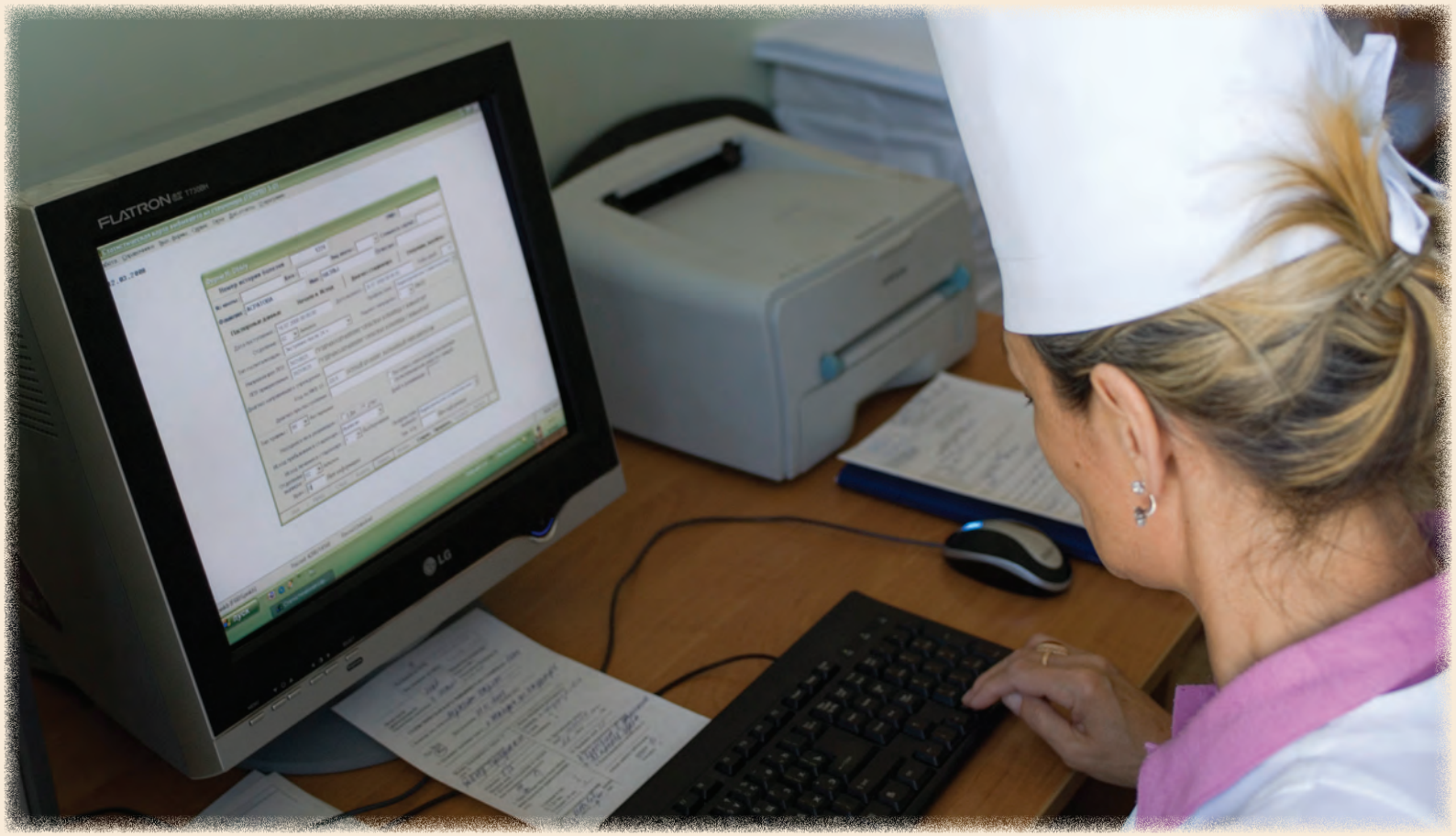
Electronic Tools



Technical Series on Safer Primary Care

World Health Organization

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Contents

Preface

Safer Primary Care

Health services throughout the world strive to provide care to people when they are unwell and assist them to stay well. Primary care services are increasingly at the heart of integrated people-centred health care in many countries. They provide an entry point into the health system, ongoing care coordination and a person-focused approach for people and their families. Accessible and safe primary care is essential to achieving universal health coverage and to supporting the United Nations Sustainable Development Goals, which prioritize healthy lives and promote well-being for all.

Health services work hard to provide safe and high quality care, but sometimes people are inadvertently harmed. Unsafe health care has been recognized as a global challenge and much has been done to understand the causes, consequences and potential solutions to this problem. However, the majority of this work up to now has focused on hospital care and there is, as a result, far less understanding about what can be done to improve safety in primary care.

