World Health Organization

Medication Safety in Transitions of Care

MEDICATION WITHOUT HARM
Global Patient Safety Challenge

Technical Report

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Contents

Abbreviations

ACE	angiotensin-converting enzyme
BPMH	best possible medication history
CI	confidence interval
EHR	electronic health record
INN	international nonproprietary name
IT	information technology
LMIC	low- and middle-income country
NSAID	non-steroidal anti-inflammatory drug
OR	odds ratio
WHO	World Health Organization

Preface

Health care interventions are intended to benefit patients, but they can also cause harm. The complex combination of processes, technologies and human interactions that constitutes the modern health care delivery system can bring significant benefits. However, it also involves an inevitable risk of patient harm that can – and too often does – result in actual harm. A weak safety and quality culture, flawed processes of care and disinterested leadership teams weaken the ability of health care systems and organizations to ensure the provision of safe health care. Every year, a significant number of patients are harmed or die because of unsafe health care, resulting in a high public health burden worldwide.

Most of this harm is preventable. Adverse events are now estimated to be the 14th leading cause of morbidity and mortality in the world, putting patient harm in the same league as tuberculosis and malaria *(1)*. The most important challenge in the field of patient safety (see Annex 1) is how to prevent harm, particularly avoidable harm, to patients during their care.

Patient safety is one of the most important components of health care delivery which is essential to achieve universal health coverage (UHC), and moving towards the UN Sustainable Development Goals (SDGs). Extending health care coverage must mean extending safe care, as unsafe care increase costs, reduces efficiency, and directly compromises health outcomes and patient perceptions. It is estimated that over half of all medicines are prescribed, dispensed or sold inappropriately, with many of these leading to preventable harm *(2)*. Given that medicines are the most common therapeutic intervention, ensuring safe medication use and having the processes in place to improve medication safety (see Annex 1) should be considered of central importance to countries working towards achieving UHC.

The Global Patient Safety Challenges of the World Health Organization (WHO) shine a light on a particular patient safety issue that poses a significant risk to health. Front-line interventions are then developed and, through partnership with Member States, are disseminated and implemented in countries. Each Challenge has so far focused on an area that represents a major and significant risk to patient health and safety (see Annex 1). In 2005, the Organization, working in partnership with the (then) World Alliance for Patient Safety, launched the first Global Patient Safety Challenge: *Clean Care Is Safer Care (3)*, followed a few years later by the second Challenge: *Safe Surgery Saves Lives (4)*. Both Challenges aimed to gain worldwide commitment and spark action to reduce health care-associated infection and the risks associated with surgery, respectively.

Recognizing the scale of avoidable harm linked with unsafe medication practices and medication errors, WHO launched its third Global Patient Safety Challenge: *Medication Without Harm* in March 2017, with the goal of reducing severe, avoidable medication-related harm by 50% over the next five years, globally *(5)*.

This Challenge follows the same philosophy as the previous Challenges, namely that errors are not inevitable, but are very often provoked by weak health systems, and so the challenge is to reduce their frequency and impact by tackling some of the inherent weaknesses in the system.

As part of the Challenge, WHO has asked countries and key stakeholders to prioritize three areas for strong commitment, early action and effective management to protect patients from harm while maximizing the benefit from medication, namely:

- medication safety in high-risk situations
- medication safety in polypharmacy
- medication safety in transitions of care.

Consider the following case scenario describing a medication error (see Annex 1) involving these three areas.

> ### Medication error: case scenario
>
> Mrs Poly, a 65-year-old woman, came to the outpatient clinic complaining of abdominal pain and dark stools. She had a heart attack five years ago. At her previous visit three weeks ago she was complaining of muscle pain, which she developed while working on her farm. She was given a non-steroidal anti-inflammatory drug (NSAID), diclofenac. Her other medications included aspirin, and three medicines for her heart condition (simvastatin, a medicine to reduce her serum cholesterol; enalapril, an angiotensin-converting enzyme (ACE) inhibitor; and atenolol, a beta blocker). She was admitted to hospital as she developed symptoms of blood loss (such as fatigue and dark stools). She was provisionally diagnosed as having a bleeding peptic ulcer due to her NSAID, and her doctor discontinued diclofenac and prescribed omeprazole, a proton pump inhibitor. Following her discharge, her son collected her prescribed medicines from the pharmacy. Among the medicines, he noticed that omeprazole had been started and that all her previous medicines had been dispensed, including the NSAID. As his mother was slightly confused and could not remember exactly what the doctor had said, the son advised his mother that she should take all the medications that had been supplied. After a week, her abdominal pain continued and her son took her to the hospital. The clinic confirmed that the NSAID, which should have been discontinued (deprescribed), had been continued by mistake. This time Mrs Poly was given a medication list when she left the hospital which included all the medications she needed to take and was advised about which medications had been discontinued and why.

The events leading to the error in this scenario and how these could have been prevented are reflected in Figure 1, and the text below.

Figure 1. Key steps for ensuring medication safety
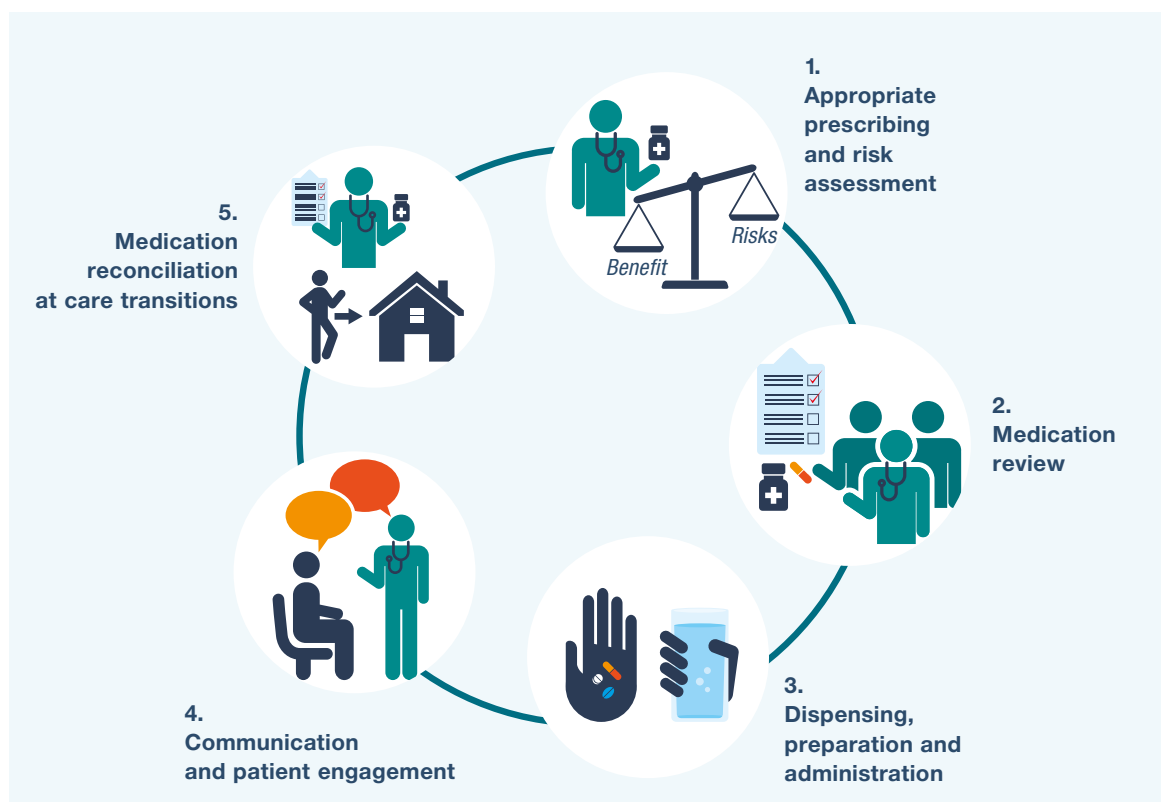
In this scenario the key steps that should have been followed to ensure medication safety in the inpatient setting include:

1. Appropriate prescribing and risk assessment
Medication safety should start with appropriate prescribing and a thorough risk–benefit analysis of each medicine is often the first step. In this case scenario, prophylactic aspirin and NSAID without a gastroprotective agent left Mrs Poly at an increased risk of gastrointestinal bleeding. NSAIDs can also increase the risk of cardiovascular events, which is of particular concern, as she had had a myocardial infarction (heart attack) five years ago. This is a good example of a high-risk situation requiring health care professionals to prescribe responsibly after analysing the risks and benefits.

2. Medication review
A comprehensive medication review (see Annex 1) is a multidisciplinary activity whereby the risks and benefits of each medicine are considered with the patient and decisions made about future therapy. It optimizes the use of medicines for each individual patient. Multiple morbidities usually require treatment with multiple medications, a situation described as polypharmacy (see Annex 1). Polypharmacy can put the patient at risk of adverse drug events (see Annex 1) and drug interactions when not used appropriately. In this case, there should have been a review of medications, particularly as Mrs Poly was prescribed aspirin and diclofenac together. The haemodynamic changes following blood loss should have also prompted temporary stopping the ACE inhibitor before restarting once the episode of blood loss has been resolved.

