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Healthcare workers' informal uses of mobile phones and other mobile devices to support their work: a qualitative evidence synthesis (Review)

Glenton C, Paulsen E, Agarwal S, Gopinathan U, Johansen M, Kyaddondo D, Munabi-Babigumira S, Nabukenya J, Nakityo I, Namaganda R, Namitala J, Neumark T, Nsangi A, Pakenham-Walsh NM, Rashidian A, Royston G, Sewankambo N, Tamrat T, Lewin S

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[Qualitative Review]

Healthcare workers' informal uses of mobile phones and other mobile devices to support their work: a qualitative evidence synthesis

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ABSTRACT

Background

Healthcare workers sometimes develop their own informal solutions to deliver services. One such solution is to use their personal mobile phones or other mobile devices in ways that are unregulated by their workplace. This can help them carry out their work when their workplace lacks functional formal communication and information systems, but it can also lead to new challenges.

Objectives

To explore the views, experiences, and practices of healthcare workers, managers and other professionals working in healthcare services regarding their informal, innovative uses of mobile devices to support their work.

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Search methods

We searched MEDLINE, Embase, CINAHL and Scopus on 11 August 2022 for studies published since 2008 in any language. We carried out citation searches and contacted study authors to clarify published information and seek unpublished data.

Selection criteria

We included qualitative studies and mixed-methods studies with a qualitative component. We included studies that explored healthcare workers' views, experiences, and practices regarding mobile phones and other mobile devices, and that included data about healthcare workers' informal use of these devices for work purposes.

Data collection and analysis

We extracted data using an extraction form designed for this synthesis, assessed methodological limitations using predefined criteria, and used a thematic synthesis approach to synthesise the data. We used the 'street-level bureaucrat' concept to apply a conceptual lens to our findings and prepare a line of argument that links these findings. We used the GRADE-CERQual approach to assess our confidence in the review findings and the line-of-argument statements. We collaborated with relevant stakeholders when defining the review scope, interpreting the findings, and developing implications for practice.

Main results

We included 30 studies in the review, published between 2013 and 2022. The studies were from high-, middle- and low-income countries and covered a range of healthcare settings and healthcare worker cadres. Most described mobile phone use as opposed to other mobile devices, such as tablets. We have moderate to high confidence in the statements in the following line of argument.

The healthcare workers in this review, like other 'street-level bureaucrats', face a gap between what is expected of them and the resources available to them. To plug this gap, healthcare workers develop their own strategies, including using their own mobile phones, data and airtime. They also use other personal resources, including their personal time when taking and making calls outside working hours, and their personal networks when contacting others for help and advice.

In some settings, healthcare workers' personal phone use, although unregulated, has become a normal part of many work processes. Some healthcare workers therefore experience pressure or expectations from colleagues and managers to use their personal phones. Some also feel driven to use their phones at work and at home because of feelings of obligation towards their patients and colleagues.

At best, healthcare workers' use of their personal phones, time and networks helps humanise healthcare. It allows healthcare workers to be more flexible, efficient and responsive to the needs of the patient. It can give patients access to individual healthcare workers rather than generic systems and can help patients keep their sensitive information out of the formal system. It also allows healthcare workers to communicate with each other in more personalised, socially appropriate ways than formal systems allow. All of this can strengthen healthcare workers' relationships with community members and colleagues.

However, these informal approaches can also replicate existing social hierarchies and deepen existing inequities among healthcare workers. Personal phone use costs healthcare workers money. This is a particular problem for lower-level healthcare workers and healthcare workers in low-income settings as they are likely to be paid less and may have less access to work phones or compensation. Out-of-hours use may also be more of a burden for lower-level healthcare workers, as they may find it harder to ignore calls when they are at home. Healthcare workers with poor access to electricity and the internet are less able to use informal mobile phone solutions, while healthcare workers who lack skills and training in how to appraise unendorsed online information are likely to struggle to identify trustworthy information. Informal digital channels can help healthcare workers expand their networks. But healthcare workers who rely on personal networks to seek help and advice are at a disadvantage if these networks are weak.

Healthcare workers' use of their personal resources can also lead to problems for patients and can benefit some patients more than others. For instance, when healthcare workers store and share patient information on their personal phones, the confidentiality of this information may be broken. In addition, healthcare workers may decide to use their personal resources on some types of patients, but not others. Healthcare workers sometimes describe using their personal phones and their personal time and networks to help patients and clients whom they assess as being particularly in need. These decisions are likely to reflect their own values and ideas, for instance about social equity and patient 'worthiness'. But these may not necessarily reflect the goals, ideals and regulations of the formal healthcare system.

Finally, informal mobile phone use plugs gaps in the system but can also weaken the system. The storing and sharing of information on personal phones and through informal channels can represent a 'shadow IT' (information technology) system where information about patient flow, logistics, etc., is not recorded in the formal system. Healthcare workers may also be more distracted at work, for instance, by calls from colleagues and family members or by social media use. Such challenges may be particularly difficult for weak healthcare systems.