Provision of safe primary care is a priority. Understanding the magnitude and nature of harm in primary care is important because most health care is now offered in this setting. Every day, millions of people across the world use primary care services. Therefore, the potential and necessity to reduce harm is very considerable. Good primary care may lead to fewer avoidable hospitalizations, but unsafe primary care can cause avoidable illness and injury, leading to unnecessary hospitalizations, and in some cases, disability and even death.

Implementing system changes and practices are crucial to improve safety at all levels of health care. Recognizing the paucity of accessible information on primary care, World Health Organization (WHO) set up a Safer Primary Care Expert Working Group. The Working Group reviewed the literature, prioritized areas in need of further research and compiled a set of nine monographs which cover selected priority technical topics. WHO is publishing this technical series to make the work of these distinguished experts available to everyone with an interest in *Safer Primary Care.*

The aim of this technical series is to provide a compendium of information on key issues that can impact safety in the provision of primary health care. It does not propose a "one-size-fits-all" approach, as primary care is organized in different ways across countries and also often in different ways within a given country. There can be a mix of larger primary care or group services with shared resources and small services with few staff and resources. Some countries have primary care services operating within strong national support systems, while in other countries it consists mainly of independent private practices that are not linked

or well-coordinated. The approach to improving safety in primary care, therefore, needs to consider applicability in each country and care setting.

This technical series covers the following topics:

Patients

- Patient engagement

Health workforce

- Education and training
- Human factors

Care processes

- Administrative errors
- Diagnostic errors
- Medication errors
- Multimorbidity
- Transitions of care

Tools and technology

- Electronic tools

WHO is committed to tackling the challenges of patient safety in primary care, and is looking at practical ways to address them. It is our hope that this technical series of monographs will make a valuable and timely contribution to the planning and delivery of safer primary care services in all WHO Member States.

1 Introduction

1.1 Scope

This monograph aims to raise awareness among World Health Organization (WHO) Member States about the role of electronic tools and eHealth in safer primary care. After outlining the approach taken to compile information, the monograph examines electronic tools used by providers and patients.

The focus is on using electronically stored data and communication technology to accomplish health systems' goals, including improving health care efficiency and quality, and empowering patients to play a more active role in their health *(1).* The term "electronic tools" in this monograph is used as equivalent definition of WHO "eHealth" throughout this monograph, which is the use of information and communication technologies in health.

1.2 Approach

To compile information for this monograph, WHO sought the advice of experts in the field recommended by the Safer Primary Care Expert Working Group and reviewed relevant research and the published literature.

International experts provided feedback, shared examples of strategies that have worked well around the world, and gave practical suggestions about potential priorities for the WHO Member States to improve the safety of primary care services.

2 Electronic tools

Electronic tools, or eHealth can have an important impact on safety in primary care. Well-designed and implemented, the use of information and communication technologies in health service delivery can link health care workers with one another and with patients and families in order to provide high-quality care that is safer, more reliable, more efficient, equitable and sustainable *(2)*. When strategically used across the health system, eHealth can enable health systems to function effectively, and support health services to deliver integrated, coordinated interventions that engage patients and address their needs across the health continuum *(3)*.

Experts from around the world identified that key vulnerabilities for patient safety in every health system include communication and teamwork, ordering and interpretation of diagnostic tests, data management, transitions between levels of care, and completeness of patient records *(4)*. eHealth can help to address these vulnerabilities by, for example, providing decision support for prescriptions and test orders, improving documentation and communication for handovers between providers, tracking and sharing diagnostic test results, and enhancing data monitoring and analysis *(5)*.

However, it must be emphasized that electronic tools support, rather than replace the expertise of high-functioning teams of health care providers. Achieving safer primary care requires thoughtful integration of eHealth into primary care service delivery. It also requires a paradigm shift away from reactive approaches towards approaches that improve quality of care, strengthen provider-patient interactions and empower patients and families as essential partners in care. Electronic tools can support this process, but are not an end in themselves.

3 Potential solutions

The following sections provide examples of how eHealth is supporting safer care in a range of health systems around the world. Overall, linking the implementation of electronic tools in local settings to a national eHealth strategy is essential as it provides the foundation, justification and support needed to go forward in a coordinated and systematic way.

3.1 Provider-facing technologies

Electronic health records

Electronic health records are digital records systems that replace or complement paper records as the means by which providers and patients keep track of patients' health information. Electronic health records also allow providers to share information more easily and communicate with one another about patient care *(6)*. They typically contain a patient's medical history, diagnoses and treatment, medications, allergies, immunizations, as well as radiology images and laboratory results *(7)*.