3. Dispensing, preparation and administration

This is a high-risk situation as the medication (diclofenac) has the potential to cause harm. However, this medication was continued after discharge when the patient transitioned from hospital to home. Dispensing this medicine and its administration caused serious harm to Mrs Poly. Dispensing this medicine and its administration caused significant harm to Mrs Poly.

4. Communication and patient engagement

Proper communication between health care providers and patients, and amongst health care providers, is important in preventing errors. When Mrs Poly was severely ill due to gastric bleeding, the NSAID was discontinued. However, the decision to discontinue the medicine was not adequately communicated either to the other health care professionals (including the nurse or the pharmacist) or to Mrs Poly. Initial presenting symptoms due to adverse effects could have been identified earlier if she had been warned about the risks.

5. Medication reconciliation at care transitions

Medication reconciliation is the formal process in which health care professionals partner with patients to ensure accurate and complete medication information transfer at interfaces of care. Diclofenac, the NSAID that can cause gastrointestinal bleeding and increase the risk of cardiotoxicity and had led to this hospital admission, was discontinued, and this information should have been communicated at the time of discharge (in the form of a medication list or patient-held medication record). This would have helped her and her caregivers in determining what the newly added and discontinued medications needed to be.

Medication-related harm is harm caused to a patient due to failure in any of the various steps of the medication use process or due to adverse drug reactions (see Annex 1 for glossary). The relationship and overlap between medication errors and adverse drug events is shown in Figure 2.

Figure 2. Relationship between medication errors and adverse drug events
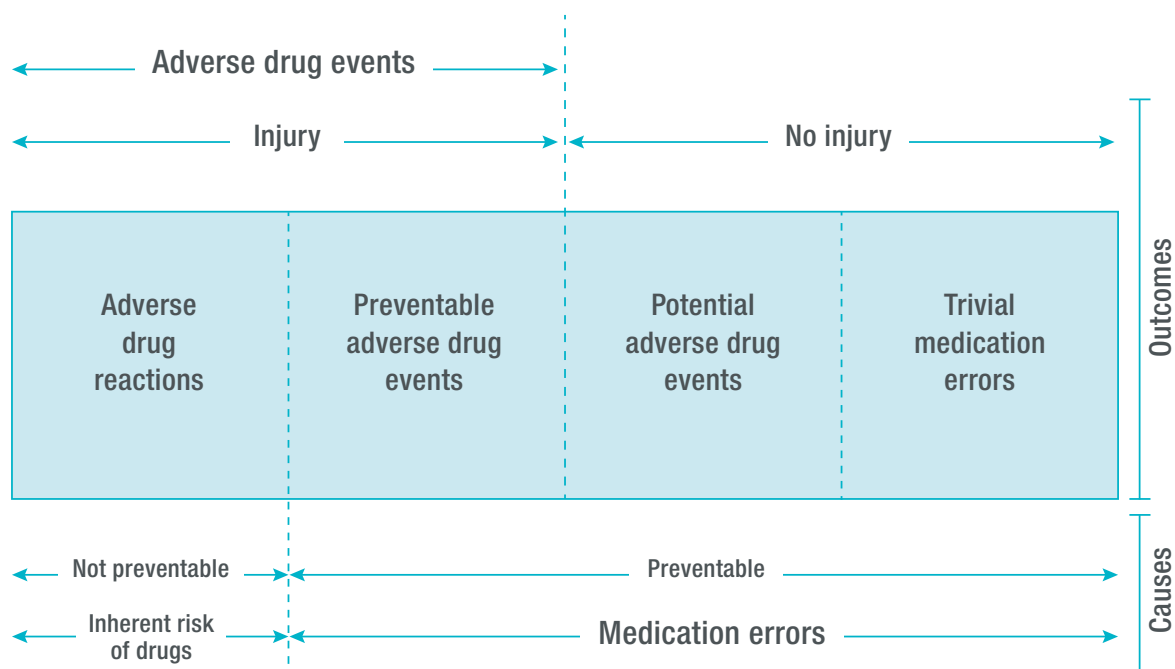
Source: Reproduced, with the permission of the publisher, from Otero and Schmitt *(6)*.

WHO is presenting a set of three technical reports – *Medication safety in high-risk situations*, *Medication safety in polypharmacy*, and *Medication safety in transitions of care* – to facilitate early priority actions and planning by countries and key stakeholders to address each of these areas. The technical reports are intended for all interested parties, particularly to inform national health policy-makers and encourage appropriate action by ministries of health, health care administrators and regulators, organizations, professionals, patients, families and caregivers, and all who aim to improve health care and patient safety.

This report – *Medication safety in transitions of care* – outlines the problem, current situation and key strategies to reduce medication-related harm in transitions of care. It should be considered along with the companion technical reports on *Medication safety in high-risk situations* and *Medication safety in polypharmacy*.

Executive summary:
medication safety in transitions of care

Unintended medication discrepancies affect nearly every patient that moves across transitions of care. The complex challenge of improving medication safety during transitions of care requires long-term commitment from health care leaders and cohesive efforts from health care professionals to substantially reduce potential patient harm.

Each country participating in the Medication Without Harm Challenge needs to give a clear, long-term leadership commitment by defining goals to improve medication safety at transition points of care, developing a strategic plan with short- and long-term objectives, and establishing structures to ensure goals are achieved. Countries need to put in place locally relevant improvement programmes to develop, test and implement effective solutions and measure progress towards the goals.

The key strategies for improving medication safety during transitions of care include:

• Implementing formal structured processes for medication reconciliation at all transition points of care by (a) building the best possible medication history (BPMH) by interviewing the patient and verifying with at least one reliable information source; (b) reconciling and updating the medication list; (c) communicating with the patient and future health care providers about changes in their medications, with agreed roles and responsibilities, training, support and provision of tools and technology.

• Partnering between patients, families, caregivers and health care professionals to agree on treatment plans, ensure patients are equipped to manage their medications safely, and ensure patients have an up-to-date medication list.

• Where necessary, prioritizing patients at high risk of medication-related harm for medication reconciliation and enhanced support, for example pre- and post-discharge contact.

• Implementing collaborative medication management between medical, nursing and pharmacy personnel and, where staffing is inadequate, planning and investing to increase workforce capacity and capability, including increasing availability and access to undergraduate and postgraduate education and training.

• Improving the quality and availability of information at transitions of care and identifying the most reliable information sources for verifying medication histories at transitions. These could include patient-held medication record (medication passport), information technology systems to facilitate reconciliation processes, and electronic health records to facilitate smoother transitions.

1.1 Transitions of care

> **Transitions of care** are the various points where a patient moves to or returns from a particular physical location or makes contact with a health care professional for the purposes of receiving health care (see Annex 1).

Transitions of care include movements of patients between home, hospital, residential care settings and consultations with different health care providers. During transitions of care, patients attend health care facilities where their medication may be reviewed and changed. This would include outpatient or primary care consultations with a health care professional. Transitions of care may also refer to transitions requiring support from other care professionals, such as caregivers at home, palliative care, social care or outreach services.

An example of the patient's journey across transitions of care and the medication use processes involved is depicted in Figure 3.

Figure 3. Patient journey across different transitions of care and medication use processes
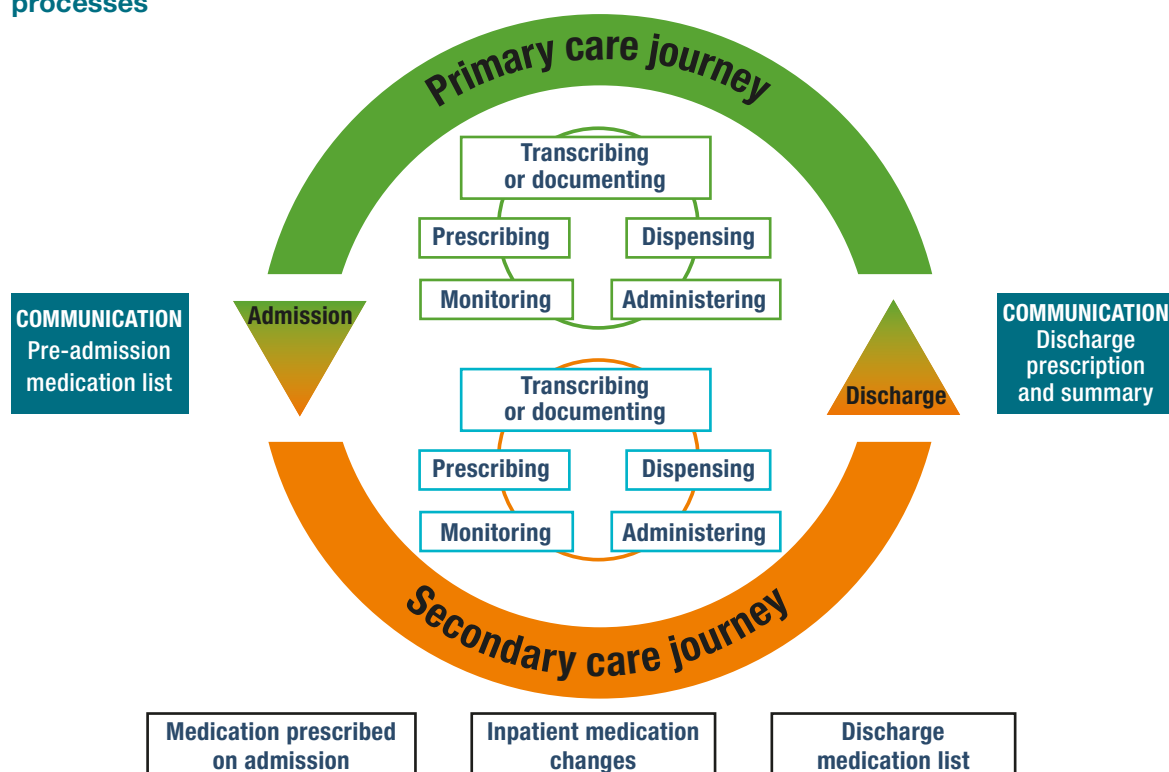
Source: Reproduced, with permission of the publisher, from Grimes T *(7)*.