Authors' conclusions

By finding their own informal solutions to workplace challenges, healthcare workers can be more efficient and more responsive to the needs of patients, colleagues and themselves. But these solutions also have several drawbacks. Efforts to strengthen formal health systems should consider how to retain the benefits of informal solutions and reduce their negative effects.

PLAIN LANGUAGE SUMMARY

What are healthcare workers' views, experiences and practices regarding their informal use of personal mobile phones to support their work?

Key messages

• Healthcare workers sometimes use their personal mobile (or 'cell') phones informally to plug gaps in the healthcare system.

• Our findings suggest that this can help them work more efficiently. It can also help them be more responsive to patients and health workers' needs.

• However, it can also lead to problems for patients and healthcare workers, and it can weaken the healthcare system.

What is informal mobile phone use?

Healthcare workers sometimes use their personal mobile phones at work even though this use is not formally regulated. This may help them carry out their work when their workplace lacks effective and accessible ways of sharing information through the formal system. But it can also lead to new problems.

What did we want to find out?

We wanted to explore healthcare workers' informal use of personal mobile phones to support their work.

What did we do?

We searched for studies about healthcare workers' views, experiences, and practices regarding their personal mobile phone use at work. We analysed their results and assessed our confidence in the review findings.

What did we find?

We found 30 studies published between 2013 and 2022. The studies were from high-, middle- and low-income countries. They explored different types of healthcare workers, including doctors, nurses, lay-health workers, pharmacists and healthcare managers working in hospitals, clinics and the community. Some of our review findings were only based on small amounts of data, which lowered our confidence in these findings. We have moderate to high confidence in the following review findings.

• Healthcare workers are faced with the gap between what is expected of them and the resources available to them. To plug this gap, they develop their own strategies. This sometimes involves using their own mobile phones, data and airtime. They also use their personal time to make and take calls outside working hours, and use their personal networks to contact others for help and advice.

• In some settings, healthcare workers' personal mobile phone use is unregulated but has become a normal part of many work processes. Some healthcare workers, therefore, feel pressure from colleagues and managers to use their personal phones. Some also use their mobile phones because of feelings of obligation towards their patients and colleagues.

• Healthcare workers' use of their personal mobile phones, time and networks helps humanise healthcare. It allows healthcare workers to be more flexible, efficient and responsive to the needs of the patient. It can connect patients with individual healthcare workers rather than impersonal systems and can help patients keep sensitive information out of the formal system. It also allows healthcare workers to communicate with each other in more personal ways than formal systems allow. All this can strengthen healthcare workers' relationships with patients and colleagues.

• However, these informal approaches can also cause problems for healthcare workers. Personal mobile phone use costs money. This is a particular problem for lower-level healthcare workers and healthcare workers in low-income settings who are likely to be paid less and may have less access to work phones or compensation. Out-of-hours use may also be more of a burden for lower-level healthcare workers as they may find it harder to ignore calls when they are at home. Healthcare workers with poor access to electricity and the internet are also less able to use informal mobile phone solutions, while healthcare workers with less education may find it difficult to appraise the information they find online. Informal digital channels can help healthcare workers expand their personal networks. However, healthcare workers who rely on personal networks to seek help and advice are at a disadvantage if these networks are weak.

• Healthcare workers' use of their personal resources can also lead to problems for patients and can benefit some patients more than others. For instance, when healthcare workers store and share patient information on their personal mobile phones, the confidentiality of this information may be broken. Furthermore, healthcare workers may decide to use their personal resources on some types of patients, but not others. Healthcare workers sometimes describe using their mobile phones, time and networks to help patients and clients whom they think are particularly in need. These decisions are likely to reflect their own values and ideas, for instance about social equity and patients' worthiness. But these may not necessarily reflect the goals and ideals that the formal healthcare system aims to achieve.

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• Finally, informal mobile phone use plugs gaps in the healthcare system but can also weaken the system. Storing and sharing of information on personal phones and through informal channels can create a 'shadow IT' (information technology) system where information about patient flow and logistics are not formally recorded. Healthcare workers may also be more distracted at work, for instance by calls from colleagues and family members or by social media. These types of challenges may be particularly difficult for weak healthcare systems.

How current is this evidence?

The evidence is current to August 2022.