Electronic health records can support safer primary care in a number of ways. First, they can help to ensure and standardize documentation of patient encounters with the health system. When they include decision support functions, they may reduce medication errors by alerting providers to potential drug-drug interactions or errors in dosage. By enabling electronic prescriptions, they can help circumvent potential errors due to illegible handwriting *(8)*. Electronic health records can also help with handovers between providers by structuring and facilitating information exchange to ensure that essential information is documented and shared *(6)*.

Electronic health records demonstrate many benefits, but evidence of their impact on safety is mixed. Poorly-designed and implemented electronic health records may create more work for providers and contribute to dissatisfaction and burnout *(9)*.

It is important for policy-makers in health systems to establish eHealth policy and to implement electronic health records strategically to ensure their integration into clinical practices as well as adaptation to the local context. For some health systems, this may involve the introduction of electronic health records to replace paper records. For others, it may mean having integrated electronic information systems between primary care and hospital and social care. A study in seven high-income countries found that some countries achieved more positive results with electronic health records than others due to a combination of financial and quality of care incentives and varying levels of government investment *(10)*. Provider expectations need to be carefully managed so electronic health records are not seen as a panacea for all care delivery and safety challenges.

Population management tools

Electronic health records document an individual's care. Building on this, population management tools can be used with aggregated electronic health records (or datasets) to review various aspects of care and plan for the care of larger patient populations. This may include initiatives to support adherence to guidelines for health promotion, disease prevention and the management of long-term conditions. These datasets can also be "mined" to look for disease trends and used as a means of detecting potential errors, including missed or delayed diagnoses *(11)*.

Other population management tools can help primary care teams and health systems to provide proactive and safe care. For example, patient registries are lists of patients with specific conditions. These can be used to identify and reach out to groups of patients for recommended preventive care, such as those requiring immunizations or cancer screenings. Well-designed population management tools create and continuously update registries by monitoring and analyzing data from electronic health records. Patient registries can also be used to track patients with important presenting symptoms (e.g., breast lump) or abnormal diagnostic findings to signal the need for follow up.

There are also examples of approaches to mining large amounts of data to find "diagnostic triggers" or instances of potential delays in diagnosis *(12).* These tools do not rely on patients returning for an appointment with their provider to register whether follow-up has happened. They can be designed with triage functionality to focus attention on the most critical situations.

Mobile technologies

Electronic tools are essential to connect members of the health care team, including community health workers. Mobile technologies are becoming an important resource for health service delivery due to their ease of use and wide acceptance *(13)*. Health personnel in remote and rural areas can particularly benefit from using smartphones to stay connected to knowledge resources and information systems as they provide care.

Mobile phone applications for data entry, electronic decision support, job aids, and the use of text messages as reminders are examples of mobile tools in broad use *(14)*. Such tools can help increase health worker's engagement within the communities they work and increase peer-to-peer communication between community health workers to facilitate support and sharing of good practice *(15)*.

3.2 Patient-facing technologies

Two growing areas of investment and innovation are patient-facing tools focused on self-management and technologies that link patients and providers directly. These tools offer more efficient possibilities for providing health services including in difficult-to-reach settings. The aim of many of these tools is to enhance patient empowerment, activity and agency in their own care, thereby improving efficiency, patient experience and safety.

Patient self-management tools

Most illness management, including medication adherence, disease monitoring, healthy lifestyle choices and symptom management, occurs outside of the formal health system. Patient self-management is therefore fundamental for better health care. A number of interventions using electronic tools have been developed to facilitate patient self-management for common conditions such as asthma, hypertension and diabetes *(16).*

With an increasing number of people using mobile phones and devices, there is great interest in fostering their availability and effective use to improve health care delivery and safety. Real-time feedback from prevention to diagnosis, treatment (including adherence) and monitoring are some of the benefits relevant to improving safety; other benefits include system-wide tracking of medication stock-outs and end-to-end tracking of medications, emergency call centres and information access.

Mobile applications to support self-management are expanding rapidly in number and scope, but to date there is mixed and somewhat limited evidence about the effectiveness of these tools. Systematic reviews of smartphone and tablet applications (apps) have found equivocal effects *(17)*.

