sortie dans un service de Médecine Interne : évaluation de la perception des médecins généralistes, *La Revue de Médecine Interne* 39 (6) 393-399.
- [23] Renaudin, P., Baumstarck, K., Daumas, A., Esteve, M.-A., Gayet, S., Auquier, P., Tsimaratos, M., Villani, P. & Honore, S. (2017). Impact of a pharmacist-led medication review on hospital readmission in a pediatric and elderly population: study protocol for a randomized open-label controlled trial. *Trials*. 18 (1) 65.
- [24] Graabaek, T., Bonnerup, D.K., Kjeldsen, L.J., Rossing, C. & Pottegard, A. (2015). Pharmacist-led medication review in an acute admissions unit: a systematic procedure description. *European Journal of Hospital Pharmacy-Science and Practice* 22, 202-206.
- [25] Nielsen, T.R.H., Andersen, S.E., Rasmussen, M. & Honoré, P.H. (2013). Clinical pharmacist service in the acute ward. *International Journal of Clinical Pharmacy* 35 (6) 1137-1151.
- [26] Wawrzyniak, C., Beuscart-Zephir, M-C., Marcilly, R., Douze, L., Beuscart, J.-B., Lecoutre, D., Puisieux, F. & Pelayo, S. (2015). Medication Review: Human Factors Study Aiming at Helping an Acute Geriatric Unit to Sustain and Systematize the Process. *Studies in Health Technology and Informatics* 218, 80-85.
- [27] Leguelinel-Blache, G., Arnaud, F., Bouvet, S., Dubois, F., Castelli, C., Roux-Marson, C., Ray, V., Sotto, A. & Kinowski, J.-M. (2014). Impact of admission medication reconciliation performed by clinical pharmacists on medication safety. *European Journal of Internal Medicine* 25 (9) 808-81.