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SUMMARY OF FINDINGS

Summary of findings 1. Summary of qualitative findings table: Individual review findings

#	Summarised review finding	Studies contributing to the review finding	GRADE-CERQual assessment of confidence in the evidence	Explanation of GRADE-CERQual assessment
THEME 1: What are healthcare workers using informal mobile-phone based approaches for?				
1	**Finding 1.1** Healthcare workers describe using their personal mobile phones to seek advice and support and exchange information with other healthcare workers regarding patient management, for instance, when making referrals and during clinical emergencies.	Ling 2020; Hampshire 2017; Venkataraghavan 2022; Chib 2013; Pimmer 2018; Bautista 2020; Abane 2021; Nerminathan 2017; Bautista 2016; Shenouda 2018; Bautista 2017; Hussain 2022; Moyer 2014; Hampshire 2021; Anstey 2018; Barnor-Ahiaku 2016; Tran 2014; Mariwah 2022; Spink 2020	High confidence	No/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance
2	**Finding 1.2** Healthcare workers describe using their personal mobile phones to socialise and exchange emotional support with other healthcare workers and to air work grievances, although some are annoyed by messages that are not directly related to work.	Pimmer 2018; Rathbone 2020; Bautista 2017; Ismail 2019	Moderate confidence	Minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; moderate concerns regarding adequacy; and no/very minor concerns regarding relevance
3	**Finding 1.3** Senior staff describe using informal mobile phone channels to co-ordinate, oversee and manage healthcare workers' work. Healthcare workers also describe using these channels to send reports to supervisors and to share practical information such as staffing schedules.	Hampshire 2017; Venkataraghavan 2022; Pimmer 2018; Abane 2021; Karusala 2020; Bautista 2017; Hampshire 2021; Anstey 2018; Barnor-Ahiaku 2016; Mariwah 2022; Ismail 2019; Spink 2020; Watkins 2018	Moderate confidence	No/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and moderate concerns regarding relevance
4	**Finding 1.4** Healthcare workers' descriptions of informal mobile phone communication usually involve colleagues at the same workplace. Far fewer healthcare workers describe using their phones to contact healthcare workers outside their workplace or linked facilities, or who are not already known to them.	Ling 2020; Hampshire 2017; Venkataraghavan 2022; Chib 2013; Pimmer 2018; Bautista 2020; Abane 2021; Rathbone 2020; Karusala 2020; Brandt 2016; Nerminathan 2017; Bautista 2016; Shenouda 2018; Bautista 2017; Hussain 2022; Hampshire 2021;	High confidence	No/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance

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		Anstey 2018; Barnor-Ahiaku 2016; Tran 2014; Mariwah 2022; Ismail 2019; Spink 2020; Watkins 2018		
5	**Finding 1.5** Healthcare workers describe using their personal mobile phones to communicate with patients, clients and their families.	Hampshire 2017; Bhat 2021; Venkataraghavan 2022; Chib 2013; Pimmer 2018; Brandt 2016; Bautista 2016; Chiang 2016; Moyer 2014; Hampshire 2021; Mariwah 2022; Watkins 2018	Low confidence	Minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and serious concerns regarding relevance
6	**Finding 1.6** Healthcare workers describe using their personal mobile phones to take photos. This includes images of patient-specific information such as images of X-rays and test results, as well as non-patient-specific information such as reports and schedules.	Bhat 2021; Venkataraghavan 2022; Pimmer 2018; Abane 2021; Karusala 2020; Brandt 2016; Nerminathan 2017; Mather 2018; Bautista 2016; Chiang 2016; Burns 2013; Shenouda 2018; Bautista 2017; Hussain 2022; Ologeanu-Taddei 2019; Hampshire 2021; Anstey 2018; Barnor-Ahiaku 2016	High confidence	No/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance
7	**Finding 1.7** In addition to taking photos of patient-specific information, healthcare workers describe using their personal mobile phones to retrieve, record and store patient information.	Hampshire 2017; Anstey 2018; Barnor-Ahiaku 2016; Mariwah 2022	Low confidence	No/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; moderate concerns regarding adequacy; and moderate concerns regarding relevance
8	**Finding 1.8** Healthcare workers describe using their personal mobile phones to search for general clinical and practical information in officially endorsed information sources, but also in sources that are not formally endorsed.	Mather 2019; Venkataraghavan 2022; Chib 2013; Bautista 2020; Brandt 2016; Nerminathan 2017; Bautista 2016; Shenouda 2018; Hampshire 2021; Anstey 2018; Barnor-Ahiaku 2016; Spink 2020 ; Watkins 2018	High confidence	No/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance
THEME 2: Why are healthcare workers using informal mobile-phone-based approaches?				
9	**Finding 2.1** Healthcare workers and managers explain that they use personal mobile phones because formal tools and systems are not available or functional, or because their	Mather 2019; Bhat 2021; Venkataraghavan 2022; Chib 2013; Bautista 2020; Rathbone 2020; Bautista 2016; Burns 2013;	High confidence	No/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequa-