By contrast, reviews of online interventions for lifestyle and nutritional behaviour change have generally positive outcomes, particularly where there is interaction involved *(18).* Text messaging reminders and decision support also often have positive outcomes *(19).*

Socioeconomic and geographic factors may be a barrier to accessing health care facilities, especially among the most poor and vulnerable populations. A number of low-income countries have started to adopt electronic tools to support patient self-management to fill in the gap of access to health care. Research by WHO found that 77% of low-income countries were using text messages or other mobile communication tools to improve treatment concordance *(20).*

Patient portals

In high-income countries, electronic health records are increasingly linked to personal health records or patient portals. These portals allow patients to access all or part of their own health information (e.g. medication lists and laboratory test results). Such tools may also allow direct and secure communication between the patient and a health care provider about scheduling, test results, prescription refills and clinical questions. Having access to records can help patients correct or prevent potential medical errors *(21)*. Research suggests that this approach is acceptable to clinicians and can increase patient satisfaction and adherence *(22)*.

Telemedicine

Telemedicine is a classic eHealth tool linking patients to providers, as well as providers with one another by means of an audio-visual link. In this way, patient consultation is provide from a distance instead of through face-to-face interaction.

Telemedicine is typically used to help patients and communities that would otherwise have limited access to primary care providers. Primary care providers have also used telemedicine to gain help interpreting diagnostic imaging results with support from specialists in other locations. Telemedicine support such as this can be of an equivalent quality to in-person specialist visits *(23)*.

Patient barriers to adoption

While electronic tools have much potential, it is important to recognize barriers that may prevent patients from using them. Internet access and computer or smartphone availability and literacy are often required as a minimum. Age, gender, ethnicity, language, education level and socioeconomic status may also be potential hurdles *(24)*.

4 Practical next steps

Electronic health tools have been implemented around the world. They create an opportunity for safer primary care in many settings, although there can be unintended consequences, such as technical errors, data security concerns and altering the dynamics of communication between patients and providers *(25)*. In some rural areas, more people may have more access to mobile phones than to clean toilets. Each country and community needs to consider the local context when planning to use electronic tools to support safer primary care.

Strategies that WHO Member States could consider prioritizing while implementing electronic tools to improve safety in primary care include:

1. Investing strategically

- planning the adoption of electronic tools in line with national programmes or strategies for eHealth development;
- ensuring that electronic tools are fit-for-purpose at the primary care level, and adapted to the local context;
- recognizing that the tools themselves will not be stand-alone solutions and therefore adopting standards that will allow later integration with other eHealth tools.

2. Learning from trends and experience

- sharing of the eHealth experience of other countries, as well as trends and best practices; understanding of the outcomes that can be achieved, and the types of goals for which eHealth is relevant;
- investing time in this research to gain an appreciation of the potential technologies, challenges and risks that should be considered in planning *(26)*.

3. Creating an infrastructure to support the use of electronic tools

- recognizing that eHealth (in all its forms) must be implemented on a foundation of infrastructure, standards, legislation, which require a long-term outlook and commitment;
- recognizing that the adoption and effective use of eHealth in primary care settings will depend on a capable and engaged workforce;
- embedding primary care coding systems into electronic health records to allow for quality improvement activities, which are relevant to primary care.

5 Concluding remarks

Primary care services are at the heart of health care in many countries. They provide an entry point into the health system and directly impact on people's well-being and their use of other health care resources. Unsafe or ineffective primary care may increase morbidity and preventable mortality, and may lead to the unnecessary use of scarce hospital and specialist resources. Thus, improving safety in primary care is essential when striving to ensure universal health coverage and the sustainability of health care. Safer primary care is fundamental to the United Nations Sustainable Development Goals, particularly to ensure healthy lives and promote well-being for all at every age.

Understanding the magnitude and nature of harm in primary care is important because a significant proportion of health care is offered in this setting, yet there is little clarity about the most effective ways to address safety issues at this level.

This monograph summarizes the evidence and experience for the application of electronic tools and technologies in order to improve patient safety in primary care. However, electronic tools and technologies would need to be implemented in conjunction with other important aspects covered in this series.

The *Technical Series on Safer Primary Care* addresses selected key areas that WHO Member States could prioritize according to local needs. This section summarizes the key messages from all of the monographs and provides a list of 10 key actions that are likely to have the most impact on improving safety in primary care. Links to online toolkits and manuals are also referenced in order to provide practical suggestions for countries and organizations committed to moving forward this agenda.

1. Set local priorities

Countries and regions differ and a strategy that works well in one area may not transfer well to another. Similarly, issues in need of improvement in some regions may not be a priority for others. In seeking to improve safety in primary care, countries could use local information about their safety issues to identify key priorities at the national or regional level. Priority setting could be accomplished by drawing on input from patients and professionals, sourcing local statistics on safety issues and comparing key themes from the literature with local circumstances *(27).*

Checklists are also available to help identify potential patient safety issues such as environmental risks in primary care services *(28).*

One practical way to move forward is creating mechanisms for bringing together key stakeholders to consider the local information available and develop strategic and operational plans for improving safety in primary care. Communicating proposed priorities widely and amending them based on feedback from health

care professionals and patients would help to obtain their buy-in, as well as raise awareness of the importance of improving patient safety in primary care.