- [28] Van Hollebeke, M., Talavera-Pons, S., Mulliez, A., Sautou, V., Bommelaer, G., Abergel, A. & Boyer, A. (2016). Impact of medication reconciliation at discharge on continuity of patient care in France. *International Journal of Clinical Pharmacy* 38 (5) 1149-1156.
- [29] National patient safety goal effective, Joint Commission, 2017. Available at: https://www.jointcommission.org/assets/1/6/NPSG_Chapter_OME_Jan2017.pdf (accessed September 7, 2017).
- [30] Boockvar, K.S., Santos, S.L., Kushniruk, A., Johnson, C. & Nebeker, J.R. (2011). Medication reconciliation: barriers and facilitators from the perspectives of resident physicians and pharmacists. *Journal of Hospital Medicine* 6 (6) 329-337.
- [31] van Sluisveld, N., Zegers, M., Natsch, S. & Wollersheim, H. (2012). Medication reconciliation at hospital admission and discharge: insufficient knowledge, unclear task reallocation and lack of collaboration as major barriers to medication safety. *BMC Health Services Research* 12, 170.
- [32] Doerper, S., Morice, S., Piney, D., Dony, A., Baum, T., Perrin, F., Guillaume, V., Vidal, A., Ferry, O., Peter, N., Azizi, Y., Vouaux, V., Rosa, D. & Dufay, E. (2013). La conciliation des traitements médicamenteux : logigramme d'une démarche efficiente pour prévenir ou intercepter les erreurs médicamenteuses à l'admission du patient hospitalisé. *Le Pharmacien Hospitalier et Clinicien* 48 (3) 153-160.
- [33] Meguerditchian, A.N., Krotneva, S., Reidel, K., Huang, A. & Tamblyn, R. (2013). Medication reconciliation at admission and discharge: a time and motion study. *BMC Health Services Research* 13, 485.
- [34] Bartick, M. & Baron, D. (2006). Medication reconciliation at Cambridge Health Alliance: experiences of a 3-campus health system in Massachusetts. *American Journal of Medical Quality* 21 (5) 304-306.
- [35] Lee, K.P., Hartridge, C., Corbett, K., Vittinghoff, E. & Auerbach, A.D. (2014). "Whose job is it, really?" physicians', nurses', and pharmacists' perspectives on completing inpatient medication reconciliation. *Journal of Hospital Medicine* 10 (3) 184-186.
- [36] Holbrook, A., Bowen, J.M., Patel, H., O'Brien, C., You, J.J., Tahavori, R., Doleweerd, J., Berezny, T., Perri, D., Nieuwstraten, C., Troyan, S. & Patel, A. (2016). Process mapping evaluation of medication reconciliation in academic teaching hospitals: a critical step in quality improvement. *BMJ Open* 6 (12) e013663.
- [37] Lesselroth, B.J., Adams, K., Tallett, S., Wood, S.D., Keeling, A., Cheng, K., Church, V.L., Felder, R. & Tran, H. (2013). Design of admission medication reconciliation technology: a human factors approach to requirements and prototyping. *HERD* 6 (3) 30-48.
- [38] Athuraliya, N., Sarunac, J. & Robertson, J. (2017). Medication reconciliation at two teaching hospitals in Australia: a missed opportunity? *Internal Medicine Journal* 47 (12) 1440-1444.
- [39] Murphy, E.M., Oxencis, C.J., Klauck, J.A., Meyer, D.A. & Zimmerman, J.M. (2009). Medication reconciliation at an academic medical center: implementation of a comprehensive program from admission to discharge. *American Journal of Health-System Pharmacy* 66 (23) 2126-2131.
- [40] Haig, K. (2006). Medication reconciliation. *American Journal of Medical Quality* 21 (5) 299-303.
- [41] Fernandes, O. & Shojania, K. (2012). Medication Reconciliation in the Hospital: What, Why, Where, When, Who and How? *Healthcare Quarterly* 15 (Special No.) 42-49.
- [42] Vincent, C., Taylor-Adams, S., Chapman, E.J., Hewett, D., Prior, S., Strange, P. & Tizzard, A. (2000). How to investigate and analyse clinical incidents: Clinical Risk Unit and Association of Litigation and Risk Management protocol. *British Medical Journal* 320 (7237) 777-781.
- [43] Gravel, K., Légaré, F. & Graham, I.D. (2006). Barriers and facilitators to implementing shared decision-making in clinical practice: a systematic review of health professionals' perceptions. *Implementation Science* 1, 16.
- [44] Peters, M.D.J., Godfrey, C.M., Khalil, H., McInerney, P., Parker, D. & Soares, C.B. (2015). Guidance for conducting systematic scoping reviews. *International Journal of Evidence-Based Healthcare* 13 (3) 141-146.
- [45] Tricco, A.C., Lillie, E., Zarin, W., O'Brien, K., Colquhoun, H., Kastner, M., Levac, D., Ng, C., Sharpe, J.P., Wilson, K., Kenny, M., Warren, R., Wilson, C., Stelfox, H.T. & Straus, S.E. (2016). A scoping review on the conduct and reporting of scoping reviews. *BMC Medical Research Methodology* 16, 15.
- [46] Liberati, A., Altman, D.G., Tetzlaff, J., Mulrow, C., Gøtzsche, P.C., Ioannidis, J.P.A., Clarke, M., Devereaux, P.J., Kleijnen, J. & Moher, D. (2009). The PRISMA Statement for Reporting Systematic Reviews and Meta-Analyses of Studies That Evaluate Health Care Interventions: Explanation and Elaboration. *PLoS Medicine* 6 (7) e1000100.
- [47] Krippendorff, K. (2013). Content analysis. An introduction to its methodology. Third Edn. Thousand Oaks, CA: Sage.
- [48] Sebillotte, S. (1990). Les actions et les concepts généraux d'activités dans l'utilisation d'appareils domestiques, INRIA, Rocquencourt. Available at: <https://hal.inria.fr/inria-00075377>.
- [49] Gimenez Manzorro, A., Zoni, A.C., Rodriguez Rieiro, C., Duran-Garcia, E., Trovato Lopez, A.N., Perez Sanz, C., Bodas Gutierrez, P. & Jimenez Munoz, A.B. (2011). Developing a programme for medication reconciliation at the time of admission into hospital. *International Journal of Clinical Pharmacy* 33 (4) 603-609.
- [50] Hammour, K.A., Farha, R.A. & Basheti, I. (2016). Hospital pharmacy medication reconciliation practice in Jordan: perceptions and barriers. *Journal of Evaluation in Clinical Practice* 22 (6) 932-937.
- [51] Hummel, J., Evans, P.C. & Lee, H. (2010). Medication reconciliation in the emergency department: opportunities for workflow redesign. *Quality & Safety in Health Care* 19 (6) 531-535.
- [52] Stover, P.A. & Somers, P. (2006). An approach to medication reconciliation. *American Journal of Medical Quality* 21 (5) 307-309.
- [53] Garriguet, P., Beauverie, P., Yassine, S., Mouffak, S., Alemanni, J., Gaudoneix-Taïeb, M., Richard, F. &