Some of the frequent transition points in health care settings are:
- admission to hospital, community setting or primary care, where a medication history is taken, the inpatient prescription commenced and medications are started, changed or discontinued;
- transfer from one area within the hospital to another, particularly where separate paper or electronic medication records are kept, for example emergency department to intensive care unit, operating theatre to a clinical ward;
- referral from primary care setting to secondary/tertiary care;
- discharge from hospital, where a discharge prescription or instructions are issued; and
- transfer from one hospital to another hospital or to a residential care setting, for example a nursing home or rehabilitation facility.

Figure 4. Changes in medication during transitions of care between home and hospital

DAY 1   DAY 2   DAY 3   DAY 4

1   2   3   4   5   6   7   8   9
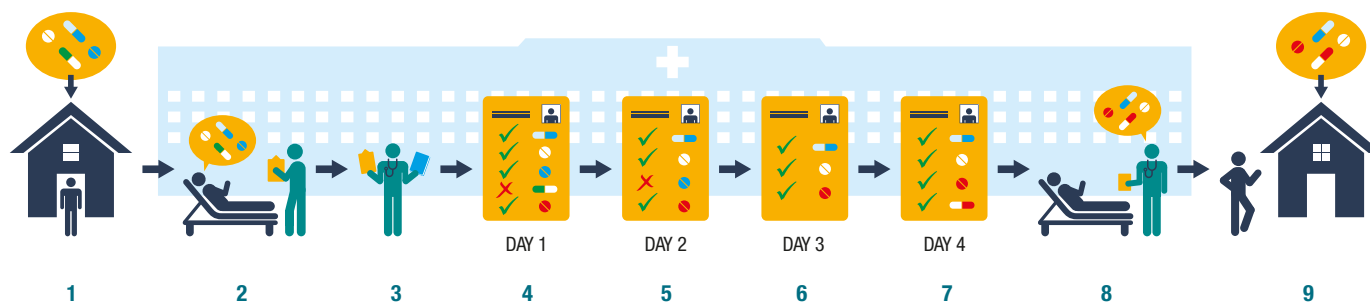
1 Admission to hospital from home
2 Obtaining medication history
3 Verifying medication history using reliable source of medication information
4–7 Changes in medication during hospital stay
      4 Medication reconciliation at admission
      7 Medication reconciliation at discharge
8 Pre-discharge communication and patient engagement
9 Discharge from hospital to home

The points of transition within or across healthcare settings are often associated with changes in medications that the patient receives, depicted in Figure 4.
In addition, patients' medication may change due to:
- starting, changing or discontinuing non-prescription or over-the-counter medication bought by the patient in pharmacies, retail outlets or online;
- starting, changing or discontinuing herbal, traditional or complementary medicines, with or without interaction with health care professionals;
- using medications obtained from friends or family members;
- using medications obtained from unsafe sources, including substandard and falsified medications; and
- using substances, including alcohol and drugs, with the potential for abuse.

Transitions of care do not include care handover or handoff during staff transitions, for example at work shift changes.

1.2 Medication reconciliation and review

At each point in transitions of care, the medication a patient was taking prior to the transition needs to be identified. The best possible medication history (BPMH, see Annex 1) may differ from what was prescribed or dispensed and so the BPMH should be used to decide on the care required. At the next transition, the updated medication list and changes made to the BPMH should be communicated to the patient and future health care providers (Figure 3).

> **Medication reconciliation** is the formal process in which health care professionals partner with patients to ensure accurate and complete medication information transfer at interfaces of care (see Annex 1).

Medication reconciliation consists of *(7)*:
- Building the BPMH. The BPMH is obtained by following a systematic process of interviewing the patient, family or caregiver and verifying the history with at least one other reliable source of information to determine the complete and correct list of the patient's actual medication use at the time of the transition.
- Reconciling the BPMH with prescribed medication. The BPMH is compared with prescribed medication, discrepancies identified and resolved (with or by the prescriber) and changes documented, thus updating the medication list.
- Communicating accurate medication information. Information on the list of current medication and reasons for changes to the previous list is provided to the patient, family or caregiver and to health care providers to whom care is being transferred.

> **Medication discrepancy** refers to any difference between the medication use history and the admission medication orders. Discrepancies may be intentional, undocumented intentional or unintentional discrepancies (see Annex 1).

Intentional discrepancies are the result of conscious decision-making by a patient or health care professional leading to the change in medication history. Undocumented intentional discrepancies are a failure to document a conscious decision. **Unintentional discrepancies** occur when no conscious decision led to the change in medication history. Undocumented intentional discrepancies and unintentional discrepancies may result in medication errors, which in turn may lead to harm. Unintentional discrepancies fall into two categories: **omission** (for example, not prescribing a required medication) and **commission** (for example, lack of patient adherence, wrong dose or frequency, wrong medication or failure to communicate the reason for changes to medication therapy) *(8)*.

> **Medication review** is a structured evaluation of patient's medicines with the aim of optimizing medicines use and improving health outcomes. This entails detecting drug related problems and recommending interventions (see Annex 1).

Once medication reconciliation has been performed to ascertain the medication the patient has been taking, the medication review determines what the future treatment plan should be, in light of the patient's current health and living conditions.

During comprehensive medication review the risks and benefits of each treatment are considered and discussed with the patient and decisions made about future therapy. This may also occur at or after transition of care, as well as in primary, residential, acute or outpatient settings.

1.3 Medication-related harm

The goal of WHO's third Global Patient Safety Challenge: *Medication Without Harm* is to reduce severe, avoidable harm related to medications by 50% over five years globally *(5)*.

Medication-related harm refers to patient harm related to medication. It includes preventable adverse drug events (e.g. due to a medication error or accidental or intentional misuse) and non-preventable adverse drug events (e.g. an adverse drug reaction) (see Annex 1).

Medication-related harm should be identified and managed to optimize patient safety and reported to pharmacovigilance (see Annex 1) or patient safety reporting systems, as appropriate. The relationship and overlap between medication errors and adverse drug events is shown in Figure 2.

Why consider medication safety in transitions of care?

2

Medication-related harm may also arise as a consequence of medication errors occurring at a transition. Most patients admitted for inpatient hospital care will experience at least one medication discrepancy at one or more transition points, which may result in harm (Figure 5). Medication-related harm may also cause or contribute to the need for a transition in care, such as hospital admission.

Figure 5. Medication discrepancies at various transitions of care and frequency of medication-related harm

14-98% of community-dwelling older persons and 27-57% of those in residential aged care facilities had medication discrepancies *(9)*

3-97% of adult patients *(9)* and 22-72% of paediatric patients *(10)* had at least one medication discrepancy at admission

Community

Hospital admission

Discharge

Transfer within hospital

25-80% of patients had at least one medication discrepancy at discharge *(9)*

62% of patients had at least one unintentional medication discrepancy at transfer between units in hospital *(11)*

2.1 Prevalence of medication discrepancies at transitions of care

Estimating the prevalence of medication discrepancies is challenging owing to variations in the definitions, methods of detection and classification systems used *(12)*. A recent Cochrane review pooled 20 studies and found that 559 out of 1000 patients are at risk of having one or more medication discrepancies at transitions of care with standard health care *(13)*. These issues are illustrated by the widely varying rates of discrepancies at transitions of care *(9–11, 14–21)*. The available evidence indicates that this is a global problem at hospital admission, internal transfer, discharge and other transition points.

Discrepancies that are not identified and resolved may place the patient at risk of medication-related harm.

Hospital admission

Evidence identifies that most patients experience at least one medication discrepancy at hospital admission *(14)* and that this is a global issue. As illustrated below:
- 3.4–97% of adult patients *(9)* and 22–72.3% of paediatric patients *(10)* had at least one medication discrepancy on admission.
- A study conducted in Colombia, found 93.6% of patients had at least one medication discrepancy at admission with standard care, including omission of all over-the-counter medication *(15)*.
- 77.5% of patients had one or more medication discrepancy 24 hours after admission to a hospital in an Iranian study *(16)*.
- 47% of patients in a Swedish hospital had at least one medication discrepancy *(17)*.
- A mean of 1.72 medication discrepancies per patient was identified on admission to six hospitals in the United States of America *(18)*.

Transfer within hospital
- According to a Canadian study, 62% of patients had at least one unintentional discrepancy during internal hospital transfer *(11)*.

Discharge
- 25–80% of patients had at least one medication discrepancy or failure to communicate in-hospital medication changes at discharge *(9)*.
- A national multi-site audit examined discharge summaries in England and found that 79% of patients had at least one new medication started (with the reason documented for approximately half of the cases), 27% of patients had at least one medication stopped (with the reason documented for 57% of cases), and 23% of patients had at least one dose changed (with a reason documented for 39% of cases). Unintentional omissions of pre-admission medication were noted for one third of patients *(19)*.