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	personal phones have better functionality and are more user-friendly.	Moyer 2014; Ologeanu-Taddei 2019; Hampshire 2021; Anstey 2018		cy; and no/very minor concerns regarding relevance
10	**Finding 2.2** Healthcare workers, including senior staff and managers, describe how the informal use of personal phones at work has become normalised and how senior staff sometimes expect it of healthcare workers.	Ling 2020; Venkataraghavan 2022; Bautista 2020; Abane 2021; Karusala 2020; Brandt 2016; Nerminathan 2017; Mather 2018; Bautista 2016; Shenouda 2018; Bautista 2017; Hussain 2022; Moyer 2014; Ologeanu-Taddei 2019; Barnor-Ahiaku 2016	High confidence	No/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance
11	**Finding 2.3** Healthcare workers describe how the use of their personal phones is driven by feelings of obligation towards their patients.	Hampshire 2017; Abane 2021; Bautista 2016; Hampshire 2021; Anstey 2018	Moderate confidence	Minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and minor concerns regarding relevance
THEME 3: What are the impacts of informal mobile-phone-based approaches?				
12	**Finding 3.1** Healthcare workers report that the use of their personal mobile phones makes it easier and faster to communicate with patients and colleagues, prevents unnecessary journeys, and can lead to better quality care.	Ling 2020; Hampshire 2017; Venkataraghavan 2022; Chib 2013; Pimmer 2018; Bautista 2020; Rathbone 2020; Brandt 2016; Nerminathan 2017; Mather 2018; Bautista 2016; Chiang 2016; Bautista 2017; Hussain 2022; Hampshire 2021; Anstey 2018; Tran 2014	High confidence	No/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance
13	**Finding 3.2** Healthcare workers describe how the exchange of personal phone numbers between healthcare workers and patients allows patients to contact healthcare workers who are already known to them and enables bidirectional communication. In contrast, many formal systems tend to be unidirectional and do not include ways of contacting a specific healthcare worker.	Hampshire 2017; Bhat 2021; Venkataraghavan 2022; Chib 2013; Brandt 2016; Bautista 2016; Chiang 2016; Moyer 2014; Hampshire 2021; Mariwah 2022; Ismail 2019; Watkins 2018	Low confidence	No/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; minor concerns regarding adequacy; and serious concerns regarding relevance
14	**Finding 3.3** Healthcare workers describe how their personal phone use can help them manage their relationships with other healthcare workers, for instance, by providing additional information to justify a	Ling 2020; Rathbone 2020	Low confidence	No/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; serious concerns regarding adequacy; and no/

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	patient referral and protect themselves against criticism about their decisions, but also to support colleagues who need their assistance out of hours.			very minor concerns regarding relevance
15	**Finding 3.4** Healthcare workers complain that the use of their personal phones for work blurs the boundaries between personal and professional life, as they are sometimes contacted by patients and colleagues at home, outside working hours, and this could be a significant disruption to their personal lives.	Hampshire 2017; Bhat 2021; Rathbone 2020; Karusala 2020; Nerminathan 2017; Chiang 2016; Shenouda 2018; Moyer 2014; Hampshire 2021; Mariwah 2022; Watkins 2018	High confidence	No/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance
16	**Finding 3.5** Healthcare workers describe how the use of their personal phones at work can lead to distraction at work, both because of other work calls to their personal phones and because of personal calls. However, some healthcare workers also appreciate the ability to stay connected to their home lives during working hours. Some managers complain that healthcare workers are distracted by their use of social media, games and videos.	Venkataraghavan 2022; Pimmer 2018; Bautista 2020; Karusala 2020; Brandt 2016; Nerminathan 2017; Bautista 2016; Hampshire 2021; Tran 2014; Mariwah 2022	Moderate confidence	No/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; mderate concerns regarding adequacy; and no/very minor concerns regarding relevance
17	**Finding 3.6** Healthcare workers are concerned about privacy and confidentiality issues when storing and sharing patient information on their personal mobile phones. However, in some cases, healthcare workers also use their personal phones to keep patient-sensitive information out of the formal system.	Ling 2020; Bhat 2021; Rathbone 2020; Karusala 2020; Brandt 2016; Nerminathan 2017; Bautista 2016; Chiang 2016; Burns 2013; Shenouda 2018; Hussain 2022; Hampshire 2021; Tran 2014; Mariwah 2022; Spink 2020	Moderate confidence	Minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; minor concerns regarding adequacy; and no/very minor concerns regarding relevance
18	**Finding 3.7** Healthcare workers are concerned about the legal implications of offering advice to patients and colleagues through informal channels.	Bhat 2021; Rathbone 2020; Chiang 2016	Moderate confidence	No/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; moderate concerns regarding adequacy; and no/very minor concerns regarding relevance
19	**Finding 3.8** Healthcare workers describe how sharing and storing information through informal digital channels and groups can lead to a loss of information in formal records, which can cause problems when managing patient care.	Ling 2020 Ologeanu-Taddei 2019	Low confidence	Minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; serious concerns regarding adequacy; and minor concerns regarding relevance