- Chaumartin, N. (2-17). Conciliation médicamenteuse en psychiatrie générale adulte : résultats de 3 années d'expérience. *Le Pharmacien Hospitalier et Clinicien* doi:https://doi.org/10.1016/j.phclin.2017.03.006.
- [54] Marinovic, I., Marusic, S., Mucalo, I., Mesaric, J. & Bacic Vrca, V. (2016). Clinical pharmacist-led program on medication reconciliation implementation at hospital admission: experience of a single university hospital in Croatia. *Croatian Medical Journal* 57 (5) 572-581.
- [55] Sen, S., Siemianowski, L., Murphy, M. & McAllister, S.C. (2014). Implementation of a pharmacy technician-centered medication reconciliation program at an urban teaching medical center. *American Journal of Health-System Pharmacy* 71 (1) 51-56.
- [56] Holland, D.M. (2015). Interdisciplinary collaboration in the provision of a pharmacist-led discharge medication reconciliation service at an Irish teaching hospital. *International Journal of Clinical Pharmacy* 37 (5) 310-319.
- [57] Carayon, P., Hancock, P., Leveson, N., Noy, I., Sznclwar, L. & van Hootegem, G. (2015). Advancing a sociotechnical systems approach to workplace safety - developing the conceptual framework. *Ergonomics* 58 (4) 548-564.
- [58] Carayon, P., Schoofs Hundt, A., Karsh, B.-T., Gurses, A.P., Alvarado, C.J., Smith, M. & Flatley Brennan, P. (2006). Work system design for patient safety: the SEIPS model. *Quality and Safety in Health Care* 15 (Supplement 1) i50-i58.
- [59] Wawrzyniak, C. (2019). La gestion d'un référentiel commun en situation coopérative de prise de décision : le cas du binôme hospitalier Médecin-Pharmacien en réunion de révision médicamenteuse, Psychologie-Ergonomique, Université de Lille.
- [60] Dieckhaus, T., Martin, K. & Clark, R. (2009). Managing the medication reconciliation process. Developing a robust reconciliation process for an institution using mixed electronic/paper medical records. *Journal of Healthcare Information Management* 23 (4) 34-37.
- [61] Endo, J. & Jacobsen, K. (2006). Medication reconciliation in Wisconsin: insights from a local initiative. *WMJ* 105 (8) 42-44.
- [62] Kent, A.J., Harrington, L. & Skinner, J. (2009). Medication reconciliation by a pharmacist in the emergency department: a pilot project. *Canadian Journal of Hospital Pharmacy* 62 (3) 238-242.
- [63] Monfort, A-S., Curatolo, N., Begue, T., Rieutord, A. & Roy, S. (2016). Medication at discharge in an orthopaedic surgical ward: quality of information transmission and implementation of a medication reconciliation form. *International Journal of Clinical Pharmacy* 38 (4) 838-847.
- [64] Tong, E.Y., Roman, C.P., Smit, D.V., Newnham, H., Galbraith, K. & Dooley, M.J. (2015). Partnered medication review and charting between the pharmacist and medical officer in the Emergency Short Stay and General Medicine Unit. *Australasian Emergency Nursing Journal* 18 (3) 149-155.
- [65] Varkey, P. & Resar, R.K. (2006). Medication reconciliation implementation in an academic center. *American Journal of Medical Quality* 21 (5) 293-295.
- [66] White, C.M., Schoettker, P.J., Conway, P.H., Geiser, M., Olivea, J., Pruett, R. & Kotagal, U.R. (2011). Utilising improvement science methods to optimise medication reconciliation. *BMJ Quality & Safety* 20 (4) 372-380.

Appendices

Appendix 1a - Detailed distribution of 67 ICFs categories among included articles (the first 19/38 in alphabetical order)

References	[22]	[38]	[34]	[30]	[1]	[2]	[20]	[60]	[32]	[61]	[53]	[49]	[24]	[40]	[50]	[56]	[36]	[51]	[62]	
Participants																				
Motivation				X			X													
Patients							X							X		X			X	
Perception	X	X		X	X										X				X	
Skills & knowledge				X	X		X							X					X	
Design		X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Evaluation		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Implementation					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Leveraging feedback					X															
Task automation																				
Dedicated tools		X					X												X	
Computerization	X		X				X												X	
Interoperability							X	X	X	X	X	X	X	X	X	X	X	X	X	
Usability		X		X			X	X	X	X	X	X	X	X	X	X	X	X	X	
Complexity		X		X															X	
Cross-checking sources							X												X	
Patient education on discharge																				
Familiarity with the task/process																				
Performance: cost/benefit ratio																X				
Rigorousness																			X	
Compliance with a validated procedure																			X	
Anticipating the patient's discharge																			X	
Checking the MRec																			X	
Time required																			X	
Allocation of tasks/responsibilities	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
The match between resources/constraints and objectives		X	X																X	
Supervisors presence																			X	
Presence of a leader					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
The type of process																			X	

References	[22]	[38]	[34]	[30]	[1]	[2]	[20]	[60]	[32]	[61]	[53]	[49]	[24]	[40]	[50]	[56]	[36]	[51]	[62]
The MRev team's working hours							x		x										
Patient identification																			
Patient involvement																			
MRev integration into existing procedures							x			x	x			x					
Community-hospital links																			
Location of equipment and facilities							x									x			
The time at which MRev is performed																			x
Multidisciplinary MRev																			x
Pharmacist presence in the service																			x
Processes																			
Face-to-face meetings																			
Human resources							x	x	x	x	x	x	x	x	x	x	x	x	x
Skills evaluation at the end of the training																			
Trainer is an expert in the MRev process																			
Continuing education																			
Integration into initial training																			
Certified body																			
Progressive independence																			
Process & associated policies																			
Training material																			
Shared learning																			
Use of the MRev tool																			
MRev: a high priority																			
Regulatory obligations																			
Perceived interest																			
Human resources																			
Centralization in a single repository																			
Availability																			
Exhaustiveness																			
Reliability																			
Security																			