Community
- 14.1–98.2% of patients had medication discrepancies when medication reconciliation was conducted in patients' homes, in the primary care clinic prior to doctor appointments or over the phone *(9)*.
- A multi-site audit of certain hospitals in England identified that intentional hospital medication changes were not actioned in the primary care system within seven days of discharge for 13% of patients and at least one change was actioned incorrectly for 6% of patients *(19)*.
- Similarly, an Irish study identified that discharge discrepancies persisted for 69% of patients and 8% had additional errors in the 10–14 days post-discharge *(20)*.

Residential aged care facilities
- 26.9–57.1% of patients had at least one medication discrepancy between the discharge summary and the residential aged care facility medication list *(9)*.
- A mean of 6.4 discrepancies per patient was identified between the resident's medication orders before and after hospitalization during medication reconciliation *(21)*.

Common types of discrepancies

There is diversity in the classifications of discrepancy employed in studies investigating medication safety at transitions of care. One systematic review identified omission of medication as the most common type of discrepancy. Other common types of discrepancy at transitions of care are wrong dose, interaction, contraindication, duplication) and failure to communicate changes *(12)*.

2.2 Medication-related harm during transitions of care

Many discrepancies at transitions of care do not result in harm; however, a considerable proportion of them do. For example, Salanitro et al. found 0.16 potentially harmful discrepancies at admission and 0.3 at discharge per patient *(18)*. In a systematic review between 11% and 59% of discrepancies at admission and discharge were considered to have potential for harm *(14)*.

Medication-related harm is a frequent cause of or contributor to hospital admission:

- 6.5% of patients' admissions to two acute hospitals in the United Kingdom were related to an adverse drug reaction, with the reaction directly leading to an admission in 80% of cases *(22)*.
- 8.8% of emergency admissions to an Irish hospital were related to adverse drug events *(23)*, with an adverse drug event identified in 26% of emergency admissions in patients aged over 65 years *(24)*.
- 11.3% of patients aged 60 years or over had an adverse drug event leading to admission, and 46.2% of patients experienced one or more adverse drug events during hospitalization in a Brazilian hospital. Risk factors for adverse drug events included multimorbidity (see Annex 1), number of medications and use of medication considered inappropriate for older patients *(25)*.

Adverse drug events may not be identified or diagnosed in the course of routine clinical screening and treatment, putting the patient at greater risk of further harm. Early confirmation of medication intake, and timely diagnosis and management of medication-related harm is necessary to minimize patient harm. Reporting adverse drug events to the patient safety incident reporting or pharmacovigilance systems, as appropriate, is necessary to facilitate learning at organizational, national and international level. It is acknowledged that there is likely to be an underrecognition and underreporting of medication-related harm in administrative health systems and databases in general *(26–28)*, when compared to research studies quantifying rates of adverse drug events. A study in England found that less than 1% of hospital admissions were due to adverse drug reactions *(29)*.In addition, in a study by Stausberg the prevalence of adverse drug events in hospitals was found to be 3.22% (3.20–3.23%) in England, 4.78% (4.73–4.83%) in Germany, and 5.64% (5.63–5.66%) in the United States of America *(30)*.

An individual patient's risk of experiencing medication-related harm, in any setting or in transitions between care settings, increases with the number of medicines (polypharmacy); high-risk medications (see Annex 1); or in the presence of morbidities (such as renal impairment). Individuals with multimorbidity and those with continuous complex care requirements may be particularly vulnerable to encounter adverse drug events associated with suboptimal care across their multiple care *(31, 32)*. Multicenter medication reconciliation quality improvement study (MARQUIS study) estimated an average of 0.45 potentially harmful medication discrepancies (either at admission or discharge) per patient in the United States of America *(18)*. However, it is difficult to estimate the potentially harmful discrepancies at admission and discharge and the number of harmed patients globally.

Harm from different types of medication discrepancies can be severe for individual patients, as in the examples below.

Omission post-discharge. A man was changed from warfarin to rivaroxaban (both anticoagulants, to reduce the risk of stroke in patients with atrial fibrillation) in hospital. The discharge prescription was transcribed onto the community prescribing system, but the anticoagulant was mistakenly omitted. Two months later, the man suffered a stroke and subsequently died.

Discharge prescribing error and delay in identifying medication-related harm. A doctor entered "LANZ" into an electronic system when wishing to prescribe lansoprazole (a proton pump inhibitor to reduce stomach acid) as a discharge medication, however incorrectly selected olanzapine (an antipsychotic), prescribing 30 mg (triple the usual starting dose and 10 mg above the maximum licensed dose). The patient became increasingly unwell, was readmitted into hospital under a different team and continued to deteriorate until a pharmacist identified the error during medication reconciliation. The patient took over 10 days to recover. The sequence of events leading to this error has been illustrated (Figure 6) in relation to the accident trajectory hypothesis of error prevention as proposed by James Reason, popularly known as the "Swiss cheese model".

Non-adherence: harm due to commission. A patient was admitted to hospital and his dose of methadone was confirmed with the national treatment centre and with the patient. On receiving his dose, the patient developed extreme opioid toxicity, requiring reversal. The patient had not been taking his methadone before admission, but had been selling it and did not wish his health care provider to know in case the dose would be reduced.

Lack of integrated care for physical and mental health. A 75-year-old resident in a nursing home was admitted to hospital with lithium toxicity due to deteriorating renal function. The physician discontinued the patient's lithium, resulting in a severe manic episode. Consequently the psychiatrist restarted lithium, as the reason for ceasing had not been communicated across the health care professional team. Lithium toxicity recurred, lithium was discontinued and mania recurred. Many months passed before treatment was stabilized when the patient's physical and mental health needs were taken fully into account.

Figure 6. Swiss cheese model as applied to medication-related harm

Discrepancy in discharge medication, olanzapine prescribed instead of lansoprazole

Patient received the wrong medication

Error went unnoticed even after patient deteriorated clinically and had to be admitted to hospital

Patient continued to receive wrong medication even while in hospital

Gaps in defences

Potential defences

A. Communication and collaboration between health care professionals

B. Access to health records to enable review

C. Medication review

D. Patient engagement and education

E. Medication reconciliation (identified by pharmacist)

Source: Adapted, with permission of the publisher, from Reason JT *(33).*

2.3 Economic impact

Medication discrepancies occurring at transitions impact on health care systems in addition to the patient. This may include the use of substantial health care resources in treating patients, staff's time in resolving discrepancies, and resources spent towards legal proceedings or claims due to negative outcomes of health care. An estimated 15% of total hospital activity and expenditure is a direct outcome of adverse events in OECD countries *(34)*. The global cost of medication errors has been estimated at US$ 42 billion annually *(35)*, with discrepancies and errors occurring at transitions of care contributing to this figure.

2.4 Limitations of the evidence base

Most studies that have quantified medication discrepancies or harm associated with medication use have been undertaken in high-income countries, with the majority performed at admission to or discharge from hospital. Less evidence is available about medication safety at transitions of care in low- and middle-income countries (LMICs) or in other points of transitions of care. However, the available evidence indicates that medication discrepancies may occur in LMICs *(15, 16, 36)* at least as frequently as in high-income countries *(11, 17)*.

3

What has been done to improve medication safety in transitions of care?

Potential solutions to address medication safety at transitions of care entail complex health care interventions, involving people, technology, systems and processes. As with many complex interventions, the targeted impact may be restricted by the prevailing national and local health service structures and organizations, resource capacities and capabilities (including human and technological resources), and cultural settings. Although many local, national and international initiatives are worthy of inclusion in this section, the potential solutions described below are selected from systematic reviews and meta-analyses. Despite having limited resources, some LMICs may still find these potential solutions applicable.

3.1 Engagement with patients, families and caregivers

Informed, knowledgeable and empowered patients and families can contribute greatly to their own positive health outcomes and safety, including preventing, identifying and taking early action to minimize harm associated with medication. Informed patients can navigate self-medication and health choices optimally *(8, 37, 38)*.

At transitions of care, partnership between health care professionals and patients, alongside families or caregivers is desirable. The patient is the single constant in patient care. Only the patient knows what medication they are actually taking at the time of a transition *(8)*.

Informed patients and patient tools
Patient education, medication literacy and appropriate use of tools can help patients in their medication management. These are crucial to preventing medication-related harm and improving medication safety at transitions of care *(38, 39)*. Two case studies of education as a solution are presented below.