Regular measurement of safety related performance indicators could be considered as one of the priorities. Policy-makers can use measurements to help identify local issues where performance is suboptimal and then evaluate different types of interventions for improvements. Priorities could be reviewed every few years to ensure that they remain in line with local needs and good practice.

2. Take a wider systems approach to improving safety

Although the series has described specific technical areas, each monograph refers to interlinkages with other areas. Focusing on improving just one factor may not have a large or sustainable impact on patient safety overall. It may be important to simultaneously improve communication with patients, train health care professionals and introduce new tools to support more streamlined care.

Taking a systems approach to safer primary care means looking at how different components relate to one another and considering various factors which could influence safety. These include factors such as workforce availability and capability.

A practical systems level initiative is to focus on increased communication and coordination across different types of care including primary, secondary and also social care. This may include strengthening technical systems for sharing records and communicating what is happening.

It is also important to build relationships between care professionals. At a policy level, this may involve considering how to develop supportive infrastructure, such as having a directory of services to help build networks of professionals and align resources. If hospital, primary care and social care professionals are able to meet and discuss safety issues, this could foster supportive relationships and increase understanding of each other's roles. Regional forums or meetings could be set up so that professionals from different organizations can get to know each other and share their successes and challenges in improving patient safety.

Manuals and reference lists are available with further ideas for improving coordination and reducing fragmentation across systems *(29,30).*

3. Communicate the importance of safety in primary care

Policy-makers, health care professionals, patients and families may not always be aware that there are important safety issues to consider in primary care. Raising awareness of this as a priority area will help stakeholders to understand why safety in primary care is essential to improve people's well-being and for safeguarding scarce health care resources.

Serious consequences due to the lack of safety in primary care, particularity relating to poor transitions of care between primary and other levels, and administrative, diagnostic and medication errors could be highlighted to raise awareness on the need to improve patient safety in primary care.

Practical ways to increase awareness include incorporating safety-related information into the training of health professionals, communicating effectively to professionals and patients through channels that would be most appropriate for them and spreading key messages through media campaigns. A communications plan could be developed in tandem with local priority setting discussed earlier.

4. Focus on building a positive safety culture

Effective leadership and supportive culture are essential for improving safety in primary care.This means creating an environment where professionals and patients feel able to speak up about safety issues that they are concerned about, without fear of blame or retribution. It means promoting an environment where people want to report risks and safety incidents in order to learn from them and reduce their recurrence, and where incidents are seen as caused largely by system failures rather than individuals. This also includes the importance of having feedback mechanisms in place to explain any improvements made after safety issues have been raised. Promoting transparency is key to building a strong safety culture.

A number of tools are available describing approaches to support the development and measurement of a positive safety culture *(31,32).*

Practical steps that could be taken to strengthen safety culture include: leadership walkrounds, whereby senior managerial and clinical leaders "walk the floor" (in this case, leaders visiting clinics and speaking with staff and patients about what is working well and not so well); starting team meetings with a patient story; using reflective practice to focus on safety issues, such as audits and having mechanisms for reporting safety issues, such as through regular team meetings. Such approaches may need to be adapted for use in smaller primary care clinics. Regardless of the specific method, the focus should be on raising awareness, encouraging safety discussions and taking concrete follow-up actions to build a safety culture.

5. Strengthen ways of measuring and monitoring patient safety

It is important to measure and monitor patient safety improvements over time. This may include having clear definitions of patient safety incidents and indicators to be measured annually, setting up national or local incident reporting systems where data is compiled regularly, or using tools to assess patient experiences and measure improvements in patient safety.

Using checklists in individual practices can both improve the quality of care and act as a structured form of record keeping. A number of examples of checklists to improve safety monitoring are available *(33).*

Data quality is fundamental to measuring improvements in patient safety. If accurate and comprehensive medical records are not kept, then errors and omissions are more likely to occur. As health systems mature, clinical governance processes tend to strengthen. This includes having processes for managing risks and identifying strategies for improvement.

A number of tools are available to measure and monitor different aspects of safety in primary care and countries could examine what is currently available and adapt materials based on local priorities *(34,35).*

6. Strengthen the use of electronic tools

The adoption of electronic tools will be critical to improving safety in many ways. Examples include the use of electronic health records for more accurate and complete patient records; timely and reliable sharing of health data; supporting the diagnosis, monitoring and management of diseases and conditions; effecting behaviour change and reduction of health risk, and empowering and engaging patients and families in their own care. eHealth can help structure communication between professionals in a way that reduces errors and improves coordination. It can reduce unnecessary consultations and hospitalizations and improve access to knowledge about health conditions and their management for both professionals and patients. However, to achieve their full potential, electronic tools need to be integrated with other parts of service delivery and adapted to the local context.