References	[22]	[38]	[34]	[30]	[1]	[2]	[20]	[60]	[32]	[61]	[53]	[49]	[24]	[40]	[50]	[56]	[36]	[51]	[62]
Effective communication				X											X				
Competition						X	X								X	X			X
Understanding the partner's actions	X																		
Interpersonal trust				X					X										
Coordination		X																	X
Experience of working together																			
Participation in key group meetings and info-sessions on patient management					X														
Face-to-face meetings								X											

Appendix 1b - Detailed distribution of 67 IFs categories among included articles (the last 19/38)

References	[35]	[37]	[54]	[33]	[63]	[39]	[25]	[5]	[23]	[7]	[55]	[52]	[64]	[31]	[65]	[9]	[26]	[66]	
Participants																			
Motivation										X				X				X	
Patients	X											X		X					
Perception					X						X	X		X				X	
Skills & knowledge				X	X	X					X			X				X	
Design	X							X		X	X	X	X	X				X	
Evaluation						X		X		X	X	X	X	X				X	
Implementation				X	X	X	X			X	X	X	X	X				X	
Leveraging feedback						X		X	X	X			X	X				X	
Task automation		X						X											
Dedicated tools		X				X						X							X
Computerization		X				X					X								X
Interoperability		X				X	X	X	X	X	X	X	X	X				X	
Usability	X	X			X	X	X	X	X	X	X	X	X	X				X	
Complexity		X																	X
Cross-checking sources								X											
Patient education on discharge					X										X			X	
Familiarity with the task/process																		X	

Performance cost/benefit ratio																						
Rigorousness																						
Compliance with a validated procedure																						
Anticipating the patient's discharge	X																				X	
Checking the MRec																					X	
The time required	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Allocation of tasks/responsibilities	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
References																						
[35]	[37]	[54]	[33]	[63]	[39]	[25]	[5]	[23]	[7]	[55]	[52]	[64]	[31]	[65]	[9]	[26]	[66]					
The match between resources/constraints and objectives																						
Supervisors presence														X								
Presence of a leader					X										X	X	X				X	X
The type of process															X							
The MRev team's working hours																						
Patient identification																						X
Patient involvement							X								X							
MRev integration into existing procedures		X							X						X							
Community-hospital links													X									
Location of equipment and facilities		X																				
The time at which MRev is performed					X	X																
Multidisciplinary MRev			X																			
Pharmacist presence in the service		X																				
Processes																		X			X	
Face-to-face meetings		X																X			X	X
Human resources			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Skills evaluation at the end of the training									X													X
Trainer is an expert in the MRev process																						
Trainer is an expert in the MRev process																		X				
Continuing education																						
Integration into initial training									X													X
Certified body																						
Progressive independence																		X				
Process & associated policies						X																
Training material																				X		

Shared learning X

Use of the MRRev tool X

References	[35]	[37]	[54]	[33]	[63]	[39]	[25]	[5]	[23]	[7]	[55]	[52]	[64]	[31]	[65]	[9]	[26]	[66]
MRRev: a high priority												X		X				X
Regulatory obligations														X				
Perceived interest																		
Human resources																		
Centralization in a single repository																		X
Availability		X				X	X	X	X	X		X						X
Exhaustiveness						X	X	X	X	X								X
Reliability		X											X			X		X
Security																		
Effective communication												X	X					
Competition		X																
Understanding the partner's actions																		
Interpersonal trust																		
Coordination																		
Experience of working together																		
Participation in key group meetings and info-sessions on patient management																		
Face-to-face meetings																		

Appendix 2 Definition of the IF categories and subcategories with related example of excerpts

(Re)designing the process. These IF related to the elements that must be considered by the stakeholders during the design, implementation/maintenance and evaluation phases of the MRev process.

Design: The elements taken into account by the stakeholders during the design phase, i.e. before the actual implementation of the process (e.g. the beneficiaries of the process, possible selection/sorting processes, the consultation or creation of documents describing the process, the creation of a dedicated multidisciplinary team for project implementation, the standardisation of the process at several sites, the involvement of the participants who will be involved in the performance of the MRev, collaboration with retail pharmacies, the purchase/design of tools dedicated to the process, the necessary resources (financial, human and material resources, time, tools, logistics, etc.), the partners' financial compensation, and the exchange of information between hospitals and community care establishment.

Evaluation: The elements that the stakeholders have to consider when evaluating the process after it has been implemented (e.g. evaluation of clinical/financial/organisational aspects, results given to the participants, gathering the participants' feedback, and reinforcement of the objectives).

Implementation: The elements that the stakeholders have to consider during the implementation and maintenance phases (but which must also be considered during the design phase). This concerns the method of implementation, the creation/maintenance over time of a multidisciplinary team dedicated to process maintenance, the phenomena of the participants' uptake or resistance to change, the participants awareness of the impact and value of the process, the time required for the participants' uptake of and familiarisation with the MRec process and the new tools.