Case study: Education as a solution to prevent errors with refill prescription

A 60-year-old Ugandan woman went to the doctor and was given a refill prescription for her blood pressure medication. She sent her grandson to the pharmacy to pick up the medicine. Fortunately, the grandson had been given health literacy education at school and he was also familiar with his grandmother's usual prescription. Although the medication was not accompanied by any printed information, the grandson immediately recognized that the dosing schedule on the container – one tablet three times a day – was incorrect. It should have been one tablet daily. Thanks to the vigilance of this young man, his grandmother did not take the excess doses of medication, which would have posed a serious danger to her. In Uganda the topic of health literacy is introduced in schools as a part of debates, music, dance and drama *(40).* Ugandan patient safety advocate, Regina Kamoga of the Community Health and Information Network (CHAIN) initiative says: "It is important to promote health literacy in schools because when children acquire knowledge early in life, they are better placed to adopt a healthy lifestyle."[1]

Case study: Improving knowledge and reducing misconceptions in a school-based intervention

A secondary school-based educational intervention in Ecuador consisting of a lecture followed by small working group seminars, improved knowledge and reduced misconceptions about self-medication and appropriate medication use. The intervention continued to demonstrate impact even after one year. Among the benefits were reductions in use of antidiarrhoeal medicines, cough suppressants, common cold medication and multivitamins, and an improved understanding of medication promotional activities *(41).*

There are multiple resources available to support engagement with patients for enhancing safe medication use. Some selected examples of these are:
- A series of information sheets about health literacy, its relevance to public policy, and the ways it can be used to promote good health is available in the WHO *Health literacy toolkit for low-and middle-income countries (42).*
- The Agency for Healthcare Research and Quality has produced the *AHRQ health literacy universal precautions toolkit*, with tools and resources highlighting self-management and empowerment, spoken and written communication, and supportive systems to promote better understanding of medications by adults and children *(43).*

Many information resources are available for patients on safe use of medication and patient engagement to support decision making in their treatment *(44–48).* Patient information materials on safe medication use (including discussing medication treatment choice, response to medication, medication adherence (see Annex 1) and asking questions about the medication with healthcare professions), reporting and prevention systems of medication safety incidents, and how to keep track of medications, are available internationally.

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1. Regina N. M. Kamoga, Community Health and Information Network, personal communication, 10 August 2017.

Patient-held medication list

The first step in the medication reconciliation process is to identify a patient's medication list. Patient knowledge and understanding about their specific medication can be supported by the use of a patient-held medication record or list.

Medication lists held by or accessible to patients, in paper (e.g. medication card or medication passport) or electronic form (e.g. mobile application), can facilitate patients to keep track of their medication and to share details with health care providers *(49)*.

Patient-held health or medication records are particularly common in LMICs. Large patient volumes, high health care professional workloads and limited availability of information technology (IT) contribute to limitations in, or absence of, organizationally stored patient records. This has led to local, regional and national systems where patients carry their medication information (or all health information) with them, bringing a booklet to healthcare appointments and pharmacies. These systems support ready access to the patient's medication list at health care interfaces. There is some evidence of the positive effect of a patient presenting a medication list at the time of hospital admission on medication safety. For example, Gleason et al. found that presenting a medication list at hospital admission was protective against medication error with potential to cause harm or to require intervention or monitoring post-admission *(50)*.

Many patients carry such a medication list with them at all times for their own needs. On the other hand, patients may not always carry a list or have it with them at the point of clinical need (either at scheduled care or acute admission). Other pragmatic suggestions include taking a photo of the list, or of the medicines, on a mobile phone, so that the information could be readily available to the patient at all times.

Mobile applications and wearables devices can be utilized to assist patients in managing their medication, by capturing and storing medication-related data on platforms, which can be remotely accessed by patients and treating health care professionals. Many of these mobile technologies have the potential for additional functionality, including medication adherence monitoring. Current development efforts also focus on platforms that integrate with patient's health records and produce mobile-accessible medication histories *(51)*. An innovative example of how medical information has been designed to be more accessible includes the wearable device to store digital vaccination records for women and children *(52)*.

Provision of specific medication information

Patients' understanding of their specific medications and how to use them can be aided by:

- **Affixing dispensing labels to the medicinal product.** It is a convention in many countries to affix dispensing labels to the medicinal product with product identification and directions for use.
- **Providing patient information leaflets.** Regulatory agencies sometimes require patients to be provided with information leaflets.
- **Providing counselling or advice on use of tools to aid patient understanding.** Limitations in the availability of time of health care professionals and other resources required to effectively engage with patients hinder the ability to consistently provide this support.

Support around discharge

A number of systematic reviews have been undertaken on the topic of medication safety at transitions of care. One of the aspects commonly identified in interventions as supporting patient safety is communication with the patient about discharge medication and follow-up with the patient after discharge. For example, Chukwuemeka Odumegwu Ojukwu University Teaching Hospital in Nigeria has a Drug Information Unit that supports patients after discharge from hospital. All medicine packets contain the unit's phone

number on which patients can call and ask questions or discuss problems related to their medication at any time.[2] Another study demonstrated that post-discharge follow-up with a pharmacist reduced medication discrepancies and improved patient knowledge 10–14 days after discharge *(53)*. This illustrates the potential benefit of providing support around discharge to reduce potential harm at transitions of care.

3.2 Medication reconciliation

Medication reconciliation is a process that facilitates transfer of accurate and complete patient's medication information at interfaces of care. Implementation of formal and structured medication reconciliation processes should include training of health care professionals with agreed roles and responsibilities of those involved. In addition, it should provide appropriate tools and technologies for the professionals to use.

The available evidence from major systematic reviews and meta-analyses on medication reconciliation indicate that a range of components can assist medication reconciliation *(54–56)*:

- medication reconciliation interventions with pharmacy staff involvement and multidisciplinary collaboration;
- interventions involving the patient, including the use of patient-held medication lists or medication passports (paper or electronic), and communication between patients and health care professionals;
- complex interventions to support discharge and post-discharge support, particularly for patients at high risk of adverse drug events; and
- communication between providers, including access to and interoperability of IT systems.

The ideal model is likely to involve a complex intervention drawing on aspects of many of these components. At each transition, patients should be asked about their experience with their medication. As outlined in section 2.2, adverse drug events are a frequent cause of or contributor to hospital admission, yet many of these reactions go unrecognized and remedial changes in medication therapy are not made.

A systematic review of hospital-based medication reconciliation on 26 controlled studies identified that performing medication reconciliation consistently reduced: 1) medication discrepancies (17 of 17 studies), 2) potential adverse drug events (5 of 6 studies) and 3) adverse drug events (2 of 3 studies). However, reduction in post-discharge health care utilization (improvement in 2 of 8 studies) was inconsistent. The interventions were categorized under pharmacist-related, IT-focused and others, such as staff education and use of a standardized medication reconciliation tool. Key aspects of successful interventions included intensive pharmacy staff involvement and targeting the intervention to a high-risk patient population *(54)*.

Although there is plenty of existing evidence to demonstrate the positive effect medication reconciliation can have on identifying and reducing the prevalence of medication discrepancies and associated potential for adverse drug events *(9, 21, 39, 54, 55, 57–59)*, there is also need to generate more evidence. A recent Cochrane review of 20 studies also emphasizes that more research on patient-level outcomes (for instance, on hospitalization, adverse drug events and healthcare utilization) is required to fully evaluate the potential of medication reconciliation as an intervention *(13)*.

Health workforce and skills mix considerations for medication reconciliation

The skills and expertise of different health care professionals should be utilized to improve medication safety at transitions of care, with collaboration and coordination to maximize efficiency and effectiveness.

A number of systematic reviews identified pharmacist or pharmacy involvement in medication reconciliation as being particularly effective *(54, 55)* and finding it economically attractive strategy for improving patient safety in acute care *(60)*. A systematic review and meta-analysis concluded that pharmacy-led medication reconciliation interventions at either admission or discharge reduced medication discrepancies *(55)*. Feldman et al. showed that medication reconciliation conducted in collaboration between nurses and pharmacists potentially prevented patient harm and was considered a cost–effective intervention *(61)*.

As part of the WHO High 5s Project, the same protocol to determine BPMH following emergency admission of patients aged 65 years and over was implemented in 12 hospitals in the Netherlands. Unintentional medication discrepancies reduced from 62% to 32% of patients with the pharmacy-based model (odds ratio (OR) 0.16; 95% confidence interval (CI) 0.12–0.21), however, there was no significant effect in hospitals where either a physician or a pharmacy technician obtained the BPMH (increase from 53% to 62%; OR 1.45, CI 0.88–2.39) *(57)*.

All United Kingdom medical schools require final year medical students to complete a prescribing safety assessment prior to commencing clinical roles, providing a reliable and consistent assessment of prescribing competence *(62)*.

Obtaining a medication history is an integral component of training of health care professionals. Multi-professional training modules should be updated to enhance the skills of all health care professionals for collecting BPMH.

The WHO *Patient safety curriculum guide* developed initially for medical schools and then as a multi-professional curriculum *(39, 63)*, addresses safe medication use, collecting complete medication histories, in addition to addressing essential topics such as: human factors, teamwork, managing clinical risk, engaging with patients, families and caregivers, and learning from errors. Both versions of the Curriculum Guide have had positive evaluations *(64, 65)* and have been found to be readily usable and comprehensive.

Educational interventions to improve medication reconciliation performance specifically have been examined in a systematic review. Varying success was achieved with medication reconciliation education interventions for students completing internal medicine clerkships or among residents. Improved competence and confidence was demonstrated in some studies, while others noted minimal effect *(66)*. More work is needed to determine successful components of educational interventions.

Medication reconciliation toolkits and resources

Health care leaders wishing to implement programmes to improve medication safety can learn from a wide selection of initiatives, many of which provide useful tips, toolkits and guidance, as described below.

WHO Patient Safety Solutions Project. As a part of its collaboration, WHO issued brief guidance with the former WHO Collaborating Centre for Patient Safety Solutions on *Assuring medication accuracy at transitions in care* in 2007 as a "patient safety solution" *(67)*.