It takes time and resources to implement electronic tools, and requires the capacity to use and maintain them. It is therefore important to be strategic and to understand the foundations and design of systems in order to ensure the best return on investment. Linking the implementation of electronic tools in local settings to a national eHealth strategy is essential as it provides the foundation, justification and support needed to go forward in a coordinated way.

Irrespective of the status of the health system, it is important to strengthen the use of electronic systems to improve patient safety. For some countries, this may involve the introduction of electronic health records to replace paper records. For others, it may mean having integrated electronic systems between primary care and hospital and social care, or making the tools easier for professionals and patients to use. Countries could draw on lessons learned from other countries about implementing electronic health records, including the challenges faced and how these were overcome, and what best practices could be applicable to their own setting.

7. Involve patients and family members

Empowering and encouraging patients to speak up, for example when something does not seem right or when a symptom is inadequately explained, can be fundamental to improving patient safety. Family members play a key role as advocates and informal carers and therefore supporting and educating them can help to improve safety.

Proactive engagement of patients and families can help to accelerate the implementation of health care safety initiatives. When systems open themselves up to patients rather than being reactive, this is likely to improve system efficiency and the quality of care.

A number of tools have been evaluated to enhance patient and family involvement and awareness, including those with limited or low literacy skills *(36-39).*

8. Strengthen workforce capacity and capability to improve safety

There is a need to strengthen the primary care workforce in many settings by training a large pool of generalist workers, including doctors, nurses and those with supporting roles.

Strengthening the workforce also involves focusing on recruitment and retention, including taking steps to enhance the physical and physiological safety of health care workers. Professional burnout, fatigue and stress can all adversely affect patient safety.

The education and training of health care professionals to manage and minimize potential risks and harm that can occur in primary care are central to improving safety at all levels of care. This includes providing training on patient safety for students (including students who may not be training to work in primary care to ensure understanding across the different care pathways), multidisciplinary and inter-professional education, as well as continuing professional development. A number of free training course materials are available to help with this *(40-42)*. As a further step, consideration could be given to making involvement in safety and quality improvement a requirement for ongoing training and professional licensure.

In addition to formal education, informal approaches could also be applied to build the capacity of health workforce to improve safety. This may include holding regional meetings and coaching sessions to review patient safety incidents and areas for improvement, and holding small team meetings to upskill staff.

9. Focus on those at higher risk of safety incidents

Some people are at greater risk of safety incidents in primary care. These include children, older people, those living in residential care or nursing homes and people with multiple health conditions. People with simultaneous mental health and physical health issues are also at increased risk of safety incidents.

Focusing on groups at higher risk may improve the quality and safety of care by providing more personalized care and ensuring smoother transitions between and within services. For instance, upskilling professionals in how to identify and treat depression may have an impact given the high rate of adverse events among those with combined mental and physical health issues.

Across the world, most systems were not designed to care for people with multiple health conditions. Systems may thus need to focus more on what can be done to improve care for people with multiple conditions, including whether social interventions would be more worthwhile than increasing medicalization.

A number of guidelines and toolkits suggest practical steps to better support people at higher risk of safety incidents *(43-47).*

10. Celebrate successes and share learning with others

Local teams, regions and countries should celebrate their successes and share learning with others. Hearing what has worked well can spark ideas in others and help to continue the momentum towards safer primary care.

Ongoing research plays a key role in identifying what works best to improve safety and how to implement best practices and success stories across diverse care settings. Although the technical series has drawn together a wide range of evidence and expertise, it has also highlighted a number of gaps about what works best to improve patient safety in the primary care context. By continuing to promote learning through research, and publishing and disseminating findings, countries could contribute to knowledge in this area.

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References

1 Harrison J, Lee A.The role of e-Health in the changing health care environment. Nurs Econ. 2006;24(6):283-8.

2 Bates D, Bitton A. The future of health information technology in the patient-centered medical home. Health Aff. 2010;29(4):614-21.

3 Sittig D, Singh H. A new socio-technical model for studying health information technology in complex adaptive health care systems. Qual Saf Health Care. 2010;19(3):i68–i74.

4 Creswell K, Panesar S, Salvilla S, Carson-Stevens A, Larizgoitia I, Donaldson LJ, et al. Global research priorities to better understand the burden of iatrogenic harm in primary care: an international Delphi exercise. PLoS Med. 2013;10(11):e1001554.