Leveraging other experiences: The elements that relate to using local or external personnel or group feedback to implement the process locally.

“The bundle has been developed by an expert group, including several types of medical specialists, nurses, pharmacists, and policy makers. In addition, several professional associations were involved, among others the association of general internists, nurses, cardiologists, paediatricians, hospitals, hospital pharmacists, and geriatrics” [31].

“Involve all participants in the design and implementation process” [34].

“Feedback about patient harm as a result of poor medication reconciliation at discharge was not provided to hospital caregivers, as they lose sight of the patients once they have been discharged” [31].

“Reward and recognition feedback is also essential” [52].

“Through the multidisciplinary work group, the pharmacy medication reconciliation task force, and numerous meetings with physician groups, a carefully planned medication reconciliation program was developed, continually modified and improved, and successfully integrated into all medical and surgical patient care units in the hospital” [39].

“It is important to clarify to the pharmacists involved that although implementing the medication reconciliation process consumes a lot of time initially, the process becomes more efficient once in place” [51].

“The rotation of residents to other non-intervention services likely caused unintended spread of improvements prior to official implementation” [66].

Participants. These IF are related to the characteristics of the participants involved in MRev, i.e. hospital- or community-based healthcare professionals and patients/carers.

Motivation: The participants' level of motivation and enthusiasm for performing the MRev.

Patients: The patient's characteristics (e.g. his/her level of knowledge of his/her medications taken at home before hospitalization and his/her ability to communicate).

Perception: The participants' ideas, representations or understandings about the MRev. It may concern clinical and/or financial interests, the workload created by the MRev, the objectives, the reason for including the patient in the process, the supposed reliability of the patient-sourced information, and the value of any tools dedicated to the MRev.

Skills & knowledge: The participants' skills, abilities and aptitudes for performing tasks related to the MRev process. This may concern the ability or comfort of professions with medication management (e.g. pharmacists, cardiologists, surgeons, technicians, etc.), the actors' statuses (e.g. seniors, students) and their experiences.

Training. These ICFs relate to the participants' training (e.g. content, forms, tools, audience, etc.).

Evaluation of skills at the end of the training period: A step that assesses the participants' ability to perform the MRev tasks.

The trainer is an expert in the MRev process: *The degree of expertise of the people training the MRev participants.*

Continuing education: The time course and frequency of training.

Integration into initial training: Training in MRec is integrated into the initial training for new arrivals.

Certified body: The training complies with or is based on institutional guidelines.

"Involvement of professionals with both a proactive attitude and an awareness of the importance of medication reconciliation will support the implementation of the bundle" [31].

"Most clinicians agreed that patients who do not know their medications, accessing outside medical records, working with inaccurate lists, or non-English-speaking patients are barriers to reconciliation" [35].

Some professionals were not convinced that medication reconciliation resulted in better care within their department. They did not recognise the care problem" [31].

"Cardiology had a high degree of concern for medication risks, an engaged physician leader and a supportive management culture, which led to immediate high levels of Med Rec compliance. [...] more challenges were encountered in the surgical areas, where different admission processes [i.e., pre-admission clinics] and a general discomfort with medication management were unanticipated barriers" [1].

"Pharmacists and pharmacy interns completing medication histories and are required to pass a medication reconciliation competency evaluation" [39].

"The training process for all MR technicians involves one-on-one supervision by an MR technician mentor. The first technician to serve in that role was trained by the lead MR pharmacist." [55].

"Education of the physician house staff continues to be ongoing, multifaceted, and supported by administration" [7].

"Training for new nurses was incorporated into their standard orientation" [66].

"New students receive theory-based and practical training [following the SFPC guidelines] on arrival. This training is completed by expert-novice pairing in

the field” [53].

Progressive independence: The training makes the participants progressively more independent regarding their responsibilities in the MRev tasks.

“Currently, all staff pharmacists are undergoing training in PTMR procedures in order to ensure adequate pharmacist supervision; most have completed the two-week training program, which includes studying the training manual, observing the MR pharmacist role, documenting an MR progress note in the EHR, and communicating recommendations to the clinicians when appropriate. The pharmacist-in-training initially performs these roles with supervision and then, when deemed competent by the mentoring MR pharmacist, independently” [55].

Processes & associated policies: The training concerns the processes (tasks, procedures, roles, etc.) and the political and financial interests/issues.

“Pharmacists received intensive training on the new workflow, policies, and procedures” [39].

Training material: The participants receive training material.

“A manual was developed to assist in the training process and is provided to each of the technicians and pharmacists during training. This manual outlines the steps of appropriate MR, the roles of MR technicians and pharmacists, the process for identifying patients who are at a higher risk for medication errors, and guidelines for formulary conversions, including appropriate dose equivalents. Materials to improve the training manual are added as needed” [55].

Shared learning: Senior staff meet with incoming residents/students to share their knowledge.