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20	**Finding 3.9** Healthcare workers who use their mobile phones to search for health information online are concerned about the quality and legitimacy of unendorsed online information and ask for more training and guidance in how to search for and assess this information.	Chib 2013; Nerminathan 2017; Anstey 2018; Barnor-Ahiaku 2016; Watkins 2018	Moderate confidence	No/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; minor concerns regarding adequacy; and minor concerns regarding relevance
21	**Finding 3.10** Healthcare workers' use of their personal mobile phones for work has cost implications, including the costs of the phone, data, airtime and electricity. Healthcare workers in low- and middle-income settings, particularly healthcare workers on lower salaries and volunteer lay health workers, describe these costs as a significant financial burden, and call for some form of compensation.	Hampshire 2017; Venkataraghavan 2022; Chib 2013; Bautista 2020; Abane 2021; Bautista 2016; Moyer 2014; Hampshire 2021; Anstey 2018; Barnor-Ahiaku 2016; Mariwah 2022; Ismail 2019; Spink 2020	High confidence	No/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance
22	**Finding 3.11** Healthcare workers describe how the use of their mobile phones to access informal digital communication channels can help them extend their networks and cross geographical and professional boundaries. But they also explain how these channels can replicate existing social and professional structures and hierarchies, thereby limiting healthcare workers' access or participation.	Chib 2013; Pimmer 2018; Rathbone 2020; Karusala 2020; Bautista 2017; Ismail 2019	Low confidence	Minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; serious concerns regarding adequacy; and no/very minor concerns regarding relevance
23	**Finding 3.12** Healthcare workers in low- and middle-income settings who use their personal mobile phones for work purposes describe many of the same practical and infrastructural challenges encountered in formal systems, including lack of electricity and internet.	Hampshire 2017; Venkataraghavan 2022; Chib 2013; Pimmer 2018; Hampshire 2021; Anstey 2018; Barnor-Ahiaku 2016; Mariwah 2022; Spink 2020	High confidence	No/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance

THEME 4: How is personal mobile phone use currently regulated?

| 24 | **Finding 4.1** Healthcare workers do not always know if policies or guidelines regulating the use of personal mobile phones in the workplace exist. Where they are aware of them, healthcare workers explain that the aim is to protect patient confidentiality and data security and avoid healthcare worker distraction. However, some healthcare workers and their managers perceive these policies as unclear or as unrealistic and difficult to enforce. | Bautista 2020; Karusala 2020; Brandt 2016; Nerminathan 2017; Mather 2018; Bautista 2016; Ologeanu-Taddei 2019; Spink 2020 | High confidence | No/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance |

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Summary of findings 2. Summary of qualitative findings table: Line-of-argument statements

#	Line-of-argument statement	Individual findings contributing to the statement	GRADE-CERQual assessment of confidence in the evidence	Explanation of GRADE-CERQual assessment
1	**The healthcare workers in this review, like other 'street-level bureaucrats'** ([Lipsky 1980](#))**, face a gap between what is expected of them and the resources available to them. To plug this gap, healthcare workers develop their own strategies** ([Tummers 2015](#))**, including using their own mobile phones, data and airtime.** They also use other personal resources ([Dubois 2010](#); [Lavee 2022](#)), including their personal time, when taking and making calls outside work, and their personal networks when contacting others for help and advice.	Finding 1.1 Findings 1.3 – 1.8 Finding 2.1 Finding 3.4 Finding 3.11	High confidence	This statement is based on 10 individual findings. These findings clearly reflect descriptions of other 'street-level bureaucrats', their working conditions and response to these conditions. Most of these findings are high-confidence findings, and the same line-of-argument statement could still be made without the low/moderate-confidence findings.
2	**In some settings, healthcare workers' personal phone use, although unregulated, has become normal and part of many work processes**. Healthcare workers may therefore experience pressure or expectations from colleagues and managers to use their personal phones.	Finding 1.3 Finding 2.2	High confidence	This statement is based on two individual findings. One of the findings is high confidence, and the same statement could still be made without the other finding, which is of moderate confidence.
3	**Healthcare workers also feel driven to use their personal phones at work and at home because of feelings of obligation towards their patients and colleagues**. Although early work described street-level bureaucrats' coping strategies as "a functional response to bureaucratic necessities" ([Lipsky 1980](#)), our review supports more recent literature showing that street-level bureaucrats are also driven by professional commitment, personal values and social norms in their discretional decisions and behaviour ([Lavee 2021](#); [Lavee2022](#)).	Finding 2.3, Finding 3.3	Moderate confidence	This statement is based on two individual findings of low and moderate confidence. The findings clearly reflect descriptions of other 'street-level bureaucrats' and some of the motivations behind their behaviour. However, the concerns about data adequacy led us to downgrade our confidence in this statement.
4	**At best, healthcare workers' use of their personal phones, time and networks helps humanise healthcare.** It allows healthcare workers to be more flexible, efficient and responsive to the needs of the patient. It can give patients access to individual healthcare workers rather than generic systems and can help patients keep their sensitive information out of the formal system. It also allows healthcare workers to communicate with	Findings 3.1-3.3 Finding 3.6	Moderate confidence	This statement is based on four individual findings that were of low, moderate and high confidence. They all describe different aspects of informal mobile phone use that people perceive as positive and that clearly reflect the 'humanisation of care' concept. However, concerns