WHO High 5s Project. The project – *Assuring medication accuracy at transitions in care: medication reconciliation (8)* – standardized recommendations and implementation of medication reconciliation in a number of

countries. An interim analysis of the WHO High 5s Project concluded that standardization was feasible and the project had a positive impact on reducing medication discrepancies in some hospitals as well as other positive effects, including improved teamwork and safety culture *(68)*. The toolkit includes a factsheet, a standard operating protocol and an implementation guide *(69)*.

The Institute of Healthcare Improvement. The Institute of Healthcare Improvement has included medication reconciliation in quality improvement campaigns since the *100,000 Lives Campaign* in 2005–2006, with many hospitals, health systems and collaboratives achieving admirable improvements (70). Resources, including the *How-to guide: prevent adverse drug events (medication reconciliation)* are available online *(71, 72)*.

The National Institute for Health and Care Excellence, National Patient Safety Agency. The guidance, issued in 2007, recommends having pharmacists involved in medication reconciliation as soon as possible after admitting an adult inpatient to hospitals in England and Wales *(73)*. It was supported by auditing and cost calculation tool.

The National Institute for Health and Care Excellence medication optimization guidance. The guidance includes recommendations on medication-related communication systems across transitions of care and medication reconciliation. It broadens the responsibility for all health care providers to share complete and accurate information about medication and reconcile medication within 24 hours of all transfers, and recommends discussing medication with patients and giving them a complete and accurate list of their current medication including any changes made during their stay prior to discharge *(74)*.

Medication at Transitions and Clinical Handoffs. Gleason et al. in collaboration with the Agency for Healthcare Research and Quality produced a comprehensive toolkit that can aid medication reconciliation improvement programmes. It guides users through a project management and process redesign approach and includes tips for conducting a patient interview, and information on metrics and the process of auditing to assess the process of the improvement programmes *(37)*.

Canadian Patient Safety Institute, Institute for Safe Medication Practices Canada and Accreditation Canada. Collaboration between these organizations and other partners aids progress in medication reconciliation and patient support *(75)*. Various resources are available including getting-started kits for acute care, long-term care and home care. The information kits include guides to medication history taking, building a BPMH, forms and formats of electronic systems, and information about quality improvement and measurement *(76, 77)*.

Many other countries and health care organizations have introduced various models, including integrated medication management and medication reconciliation solutions, with good results. For example, optimizing the medication use process in a comprehensive way has reduced morbidity, mortality, length of stay, readmission and medication administration error rate, and has improved medication appropriateness and communication across primary and secondary care interfaces *(8, 38)*. A number of other useful resources are available for which references are provided *(78–83)*.

3.3 Improvement in information quality and availability across transitions

Electronic systems can greatly facilitate seamless transfer of information, reduce transcription and decrease discrepancies at transitions of care.

Reliable information sources

Any single source of information, whether verbal, on paper or electronic, is a starting point for compiling a BPMH, and the most reliable sources should be combined with patient interview to compile the BPMH. Defining which sources are available and which are most reliable requires local evaluation.

The agreement of information sources with the BPMH, compiled from patient interview and information from all available sources, was evaluated for patients admitted through an emergency department in two Irish hospitals. This study by Grimes et al. found nursing home communication to be the most accurate source of information on what medications patients were actually using, followed by information from a national dispensing record database. The completeness of information was limited in many of the information sources for patient's medication, which highlights the need to carry out the full process to obtain a BPMH, including patient interview, rather than relying on a single information source *(84)*.

Electronic health records

Electronic health records (EHRs) are in increasing use globally. Many are single-site EHRs, or confined to inpatient records only. To optimize medication safety at transitions, EHRs or summary care records need to reflect the patient's medication usage across transitions, be accessible both to patients and to treating health care professionals, and be editable by all appropriate parties to ensure its completeness and accuracy.

A meta-analysis reported a 45% reduction in the proportion of medications with unintentional discrepancies with medication reconciliation supported by an electronic tool. It minimized particularly omission of medications *(85)*.

In addition, a systematic review of electronic tools to support medication reconciliation concluded that successful implementation of EHR required favourable context, well designed tools and attention to implementation features. Evaluations generally focused on usability, adherence and user satisfaction, with only one randomized controlled trial evaluating the effect on potential adverse drug events *(86)*.

Patients with access to EHR portals were found to have less visits, improved communication, optimal changes in their medication regime and improved adherence to treatment, however no consistent effect on health outcomes was identified *(87)*.

During the transition from primary care to secondary care the availability of EHR could enable pre-admission medication list to be viewed, confirmed with the patient, adjusted if necessary, and thus confirmed as the BPMH. Inpatient prescribing changes can then be introduced, either incorporated into the EHR or separately to the main record. On discharge, the BPMH should be referred to, with each medication confirmed as continuing, changed or discontinued and why. If any additional medications are prescribed, discharge prescription should be prepared that contains a full current medication list, with complete information including changes that occurred in hospital and rationale for them. Many countries have achieved considerable advances in improving medication information quality and availability across transitions of care *(88–92)*. This highlights the possibilities that EHR could have on safety of care during points of transition.

Tools and technology to facilitate medication reconciliation

Forms and checklists. Prompts or checklists can aid staff to perform all stages of complex processes. These can be in paper form or

converted to simple electronic forms, such as discharge communication requiring changes or discontinuations to be indicated and the reasons for them *(37, 38)*.

Information technology systems. Systems to facilitate medication reconciliation processes can improve safety and efficiency, and can be relatively inexpensive to develop and implement. A simple electronic system where discharge medication was entered in predefined fields, which then populated both the discharge prescription and summary, was demonstrated to be protective against non-reconciliation compared to handwritten discharges in Ireland. The electronic system has since been enhanced so that the BPMH is entered on or after admission *(93)*. At discharge, each medication is communicated as continued, changed (with a required reason), discontinued (with a required reason), or added.

Hospital computerized physician order entry systems and EHR can facilitate streamlined production of a more accurate and complete discharge summary and prescription *(94)*. Meta-analyses have found that medication reconciliation supported by an electronic tool minimized unintended discrepancies at transitions *(85, 95)*.

3.4 Discharge and post-discharge interventions

In order to ensure patient safety during and after discharge several interventions have been developed. These interventions vary in level of commitment, the involved health care provider and complexity and include *(54, 96–98)*:
- discharge planning
- medication reconciliation
- medication review
- electronic tools to facilitate information transfer to health care professionals and patients
- shared involvement in follow-up by hospital and community care providers, including

nurses, general practitioners and pharmacists
- web-based access to discharge information for general practitioners
- discharge letter shared with health care providers
- patient education and counselling at discharge and post-discharged.

The efficacy of these interventions in terms of improving post-discharge health outcomes is currently indefinite. A systematic review on improving patient handover from hospital to primary care, showed that various interventions, such as specific discharge programmes or comprehensive post-discharge follow-up, had positive effects on patient care, however the evidence is limited due to heterogeneity and the complexity of the interventions *(96)*. Additionally, two systematic reviews analysing community pharmacists' role in transitions of care *(97)* and patient education and counselling *(98)* as an intervention around discharge shared similar conclusions. Studies on specific interventions to reduce patient harm at discharge were also conducted, mainly on the effects of medication reconciliation and medication review. Although there is evidence for both interventions, more research is required *(9, 99, 100)*.

The main limitations with current evidence on the efficacy of interventions to improve health outcomes around discharge are the large heterogeneity, study characteristics and localized setting *(58, 96, 98)*. In addition, the clinical outcomes used to determine the efficacy of discharge interventions would need to be standardized to allow better comparability. Interventions reducing patient harm around discharge would preferably be multifaceted medication programmes, combining active counselling and medication reviews to attain safe discharge *(101)*.

3.5 The economic case

Admissions associated with an adverse drug reaction had a median inpatient stay of eight days and accounted for 4% of the hospital bed capacity in an English study. The projected annual cost was £466 million to the National Health Service *(22)*.

Investments in staffing to improve medication reconciliation processes have consistently been found to produce a return exceeding investment, due to shorter lengths of stay, reduction in patient harm and reduction in wastage of resources *(8, 102, 103)*. In order to justify the cost–benefit, modelling may be required to gain the support of health care leaders and other stakeholders. Two models are available as examples, these were created to justify improved or newly designed medication reconciliation implementation *(37)*. Research from many countries has demonstrated a positive economic impact of introducing medication reconciliation *(102, 104, 105)*. A return on investment (particularly in pharmacy staffing) of £5–£8 was achieved for each £1 invested *(104)*. Pharmacist-led medication reconciliation was one of only four strategies for improving patient safety judged to be economically attractive according to a systematic review by Etchells et al. *(60)*.

It is necessary to design measure and continuously improve any system or interventions to reduce patient harm arising at transitions. This ensures that systems and interventions achieve the maximum effect, are efficient and reduce unnecessary use of resources. The economic case for medication reconciliation should be built by medication safety experts alongside health economists to advocate to policy makers for investing resources in medication reconciliation, particularly in LMICs.

3.6 Challenges

Achieving medication safety in transitions of care is complex. Some of key challenges that need to be addressed include:

- recognition of the ubiquity and seriousness of the problem by health care leaders, providers, professionals and patients;
- leadership commitment to sustained improvement, with long-term planning, and strategic and operational implementation;
- need for coordination between and within primary and secondary health care settings, with communication, collaboration and information sharing;
- resource availability, including (a) health care professional staffing, (b) clinical pharmacy staffing, (c) access to high quality medication information, and (d) IT support;
- cultural, organizational and professional barriers to collaboration, communication and integration between health care professional groups, health care organizations and health care professionals and patients;
- patient understanding about how to use medication safely; and
- education, training and availability of tools and systems to support patients and health care professionals.