“At the end of each academic year, departing chief residents met with the incoming chiefs to relay the responsibilities of the position and lessons learnt” [66].

Use of the MRev tool: The training concerns the use of MRev-dedicated tools.

“In both departments all the doctors were trained in the use of the APLICON” [49].

Information. These ICFs relate to the information in the MRev process (e.g. flow, tools, availability, reliability, and recovery)

Centralization in a single repository: The information required for MRev is centralised in a single repository.

“An institutional policy was created and widely communicated for the inclusion of all medications in a single repository, the “Current Medication” section of electronic clinical notes” [65].

Availability: The availability of the information required for MRev, and the time needed to obtain this information.

“Difficulties to retrieve information” [26]

“it was argued that the prescriber often had to wait for too long before the BPMH was available” [2].

Exhaustiveness: The exhaustive, complete character of the information required for MRev.

“The documents used to gather information about the patient’s medication history [ED notes, anaesthesia notes] were often incomplete. Indeed, surgeons used those documents to write the AOs” [2].

Reliability: The reliability of (i) the information required for MRev, (ii) the results generated by MRev, and (iii) the information given by community participants and patients.

“Although medication reconciliation was completed, accuracy remains a concern” [66].

“One problem encountered in implementing the admission phase of MR was that staff tried to obtain a “perfect” home medication list. Despite checking multiple sources for the information, this was not always possible because of several barriers: staff had interruptions; staff members were too busy; the office did not have an updated list or the nursing home list was confusing; or the patient brought in an incorrect list, did not take what was marked on the bottle, did not know the names of meds, or was unable to communicate” [40].

Security: Secure access, transmission and storage of the information required for MRev.

“The installation of a secure messaging system [MSSanteW] will ensure that the data remains confidential and is sent rapidly at discharge, with a view to greater uptake by the healthcare professionals who will continue patient care” [48].

Organisation. The ICFs of this level relate to whatever shapes the process (e.g. tasks content/definition, assignment of tasks and responsibilities, organisation of work time, and the structure of the process)

Assignment of tasks/responsibilities: The assignment of tasks, roles and responsibilities at each step in the process. This concerns also the assignment of the tasks between humans and machines, and the assignment of tasks depending on the level of training/responsibility.

“It is crucial that interprofessional teams are established with clearly defined roles and responsibilities, and how these roles and responsibilities may change in various situations or services” [35].

The match between resources/constraints and objectives: The targets match the resources given to the participants and the constraints that they have to deal with.

“Implement the admission MRec process in several hospital with functioning differences causes difficulties, especially because the admissions process differs between campuses, times of day, and departments” [34].

Presence of supervisors: The unit managers (heads) are present and involved in the process.

“The presence of both surgery department heads during the meetings also increased the enthusiasm of the project participants and their commitment” [2].

Presence of a leader: One or several leaders are available to drive the maintenance of the process and meet the objectives. This concerns also the leader's roles and profile.

“Executive support:
- Strong support from director of pharmacy regarding staffing increases
- Physician vice-president of quality and chief nursing executive key in moving physician and nursing roles forward” [1].

“A pharmacy-driven multidisciplinary admission history and medication reconciliation process has reduced medication errors in an academic medical center” [39].

The type of process: The type of reconciliation/review implemented (pro-active or retroactive) and the series of steps.

“The approach is especially efficient when the reconciliation is proactive, but this procedure remains daunting in organisational terms for the professionals” [32].

The MRev team's working hours: The periods during which it is possible to perform the MRev.

“In spite of Sunnybrook's increased clinical pharmacist resources, pharmacists are available to do Med Rec only during regular business hours, resulting in the screening of approximately 75% of general medical patients and the reconciliation of about 80% of high-risk patients identified” [1].

Patient identification: Identifying the patients to be included.

“Patients listing incomplete [unidentified patient for the MRev meeting]” [26].

Patient involvement: The patient is involved in the process.

“In 181 [96 %] of the cases, the CPs obtained medication history by including patient interviews” [25].

Integration of MRev into existing procedures: The integration of the MRev process into the overall patient management process.

“Medication reconciliation has become part of the everyday work process” [7].

Community-hospital links: Collaboration with community-based participants.

“Another major barrier is a lack of communication, understanding and collaboration between hospital and community caregivers. The introduction of more competitive market forces has made matters worse” [31].

Location of equipment and facilities: The availability, location and operation of physical equipment (materials, rooms, etc., and not interfaces) required for MRev.

“Clinical workstation terminals are located in nursing stations or team rooms, thus limiting interpersonal communication and bedside interactions” [63].

The time at which MRec takes place: When the different steps must be performed.

“There are no agreements about when medication reconciliation should take place and the bundle is not yet implemented at every hospital department. If medication reconciliation is not performed at every transfer, the medication list at the point of discharge will be inaccurate” [31].

The time at which MRev is performed: Elements specifically related to the time at which the MRev is performed.