5 Bates D, Gawande A. Improving safety with information technology. N Engl J Med. 2003;348(25):2526-34.

6 Jones SS, Rudin RS, Perry T, Shekelle PG. Health information technology: an updated systematic review with a focus on meaningful use. Ann Intern Med. 2014;160(1):48-54.

7 Third global survey on eHealth, 2015. WHO Global Observatory for eHealth. (http://www.who.int/goe/survey/2015survey/en/) access on 19 September 2016.

8 Bright T, Wong A, Dhurjati R, Bristow E, Bastian L, Coeytaux R, et al. Effect of clinical decision-support systems: a systematic review. Ann Intern Med. 2012;157:29-43.

9 Ash J, Sittig D, Poon E, Guappone K, Campbell E, Dykstra R. The extent and importance of unintended consequences related to computerized provider order entry. J Am Med Inform Assoc. 2007;14:415-23.

10 Jha AK, Doolan D, Grandt D, ScottT, Bates DW.The use of health information technology in seven nations. Int J Med Inform. 2008;77(12):848-54.

11 Zheng H, Gaff H, Smith G, DeLisle S. Epidemic surveillance using an electronic medical record: an empiric approach to performance improvement. PLoS ONE. 2014;9(7):e100845.

12 Murphy DR, Laxmisan A, Reis BA, Thomas EJ, Esquivel A, Forjuoh SN, et al. Electronic health record-based triggers to detect potential delays in cancer diagnosis. BMJ Qual Saf. 2014;23:8-16.

13 WHO EB139/8, 27 May 2016. mHealth: use of mobile wireless technologies for public health.

14 Kallander K, Tibenderana JK, Akpogheneta OJ, Strachan DL, Hill Z, Ten Asbroek AH, et al. Mobile health (mHealth approaches and lessons for increased performance and retention of community health workers in low- and middle-income countries: a review. J Med Internet Res. 2013;15(1):e17.

15 Strachan DL, Kallander K, Ten Asbroek AH, Kirkwood B, Meek Sr, Benton L, et al. Interventions to improve motivation and retention of community health workers delivering integrated community case management (iCCM): stakeholder perceptions and priorities. Am J Trop Med Hyg. 2012;87(5 Suppl):111-19.

16 Catwell L, Sheikh A. Evaluating eHealth interventions: the need for continuous systemic evaluation. PLoS Med. 2009;6(8):e1000126.

17 Marcano Belisario JS, Huckvale K, Greenfield G, Car J, Gunn LH. Smartphone and tablet self-management apps for asthma. Cochrane Database Syst Rev. 2013;11:CD010013.

18 Moore JO, Marshall MA, Judge DC, Moss FH, Gilroy SJ, Crocker B, et al. Technology-supported apprenticeship in the management of hypertension: a randomized controlled trial. JCOM. 2014;21(3):110-22.

19 Free C, Phillips G, Galli L, Watson L, Felix L, Edwards P et al. The effectiveness of mobile-health technology-based health behaviour change or disease management interventions for health care consumers: a systematic review. PLoS Mes. 2013;10(1):e10011362.

20 WHO Global Observatory for eHealth. Global diffusion of eHealth: Making universal coverage achievable. 2016. World Health Organization, Geneva.

21 Goldzweig CL, Orshansky G, Paige NM, Towfigh AA, Haggstrom D, Miake-Lye I, et al. Electronic patient portals: evidence of health outcomes, satisfaction, efficiency and attitudes. Ann Intern Med. 2013;159(10):677-87.

22 Delbanco T1, Walker J, Bell SK, Darer JD, Elmore JG, Farag N, et al. Inviting patients to read their doctors' notes: a quasi-experimental study and a look ahead. Ann Intern Med. 2012;157(7):461-70.

23 Arora S, Thornton K, Murata G, Deming P, Kalishman S, Dion D, et al. Outcomes of treatment for hepatitis C virus infection by primary care providers. N Engl J Med. 2011;364:2199-207.

24 Kirigia JM, Seddoh A, Gatwiri D, Muthuri L, Seddoh J. E-health: determinants, opportunities, challenges, and the way forward for countries in the WHO African region. BMC Public Health. 2005;5:137.

25 Sittig DF, Singh H. A new sociotechnical model for studying health information technology in complex adaptive healthcare systems. Qual Saf Health Care. 2010;19 (Suppl.) 3:i68-74.

26 WHO-ITU National eHealth Strategy Development Toolkit. 2012. World Health Organization, Geneva.

27 Improving safety in primary care. London: The Health Foundation; 2011; (http://www.health.org.uk/publication/improving-safety-primary-care, accessed 19 September 2016).