Obtaining the BPMH and reconciling medication on admission to hospital is resource intensive, taking 15 to 30 minutes per intervention. More time may be required if medication review, patient discharge counselling or other services are included. Certain patient groups might be at higher risk (e.g. patients with cognitive impairment or limited health literacy) for medication-related harm during transitions if not supported sufficiently *(37)*.

Limitations in workforce capacity and capability are a frequent barrier to improving medication safety at transitions, despite evidence that there is a return on investment that exceeds expenditure. Planning for and investing in the future health care workforce capacity, capability and skills mix, in all health care settings, is a

crucial component of achieving medication safety at transitions. Multiple studies have shown that there is a recognized benefit for clinical pharmacists in supporting rational medication therapy by doctors and nurses *(106–108)*. A recent study from Sri Lanka demonstrated that ward-based clinical pharmacy services reduced the frequency of medication-related problems and readmissions significantly for patients with non-communicable diseases *(109)*.

Solutions to improve medication safety at transitions of care are likely to be influenced by different national contexts. A WHO monograph, *Transitions of care: technical series on safer primary care*, identified some potential solutions and success factors in providing safer transitions of care *(38)*. The publication listed organizational culture as one of the most important factors in improving transitions of care. Research is needed to define common pathways of care in countries where health infrastructure and access is limited; map transition points where medication interfaces occur and reconciliation can fail; and develop and evaluate interventions to improve medication safety at transitions.

In addition, IT can also contribute to medication safety at transitions for instance, by facilitating access to information and reducing transcribing errors *(110)*. However, these solutions can be expensive and complex and may require both capital and human resources to develop, test, and continuously improve systems. The increasing availability of open platforms and portals however is making this potentially more achievable in economic terms. Challenges are also experienced with data protection and governance, developing reliable data dictionaries, interoperability of different systems, enabling access for patients, health care professionals and different health care providers, messaging between systems and the procurement process.

4 What needs to be done

Each country participating in the third WHO Global Patient Safety Challenge: *Medication Without Harm* is urged to take early priority action to improve medication safety in transitions of care.

4.1 Leadership commitment and planning

Health care leaders and providers would need to understand and acknowledge the ubiquity and seriousness of the problem *(8, 37)*. The following actions need to be undertaken in the area of leadership commitment and planning to develop improvement programmes for reducing medication-related harm at transitions of care:

- develop collaboration with key stakeholders and define clear goals;
- develop a long-term strategy to achieve the goals and put in place governance arrangements to oversee implementation and progress;
- identify and allocate sufficient resources, both in workforce and IT, to deliver the goals in the short, medium and longer term;
- invest in research to inform understanding of problems and solutions, particularly where health care contexts differ from those studied to date;
- plan, adapt, support and monitor the improvement programmes; and
- develop mechanisms for education and training for health care professionals and patients.

4.2 Improvement programmes

It is central to agree on goals and measures to make sure staff and patients are engaged in the process of achieving safer transitions of care. Quality improvement methods should be tested and tailored to the local situations before implementation. The improvement programmes should incorporate the key elements of patient empowerment, medication reconciliation and access to quality information. Measurement should track whether changes are resulting in the desired improvements. Examples of resources and toolkits for medication reconciliation are detailed in section 3.2.

4.3 Partnering with patients, families and caregivers

The patient is the one constant through all of their health care transitions and should be recognized as the key stakeholders in their health care *(8)*. Countries are encouraged to build upon the motivation and passion of patients and the public, to ensure medication safety, and engage patients and the public in all stages of improvement programmes. Extra support may be considered for patients for whom health, social, financial or cultural barriers may make safe transitions of care more challenging.

Proposed strategies to be implemented to engage patients, families and caregivers include:

- keeping a complete, up-to-date list of all medications, in paper or electronic form, including traditional, complementary and over-the-counter medicines;
- understanding the benefits and risks of their medications and to engage with healthcare professionals to agree which medications they will take;
- understanding how to use each medication, facilitated by dispensing labels, patient information materials, tools and records to improve medication literacy;
- be involved in the planning, design, delivery and monitoring of improvement initiatives (co-production); and
- identifying and reporting medication errors and adverse drug events.

4.4 Medication reconciliation

Implementing formal structured processes for building the BPMH, reconciling medication and supporting safe use of medication at all transition points can deliver positive patient outcomes.

Roles and responsibilities of health care professionals should be clearly defined, adequate financial and technical resources provided as well as support systems be established (including IT) to ensure effective medication reconciliation processes take place at every transition point *(8)*. Health care professionals involved in the reconciliation processes should receive appropriate competency-based education and training to ensure medication safety at transitions of care.

BPMH and reconciling medication on admission should be carried out by the following steps *(8)*:
- interviewing the patient, family or caregivers in a structured format designed to elicit information about all medications;
- verifying the information given by the patient, family or caregiver against at least one reliable source of information before returning

to the patient and confirming the list of medications;
- reconciling the BPMH with the current admission prescription to identify and resolve any discrepancies; and
- sharing the final medication list with the patient and other health care professionals.

Reconciling and communicating medication changes on discharge involves:
- retrieving the BPMH on admission (or determining this if it wasn't completed on admission);
- defining the final medication list at the time of discharge or transfer;
- deciding which medication is required after discharge or transfer and prescribing or listing it; and
- noting reasons for changes or discontinuations to medication during the admission and updating records to indicate the discharge list and changes.

It is also important to make tools, checklists and forms available to act as reminders and forcing functions (see Annex 1) to complete these processes *(37)*. Examples include a separate section on discharge documentation to indicate changes in medication on the time of admission; BPMH or medication reconciliation shared record; and cards, posters or tools highlighting the steps for medication reconciliation process.

Targeting medication reconciliation interventions to high-risk patients, including older persons, those on high number of medications, on high-risk medications or with morbidities such as renal impairment, may be of highest yield *(38, 54, 59)*.

4.5 Information quality and availability at all care transitions

Information to build the BPMH
Patients and health care professionals should have access to high-quality, up-to-date patient medication list information to aid seamless

transitions, for example:
- patient-held medication records, medication lists or medication passports, in paper or mobile app form;
- simple IT systems to facilitate or streamline medication reconciliation; and
- EHRs.

Communication and coordination should be improved between hospitals (public and private), the community (general practitioner, pharmacist and other health care providers), residential care, patients, and families or caregivers, including ensuring IT interoperability.

Information to support safe medication use

Health care professionals and patients should be ensured access to high-quality, up-to-date general medication information. National medication authorities, regulators, pharmacovigilance centres or patient safety agencies can support provision of accessible information for patients to understand and use medication effectively and safely. Access to such information will help health care professionals to identify medication (for example, through a database for identification of tablets and capsules) and to store, prescribe, dispense and administer safely. Medication information services can provide a valuable query-answering service within hospitals and to health care professionals and patients.

Confusion and medication error, including discrepancies at transitions, could be reduced by naming, packaging and labelling of medication that communicates the key information prominently (including name, strength, and form) and ensuring medication information is readily accessible to and usable by patients and health care professionals.

Use of the international nonproprietary name (INN) should be promoted to improve clarity and understanding for both patients and health care professionals. Patients and health care professionals also need to understand the limited situations (for example, some modified release or low therapeutic index medication such as antiepileptic medication) in which a specific brand should be used and not substituted. Understanding can be aided by ensuring the prominence of the INN in packaging, labelling and product information.

4.6 Building capacity of health care professionals

Improvement in medication practices across transitions of care requires health care professionals who are informed and educated about:
- the problem of unsafe medication practices and medication errors and their impact, while being motivated to lead and advocate implementation of appropriate measures with decision makers;
- how to address the problem, including obtaining a BPMH, when, by whom and how to carry out medication reconciliation, and how to communicate changes to other health care providers;
- considering patients as partners who need to be involved in decisions about their medication and who need to understand and agree with medication plans, and supported with training and tools to do so;
- collaborating in multidisciplinary environments, with roles and responsibilities clearly defined and working to maximize medication safety for patients at transitions; and
- working within systems and processes that support safe practice, with streamlined and better information, medication reconciliation and patient support.

These elements should be incorporated into undergraduate, postgraduate and continuing professional development curricula for all professionals involved in medication-related processes. Performance should be evaluated and feedback given, within the professional's work structure and as part of formal credentialing and professional appraisal.

4.7 Monitoring and measurement

Monitoring and measurement are a crucial part of improving healthcare processes *(8)*. Data and insight from measurement can enable health care leaders to monitor performance in transitions of care and to evaluate whether changes designed to facilitate medication safety in transitions of care translate to meaningful reductions in discrepancies and patient harm *(38)*.

In improvement programmes, goals are defined and samples are measured over time to determine if progress is being made towards the desired goals, if performance is showing normal variation or if there is deterioration. This is measurement for improvement, not research or judgement *(111)*. Both process and outcome measures should be tracked to give a realistic evaluation of the quality of transitions of care performance *(8, 72)*. Where possible, measurement should be embedded into routine processes or quality assurance systems and existing data sets should be used to minimize workload. If specific measurements are required, small sequential samples can be taken and run charts or control charts may be used to track and interpret data over time. Institute for Healthcare Improvement provides further guidance on this in their quality improvement toolkit *(112)*.