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	each other in more personalised, socially appropriate ways than formal systems allow. All of this can strengthen healthcare workers' relationships with community members and colleagues.			regarding adequacy or relevance led us to downgrade our confidence in this statement.
5	**However, these informal approaches can also replicate existing social hierarchies and deepen existing inequities amongst healthcare workers**. Personal phones cost healthcare workers money. This is a particular problem for lower-level healthcare workers and healthcare workers in low-income settings as they are likely to be paid less and may have less access to work phones or compensation. Out-of-hours use may also be more of a burden for lower-level healthcare workers as they may find it harder to ignore calls when they are at home. Healthcare workers with poor access to electricity and the internet are less able to use informal mobile phone solutions, while healthcare workers who lack skills and training in how to appraise unendorsed online information are likely to struggle to identify trustworthy information. Informal digital channels can help healthcare workers expand their network. But healthcare workers who rely on personal networks to seek help and advice are at a disadvantage if these networks are weak.	Finding 3.4 Findings 3.9-3.12	Moderate confidence	This statement is based on six individual findings. Most of these are high-confidence findings, and the same line-of-argument statement could still be made without the low-/moderate-confidence findings. These findings describe the negative implications of informal mobile phone use for healthcare workers. They also describe, to varying degrees, how these implications may be particularly negative for certain groups. However, the data on this aspect are thin in some of the findings, and this adequacy concern led us to downgrade our confidence in this statement.
6	**Healthcare workers' use of their personal resources can also lead to problems for patients and can benefit some patients more than others.** For instance, when healthcare workers store and share patient information on their personal phones, the confidentiality of this information may be broken. In addition, healthcare workers may decide to use their personal resources on some types of patients but not others. Healthcare workers sometimes describe using their personal phones and their personal time and networks to help patients and clients whom they assess as being particularly in need. These decisions are likely to reflect their own values and ideas, for instance, about social equity and patient 'worthiness' (Lavee 2022). But they may not necessarily reflect the goals, ideals and regulations of the formal healthcare system.	Finding 2.3 Finding 3.2 Finding 3.6	Moderate confidence	This statement is based on two individual findings of moderate confidence and one low-confidence finding. Healthcare workers' use of their personal resources to help certain groups of patients and clients is often implied rather than directly described in the findings, and this coherence concern led us to downgrade our confidence in this statement.
7	**Finally, informal mobile phone use plugs gaps in the system but can also weaken the system**. Storing and sharing of information on personal phones and through informal channels can represent a 'shadow IT' system where information	Finding 3.5 Finding 3.8	Moderate confidence	This statement is based on two individual findings of low and moderate confidence. The findings had moderate to serious concerns regarding adequa-

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about patient flow, logistics, etc. is not recorded in the formal system. Healthcare workers may also be more distracted at work, for instance, by calls from colleagues and family members or by social media use. These types of challenges may be particularly difficult for weak healthcare systems.

cy which led us to downgrade our confidence in this statement.

Abbreviation

IT: information technology

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BACKGROUND

This review focuses on healthcare workers' informal use of mobile phones to support their everyday work. Countries are increasingly implementing digital strategies, including through mobile phones and other mobile devices, in an effort to increase access to healthcare, enhance health-workforce performance, and strengthen health systems (WHO 2021). However, it can be challenging to implement these strategies, and they may have mixed success (Agarwal 2018; Agarwal 2020; Agarwal 2021; Ames 2019; Gonçalves-Bradley 2020; Gonçalves-Bradley 2018; Odendaal 2020; Palmer 2020a; Palmer 2020b; Vasudevan 2021). At the same time, individual healthcare workers are increasingly using mobile phones to find their own solutions to the challenges they face in their daily work and to address gaps in the system (Hampshire 2021). These informal solutions can represent approaches that health systems can learn from, but they can also create challenges of their own. This review aims to explore what we can learn from healthcare workers' own solutions by exploring their views, experiences, and practices regarding informal mobile phone use. We will use these review findings to discuss the implications of these solutions for formal practice, policy, and governance.

The review covers all types of mobile devices, such as mobile phones, laptops, and tablets. However, as the most common type of mobile device is the mobile phone, and as the majority of studies in this review referred only to mobile phones, we will primarily refer to this term.