“In addition, significant time can be wasted by nursing staff chasing the appropriate medical staff to chart medications for patients, particularly if medications are not the primary reason for the patient’s presentation to hospital” [64].

Multidisciplinary MRev: The multidisciplinary aspect of the MRev process.

“This study demonstrates how interdisciplinary collaboration has the potential to contribute to the delivery of a discharge medication reconciliation service at an Irish teaching hospital” [56].

The presence of a pharmacist in the service: The hospital pharmacist involved in the process is present in the service concerned.

“This project also impacted on the role and the position of the pharmacist in the wards. In fact, pharmacists are often underutilized in MR processes [18]. In our hospital, the PRs and the 5th year pharmacy students are now present on the ward on a daily basis and are able to meet almost every patient at admission. This allows a more efficient and effective control of electronic prescriptions: pharmacists have shifted from a silo pharmacy based activity to a collaborative ward based value added practice” [2].

Processes: Dependence of the quality of the process on one person or a particular role (e.g. if the leader leaves, the process stops).

“A barrier to self-efficacy among pharmacists is their dependence on physicians to write the orders needed to address the findings of medication reconciliation” [30].

Face-to-face meetings: The modes of information exchange between participants.

“The pharmacist and medical officer have a face-to-face clinical discussion for every patient, ensuring pre-admission medications are considered early and allowing pharmacist input into prescribing for acute conditions, new therapies, changes to chronic medication regimens, and medication-related investigations, adding clinical value to medication charting for complex patients requiring hospital admission” [64].

Human resources: The human resources needed for MRev (specialty/expertise, responsibilities, training/qualifications, number, turnover, etc.).

“Projects like this are always costly, both in terms of human resources and the time required” [49].

“The AGU is chronically understaffed [as regards geriatrician and pharmacist resources]” [26].

Tools. These ICFs relate to the characteristics of the tools used/ designed to perform the MRev

Task automation: Elements that relate to partial or full automatization of the tasks.

“In order to improve the accuracy of the discharge medication orders, a discharge medication reconciliation report form was created through the EMR. This form captures patients’ home and inpatient medications and is used to order medications at discharge” [39].

Dedicated tools for participants: Some dedicated tools depending on the operator’s profile (patients and pharmacists).

“To improve the process whereby the patient verifies his or her prescriptions, the software matched outpatient prescriptions with pharmaceutical photographs using metadata tags” [37].

“There also exists a pharmacist medication checklist including the BPMH [copied out from the MRev support] and the hospitalization treatment [recovered from the Medication Administration Record [MAR]] as well as the prescription analysis and comments. It is only documented and used by pharmacists” [26].

Computerization: The existence of electronic MRev support tools, and the transition from paper to a computerised version.

“Although study respondents indicated that the computerized tool reduced the time required to complete the task, they also expressed concern that because medication reconciliation was automated in part at the VA, they spent less time with patients on the process” [30].

Interoperability: Concerns the interoperability of information system (between the software systems used within the hospital, and between the software used in hospital and that used in the community for secure transmission of patient information).

“Since the four medication sources may contain repetitive information, we organize the list to facilitate review by the user. However, the different medication terminology systems used by each data source make this organization challenging” [5].

Usability: Aspects related to the usability of the tools (ease of use, reliability, ease of understanding, target attainment, trust, design, intuitiveness, labels, interfaces, handling, complexity, allocation of the tasks between humans and machines.)

“Preadmission medication list generated by the tool may show medications in duplicate and may require extensive scrolling” [30].

“[...] providers’ reliance on the computer can lead to less thorough patient interviews, and computerized medication information may be incomplete, both unintended consequences of the electronic health record” [30].

Institutional support. The ICFs in this meta-category relate to the support provided (or not) by administrations, associations and organisations at the local, regional, national and international levels. These are more general than most of the other ICFs.

“MRec at Luneville Hospital was facilitated by the establishment’s inclusion in the WHO’s MRec project” [32].

MRev: a high priority: The importance or priority given to the MRev by the hospital administration in its overall policy.

“MRec at Luneville Hospital was facilitated by the establishment’s inclusion in the WHO’s MRec project” [32].

Regulatory obligations: The national policy of healthcare impose the implementation of the MRev process in the hospital.

Perception of interest: The hospital administration's level of interest in the MRev process.

Human resources: The hospital administration allocates the decisional roles and the management of MRev project.

"Major drivers are a good implementation plan, patient awareness, and obligation by the government" [31].

"This development is now acknowledged locally at the institutional level, it is integrated into the patient pathways and is part of a project for generalizing a set of hospital pharmacist activities to the establishment as a whole" [53].

"Executive support:

- Strong support from director of pharmacy regarding staffing increases
- Physician vice-president of quality and chief nursing executive key in moving physician and nursing roles forward" [1].

"Our goal was to empower pharmacists, accentuate their unique role as medicine experts, and finally employ them as accessible workforce in the hospital. In addition, a position of pharmacy technicians in Croatia is unsatisfactory due to workload shortages. Their number is still undersized and their competencies are neither recognized nor defined" [54].