28 Primary risk in management services. Cardiff: Public Health Wales; 2015 (http://www.wales.nhs.uk/sites3/page.cfm?orgid=457&pid=73076, accessed 19 September 2016).

29 The improving chronic illness care program. Primary care team guide. Seattle, WA: The MacColl Center; 2016 (http://www.improvingchroniccare.org/downloads/reducing_care_fragmentation.pdf accessed 19 September 2016).

30 Care coordination resource list. Beerse: Janssen Pharmaceuticals Inc.; 2014 (http://www.janssenpharmaceuticalsinc.com/sites/default/files/pdf/Care-coordination-resource-list.pdf accessed 19 September 2016).

31 Seven steps to patient safety. London: National Patient Safety Agency; 2004 (http://www.nrls.npsa.nhs.uk/resources/collections/seven-steps-to-patient-safety/?entryid45=59787, accessed 19 September 2016).

32 Safety and improvement in primary care. Edinburgh: NHS Education for Scotland; 2011 (http://www.nes.scot.nhs.uk/media/3437356/Safety-and-Improvement-Educational%20Resources-A-Toolkit-for%20Safe-Effective-Person-Centred-Care.pdf, accessed 19 September 2016).

33 Accreditation handbook for ambulatory health care Skokie, IL: Accreditation Association for Ambulatory Health Care, (http://www.aaahc.org/Global/Handbooks/2015_Accreditation%20Handbook_FNL_5.22.15.pdf, accessed 19 September 2016).

34 Tools. Cambridge, MA: Institute for Healthcare Improvement; 2016 (http://www.ihi.org/resources/Pages/Tools/default.aspx, accessed 19 September 2016).

35 Patient safety toolkit. London: Royal College of General Practitioners; (http://www.rcgp.org.uk/clinical-and-research/toolkits/patient-safety.aspx, accessed 19 September 2016).

36 Partnering with patient and families to enhance safety and quality: a mini toolkit. Bethesda, MD: Institute for Patient- and Family-Centered Care; 2013 (http://www. ipfcc.org/tools/Patient-Safety-Toolkit-04.pdf, accessed 19 September 2016).

37 Health literacy toolkit for low-and middle-income countries. New Delhi: World Health Organization Regional Office for South-East Asia; 2015 (http://www.searo.who.int/entity/healthpromotion/documents/hl_tookit/en/ accessed 19 September 2016).

38 Health literacy universal precautions toolkit. Rockville, MD: Agency for Healthcare Research and Quality; 2016 (http://www.ahrq.gov/professionals/quality-patient-safety/quality-resources/tools/literacy-toolkit/index.html, accessed 19 September 2016).

39 The Boston Medical Center patient navigation toolkit. Boston, MA; The AVON Foundation and the National Cancer Institute; (https://nciphub.org/resources/1600/download/BMC_Patient_Navigation_Toolkit_-_Vol_1.pdf, accessed 19 September 2016).

40 Patient safety research: introductory course (on-line). Geneva: World Health Organization; 2016 (http://www.who.int/patientsafety/research/online_course/en/, accessed 19 September 2016).

41 Master in Health Administration. 65+ free online healthcare courses. Davis, CA; University of California; 2016 (http://mhadegree.org/free-online-healthcare-courses/, accessed 19 September 2016).

42 Patient safety network. Training catalog. Rockville, MD: Agency for Healthcare Research and Quality; 2016 (https://psnet.ahrq.gov/pset, accessed 19 September 2016).

43 Age-friendly primary health care centres toolkit. Geneva: World Health Organization; 2008 (http://www.who.int/ageing/publications/AF_PHC_Centretoolkit.pdf, accessed 19 September 2016).

44 Patient safety collaborative manual. Hamilton/Mount Gambier/Warrnambool; Greater Green Triangle/Australian Primary Health Care Research Institute; 2016 (http://www.greaterhealth.org/resources/patient-safety-collaborative-manual, accessed 19 September 2016).

45 Toolkit for general practice in supporting older people with frailty and achieving the requirements of the unplanned admissions enhanced (2014). NHS England South Region; 2014 (http://www.nhsiq.nhs.uk/media/2630779/toolkit_for_general_practice_in_supporting_older_people.pdf, accessed 19 September 2016).

46 Stay independent falls prevention toolkit for clinicians. Health Quality and Safety Commission New Zealand; 2015 (http://www.hqsc.govt.nz/our-programmes/reducing-harm-from-falls/publications-and-resources/publication/2232/, accessed 19 September 2016).

47 Prevention and control of noncommunicable diseases: guidelines for primary health care in low-resource settings. Geneva: World Health Organization; 2012 (http://apps.who.int/iris/bitstream/10665/76173/1/9789241548397_eng.pdf, accessed 19 September 2016).

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