Description of the topic

Formal digital health strategies

Over the past few decades, digital technologies have increasingly been adopted to address health needs and are now a common part of most healthcare systems. In the World Health Assembly Resolution on Digital Health from 2018, ministries of health were urged to consider the use of digital technologies as a means of promoting equitable, affordable, and universal access to health for all (WHO 2018). The World Health Organization (WHO) was also given the task of providing guidance on the use of these technologies (WHO 2018).

In response to this call, WHO published its first guidelines on digital technologies for health systems strengthening in 2019 (WHO 2019a). The guidelines focused on digital strategies accessible through healthcare workers' mobile devices, including tools and channels that enabled them to communicate with patients and other healthcare workers, receive training and decision support, manage drug stocks and other commodities, and notify births and deaths. To inform the guidelines, Cochrane prepared a series of Cochrane reviews exploring the effectiveness, acceptability, and feasibility of these interventions (Agarwal 2018; Agarwal 2020; Agarwal 2021; Ames 2019; Gonçalves-Bradley 2018; Gonçalves-Bradley 2020; Odendaal 2020; Palmer 2020a; Palmer 2020b; Vasudevan 2021). Several co-authors of the current review (TT, CG, SL, SA) were closely involved in the guideline process and in the preparation of the related Cochrane reviews.

When preparing the guidelines, WHO's focus was on formal rather than informal digital health strategies, a distinction explained more fully below. Similarly, most of the studies identified through the Cochrane reviews for the guideline focused on strategies initiated by government departments, non-governmental organisations or by research teams, rather than by healthcare workers (although this was not a requirement of the reviews). These reviews highlighted many research gaps. Where research did exist, it indicated mixed results regarding the effectiveness and the acceptability of these types of strategies, as well as a range of implementation challenges, many of which had implications for equity (Agarwal 2018; Agarwal 2020; Agarwal 2021; Ames 2019; Gonçalves-Bradley 2018; Gonçalves-Bradley 2020; Odendaal 2020; Palmer 2020a; Palmer 2020b; Vasudevan 2021). Common challenges included healthcare workers' out-of-pocket expenses (e.g. for the costs of phones, electricity, mobile phone data and airtime), poor access to electricity and the internet, and limited literacy or digital literacy. In addition, as underlined by WHO when publicising the guidelines, digital strategies cannot replace other strategies that aim to foster functioning health systems, including ensuring sufficient healthcare workers, drugs, and supplies (WHO 2019b). While acknowledging these challenges, the guideline panel chose to recommend most of the interventions, at least in settings where specific health system and infrastructure components were in place. Their decision to recommend these interventions was based on considerations regarding the potential of digital strategies to strengthen health systems and increase access to health services (WHO 2019a).

While formal implementation of digital strategies has many challenges, we were aware anecdotally that healthcare workers were using mobile phones and other mobile devices informally to develop their own solutions. We were therefore keen to explore these informal practices and to assess whether formal systems could learn any lessons from these on-the-ground initiatives. This led to the establishment of the mHEALTH-INNOVATE project, which received funding from the Norwegian Research Council in 2021, and of which this systematic review is a central part.

Healthcare workers' informal use of mobile devices to address infrastructural and health system bottlenecks

In many settings, healthcare workers face infrastructural and health system challenges, including lack of adequate transportation to reach their communities, limited training opportunities, workforce shortages, inadequate financing, drug stock-outs, and problems with referral pathways. These challenges are often exacerbated by a lack of supervisory support, which undermines healthcare workers' roles and the development of learning health systems (Karimi-Shahanjarini 2019; Sheikh 2020). Events such as natural and man-made disasters, conflicts, and, most recently, the COVID-19 pandemic, contribute additional challenges for which health systems may not be prepared. To overcome these challenges and deliver the services expected of them, healthcare workers and managers may take the initiative to develop their own informal solutions (Alwy 2020; Munabi-Babigumira 2019). These solutions increasingly involve the use of mobile devices (Anstey 2018; Hampshire 2021).

At the beginning of the mHEALTH-INNOVATE project, we carried out several rounds of discussion and feedback to create a working definition of informal mobile device use. This was based on existing research and on input from project members, the international advisory group, and a stakeholder discussion (Glenton 2022). We currently define informal mobile device use as healthcare workers' use of mobile phones and other mobile devices to support their work, using approaches that are *initiated* by the healthcare workers

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themselves, and that are *not initially standardised, regulated, or endorsed* by the health system or organisation to which they belong. (See the Discussion section for further comments about this definition).

Informal digital strategies may involve the establishment of 'shadow IT' (information technology) systems that work alongside the formal system (Wikipedia 2022). However, informal strategies may also involve 'non-prescribed use' where healthcare workers use digital systems provided to them by their workplace, but in non-prescribed ways.