Task. These ICFs relate to the characteristics of performing (i) tasks in general during the process (e.g. the duration, complexity and monitoring of a procedure), (ii) specific, identified tasks (e.g. patient identification, establishing the MRev).

Complexity: The influence of the complexity of the patient cases on the performance of the MRev.

Cross-checking sources; Elements specifically related to cross-checking the sources for establishment of the MRev and the associated workload.

Patient education on discharge: Elements specifically related to educating the patient about his/her new medication before discharge.

Familiarity with the task/process: The participants' level of familiarity with the MRev tasks and/or process.

"Considerable workload variation per clinical pharmacist day as a function of patient movement, team census, patient complexity, and logistic contingencies" [37].

"accessing other information sources frequently requires time and effort beyond the capacity of the triage nurse without seriously disrupting patient flow" [51].

"Patient counselling is a key component of this process, providing an opportunity to inform patients of new medications, treatment modifications, and drug administration schedules" [63].

"The involvement of clinical pharmacists was achieved with far less effort. This is likely because a less-structured version of Med Rec was already part of their practice" [34].

<p>Performance: cost/benefit ratio: Elements specifically related to the cost/benefit ratio for performing MRRev tasks.</p>	<p>“One problem encountered in implementing the admission phase of MR was that staff tried to obtain a “perfect” home medication list. Despite checking multiple sources for the information, this was not always possible because of several barriers: staff had interruptions; staff members were too busy; the office did not have an updated list or the nursing home list was confusing; or the patient brought in an incorrect list, did not take what was marked on the bottle, did not know the names of meds, or was unable to communicate” [40].</p>
<p>Rigorouslyness: Elements specifically related to the level of care needed to perform the tasks.</p>	<p>We must all approach medication reconciliation with great care, particularly because its results reach far beyond hospital walls” [61].</p>
<p>Compliance with a validated procedure: Elements specifically related to compliance with the standard operating procedure for the tasks.</p>	<p>“During the MRRev in the care unit, the pharmacist starts the process a third time but does so in a structured manner according to the medication reconciliation SOP: an exhaustive, complete list is generated, and the sources are documented” [32].</p>
<p>Task: anticipating the patient’s discharge: Elements linked to anticipating the patient’s discharge.</p>	<p>“We saw considerable variation in work as a function of team census and the number of anticipated discharges” [37].</p>
<p>Task: checking the MRRec: Elements linked to third-party verification.</p>	<p>“A second pharmacist independently reviewed all medications charted by a pharmacist within 24 h, to provide a second check” [64].</p>
<p>Time required: Elements specifically related to the time required for performing MRRev tasks and the associated workload.</p>	<p>“The work load induced by the activity of reconciliation - 30 minutes per patient – can be considered as an obstacle to its implantation” [32].</p>
<p>Teamwork. The ICF of this level relate specifically to the collective activity between the participants involved in the hospital (e.g. coordination, confidence, understanding, exchange of information</p>	<p>the participants involved in the hospital (e.g. coordination, confidence,</p>
<p>Effective communication: Elements specifically related to the communication between the participants involved in the MRRev.</p>	<p>“Such miscommunication among staff can be highly disruptive for the emergency department workflow and is responsible for many of the inefficiencies in the medication reconciliation process” [51]</p>
<p>Competition: Elements concerning the introduction of a competitive relationship between the various MRRev teams or units.</p>	<p>“Another major barrier is a lack of communication, understanding and collaboration between hospital and community caregivers. The introduction of more competitive market forces has made matters worse.” [31]</p>
<p>Understanding the partner’s actions: Elements relating to mutual understanding of each other’s actions.</p>	<p>“It is difficult to determine physicians’ rationale for prescribing changes, which is needed for the reconciliation document” [30]</p>

Interpersonal trust: Elements regarding the trusting relationship between the participants.

“Each pharmacist involved in producing BPMHs noted a lack of confidence that their output was routinely reviewed by the patient’s medical team” [36].

Coordination: Elements specifically related to coordination between the participants.

“Poor co-ordination of medication information gathering efforts among staff” [51].

Experience of working together: Elements relating to participants being used to working together.

“We consider it easier to implement the experimentation in adherent centers, where the pharmacist teams and medical teams are working together, the best guarantee of the feasibility of the study” [23].

Participation in key group meetings and information sessions on patient management:

- Morning rounds, staff meetings, resident lectures
- Morbidity and mortality reviews, staff meetings, resident lectures” [1].

Elements concerning multidisciplinary information exchange between the MRev participants.

Face-to-face meetings: Elements concerning the procedures for meetings between MRev participants.

“The credentialed pharmacist took a best possible medication history, performed a VTE risk assessment then had a face-to-face discussion with the admitting medical officer about current medical and medication related problems and the medication management plan was agreed upon. This early interaction also allowed pharmacist input into prescribing for acute conditions, new therapies, changes to chronic medication regimens, and medication-related investigations” [64].