Some suggested measures are presented below.

1. Outstanding unintentional medication discrepancies

This process measure helps to verify the overall quality and effectiveness of the medication history and reconciliation processes *(8)* at any point of transition. This measure can be assessed using multiple indicators. A few indicators from the WHO High 5s Project *(8)* have been adapted to assess any point of transition. These adapted measures are presented below.

$$\text{Percentage of patients with at least one outstanding unintentional discrepancy}$$
$$= \frac{\text{Number of patients with at least one outstanding unintentional discrepancy}}{\text{Number of eligible* patients}} \times 100$$

$$\text{Mean number of outstanding unintentional medication discrepancies per patient}$$
$$= \frac{\text{Number of outstanding unintentional discrepancies}}{\text{Number of eligible* patients}}$$

* Eligibility may be adjusted depending on country and hospital context. All inpatients is recommended unless decisions have been made to focus improvement efforts and measurement on specific patient groups. A random sample of at least 30 patients is recommended by the WHO High 5s Project *(8)*.

2. Percentage of patients receiving medication reconciliation

This is a process measure that tracks the extent to which medication reconciliations are performed *(8)*, at any point of transition. This should be used in combination with other types of measures to track the safety of transitions of care. One indicator from the WHO High 5s project has been adapted to assess any point of transition. This adapted measure is presented below.

$$\text{Percentage of patients receiving medication reconciliation}$$
$$= \frac{\text{Number of eligible* patients receiving medication reconciliation}}{\text{Number of eligible* patients admitted}} \times 100$$

* Eligibility may be adjusted depending on country and hospital context. All inpatients is recommended unless decisions have been made to focus improvement efforts and measurement on specific patient groups.

3. Patient-centred measures

Patient and family engagement is considered as one of the foundations for safe, quality transitions of care *(113)*. Periodic assessments of patient experience and understanding could be considered to monitor the effectiveness of programmes, using validated patient survey instruments *(38, 114)*. Patient surveys can consist of a variety of questions to assess the transitions of care – one example from Ireland is displayed below. Further medication safety related survey questions, which have been used in Canada *(115)* and England *(116, 117)* are also available. In addition to patient surveys, patient and provider stories and experiences can also provide important perspectives to improve patient-centred measures *(118)*.

> Did a member of staff explain the purpose of the medicines you were to take at home in a way you could understand?
>
> ☐ Yes, completely
> ☐ Yes, to some extent
> ☐ No
> ☐ I did not need an explanation
> ☐ I had no medicines

4. Measuring medication-related harm arising at transitions of care

Measuring the prevalence of medication-related harm associated with transition of care is indispensable to understand whether the interventions to make processes safer are effective. To build empirical evidence on medication-related harm arising at transition of care, it is needed to have robust research methodology and periodic collection of data. Quantifying this harm is also significant for justifying rationale for investment in resources to implement medication safety interventions.

Other sources of information relating to medication safety at transitions of care may also be analysed to inform improvement efforts, e.g. patient safety incident and near miss reports (see Annex 1), patient, family, caregivers and staff complaints, pharmacovigilance reports, claims, and morbidity and mortality reviews. The rich information available from these sources should be considered qualitative and used to complement the quantitative measures suggested above, for example to obtain patient stories associated with transitions. However, they should not be used to measure the prevalence or incidence of harm.

Conclusions

Unintended medication discrepancies affect nearly every patient that moves across transitions of care. WHO urges countries to commit to prioritizing effective action for improving medication safety in transitions of care.

Information from global research and innovation is shared in this report, with the objective of facilitating those initiating or enhancing existing programmes to improve medication safety in transitions of care.

Meeting the complex challenge of reducing medication-related harm arising at transitions requires long-term leadership commitment, coordination and collaboration, formulation of goals and strategies, and investment of resources. Improvement programmes are needed to meet the goals. Key elements of programmes include implementing formal structured processes with enhanced workforce capacity and capability to deliver medication reconciliation at transitions, partnering with patients and families, improving information quality and availability, in particular a patient-held medication record or medication passport, and measurement.

Prioritizing this area for early and sustained action over the next five years will contribute to achieving the goal of the third WHO Global Patient Safety Challenge: *Medication Without Harm* – which is to reduce severe, avoidable medication-related harm by 50% globally.

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Annex 1. Glossary

Term	Definition and source used in glossary (see separate glossary references below)
Adverse drug event	Any injury resulting from medical interventions related to a drug. This includes both adverse drug reactions in which no error occurred and complications resulting from medication errors *(1)*
Adverse drug reaction	A response to a drug which is noxious and unintended and that occurs at doses used in humans for prophylaxis, diagnosis or therapy of diseases, or for the modification of physiological function *(2)*. These are often classified as two types: Type A and Type B *(3)* *Type A adverse drug reaction* An augmented pharmacologically predictable reaction which is dose dependent. It is generally associated with high morbidity and low mortality *(4)* *Type B adverse drug reaction* A bizarre reaction which is unpredictable pharmacologically and is independent of dose. It is generally associated with low morbidity and high mortality *(4)*
Anaphylaxis	A severe, life-threatening systemic hypersensitivity reaction characterized by being rapid in onset with potentially life-threatening airway, breathing, or circulatory problems and is usually, although not always, associated with skin and mucosal changes *(5)*
Best possible medication history	A medication history obtained by a clinician which includes a thorough history of all regular medication use (prescribed and non-prescribed), using a number of different sources of information *(6)*
Deprescribing	The process of tapering, stopping, discontinuing, or withdrawing drugs, with the goal of managing polypharmacy and improving outcomes *(7)*
Essential medicines	Essential medicines are those that satisfy the priority health care needs of the population *(8)*
Forcing function	An aspect of a design that prevents the user from taking an action without consciously considering information relevant to that action. It forces conscious attention upon something ("bringing to consciousness") and thus deliberately disrupts the efficient or automatized performance of a task *(9)*
Formulary	A list of medicines, usually by their generic names, and indications for their use. A formulary is intended to include a sufficient range of medicines to enable medical practitioners, dentists and, as appropriate, other practitioners to prescribe all medically appropriate treatment for all reasonably common illnesses *(10)*

Term	Definition and source used in glossary (see separate glossary references below)
High-risk (high-alert) medications	Drugs that bear a heightened risk of causing significant patient harm when they are used in error. Although mistakes may or may not be more common with these medications, the consequences of an error are clearly more devastating to patients *(11)*
Medication adherence	The degree to which use of medication by the patient corresponds with the prescribed regimen *(12)*
Medication discrepancy	Any difference between the medication use history and the admission medication orders *(13)*. Discrepancies may be intentional, undocumented intentional or unintentional discrepancies *(6)*
Medication error	Any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer *(14)*
Medication reconciliation	The formal process in which health care professionals partner with patients to ensure accurate and complete medication information transfer at interfaces of care *(6)*
Medication-related harm	Patient harm related to medication. It includes preventable adverse drug events (e.g. due to a medication error or accidental or intentional misuse) and non-preventable adverse drug events (e.g. an adverse drug reaction)
Medication review	A structured evaluation of patient's medicines with the aim of optimizing medicines use and improving health outcomes. This entails detecting drug related problems and recommending interventions *(15)*
Medication safety	Freedom from accidental injury during the course of medication use; activities to avoid, prevent, or correct adverse drug events which may result from the use of medications *(16)*
Medication use process	The multistep process in the use of medications by or for patients, including: prescribing, ordering, storage, dispensing, preparation, administration and/or monitoring
Medicines optimization	Ensuring that the right patients get the right choice of medicine, at the right time. By focusing on patients and their experiences, the goal is to help patients to (a) improve their outcomes; (b) take their medicines correctly; (c) avoid taking unnecessary medicines; (d) reduce wastage of medicines; and (e) improve medicines safety *(17)*
Multimorbidity	The presence of two or more long-term health conditions, which can include (a) defined physical and mental health conditions such as diabetes or schizophrenia; (b) ongoing conditions such as learning disability; (c) symptom complexes such as frailty or chronic pain; (d) sensory impairment such as sight or hearing loss; and (e) alcohol and substance misuse *(18)*
Near miss	An incident that did not reach the patient *(19)*
Patient safety	The absence of preventable harm to a patient and reduction of risk of unnecessary harm associated with health care to an acceptable minimum. An acceptable minimum refers to the collective notions of given current knowledge, resources available and the context in which care was delivered weighed against the risk of non-treatment or other treatment *(20)*
Pharma-covigilance	Science and activities relating to the detection, assessment, understanding and prevention of adverse effects or any other drug-related problem *(2)*

Term	Definition and source used in glossary (see separate glossary references below)
Polypharmacy	Polypharmacy is the concurrent use of multiple medications. Although there is no standard definition, polypharmacy is often defined as the routine use of five or more medications *(21)*. This includes over-the-counter, prescription and/or traditional and complementary medicines used by a patient
Potentially inappropriate medications	Medications with ineffectiveness or high risk–benefit ratio for a particular individual or group of individuals *(22)*
Safety	The reduction of risk of unnecessary harm to an acceptable minimum *(19)*
Side effect	A known effect, other than that primarily intended, related to the pharmacological properties of a medication *(19)*
Transitions of care	The various points where a patient moves to, or returns from, a particular physical location or makes contact with a health care professional for the purposes of receiving health care *(23)*

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