Informal digital strategies can also vary in the amount of work that has gone into their development and the number of people they involve. Some may be simple solutions implemented by individual healthcare workers. For instance, healthcare workers may use their personal phones to communicate directly with patients, colleagues, or specialists (Glenton 2022), to retrieve test results, or to gain information (Anstey 2018; Hampshire 2021). Healthcare workers may see this direct communication as quicker and more convenient than the health system's formal systems. Other solutions may require more planning and involve larger numbers of people. For instance, healthcare workers may establish private WhatsApp groups that healthcare workers and managers use to contact each other about clinical and practical matters (Anstey 2018; Glenton 2022; Hampshire 2021). They may also design their own digital applications, for instance to improve referral processes or specialist consultations (Anstey 2018). Finally, in some cases, solutions that may start off as simple, spontaneous, and individualised responses to everyday challenges may evolve into something more extensive.

Informal approaches are *developed in direct response to a felt need* by the people who go on to use them. This may differ from formal digital strategies that are sometimes designed by groups working at a distance from people's actual needs and expectations and without a good understanding of contextual realities (van Niekerk 2017). Since such approaches are developed organically by healthcare workers, they are also *more likely to have addressed the challenges* that have been identified within formal digital strategies (Odendaal 2020). In other words, their own solutions may be low-cost, easier to learn and to use, and work well within the given ecosystem, although they may also struggle with infrastructural challenges such as poor electricity or internet access. Informal approaches can therefore remove bottlenecks, create opportunities, and empower and enable healthcare workers.

Challenges when healthcare workers adopt (informal) mobile device solutions

Informal approaches, including the informal use of mobile devices, can, however, lead to challenges. Some of these challenges are also found in formal strategies, but may be exacerbated by informal approaches. For instance, an increased use of mobile phones, particularly when these phones are the healthcare worker's own, could push the *burden of cost* from the health system on to healthcare workers (Odendaal 2020). In addition, the use of digital channels or tools that are not available to *all* healthcare workers or citizens, for example, because of poor access to electricity, the internet, or functional mobile phones or because of lower literacy and digital literacy levels, could increase access for some but *worsen inequities* for others (Odendaal 2020).

Other challenges may be particular to informal approaches. For instance, private WhatsApp groups could improve communication for some healthcare workers, but could also *exclude* others as groups may be based on social rather than organisational ties. In addition, the sharing of information via unregulated digital communication channels can have implications for data security and patient privacy and can breach medical ethics standards.

Informal digital strategies can also undermine the goals that formal digital strategies are designed to address, particularly if they are used *instead* of formal systems. The digitisation of healthcare systems is often motivated by a desire to gather information in more efficient ways, monitor staff performance, streamline decision-making, and increase standardisation (Alshallaqi 2022). Healthcare workers' transfer of information *away* from these formal systems can lead to the development of parallel systems. This can cause problems with the continuity of information when healthcare workers change teams or institutions. This can also weaken governments' and organisations' opportunities to gain oversight, learn, and improve. The limited oversight of devices and information flows also poses concerns for cybersecurity, particularly in situations where data may be hacked or compromised beyond the control of the healthcare worker and requires timely resolution through a formal institution.

Theoretical perspectives relevant to the development and uptake of work practices such as digital strategies

Several theoretical perspectives may be helpful when studying the development and uptake of different work practices. For this review, we originally considered three theories of potential relevance for the topic area: social innovation theory; normalisation process theory; and street-level bureaucracy.

The concept of social innovation has been defined by Phills and colleagues as "any novel and useful solution to a social need or problem, that is better than existing approaches [....], and for which the value created (benefits) accrues primarily to society as a whole rather than private individuals" (Phills 2008). One possible difference between our topic and the social innovation literature is that much of this literature is framed in terms of a business model that aims to achieve social value and is a response to the 'for-profit' business model which focuses on personal or shareholder wealth (Phillips 2015). In this literature, social innovators do not only *respond* to their own individual challenges. They also *proactively* search for problems to solve, and spend time designing solutions and planning the broader uptake of these solutions (van Niekerk 2017). While some of the healthcare workers that are the focus of our review may have similar ambitions, the healthcare workers in most of the included studies had goals that were more modest and limited to their own practice. We therefore decided against using this concept as our data analysis progressed. Similarly, we chose not to apply normalisation process theory as this theory has often focused on the processes by which ground-level staff normalise interventions that are introduced from above and are *institutionally sanctioned* (May 2007).

During the review's analysis stage we decided that the street-level bureaucracy literature was the theoretical perspective that most closely resonated with the data in the included studies and decided to adopt this perspective. Lipsky's 'street-level bureaucrat' concept is also concerned with the interpretation and adoption of practices that are directed from higher levels of the system (Lipsky 1980).

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However, the focus here is on street-level providers' *adaption* of these practices rather than on their successful (or unsuccessful) implementation. Lipsky describes how people working at the interface between citizens and government – including healthcare workers – who are expected to deliver policies and practices established elsewhere, create *their own* interpretations, routines, and strategies to deliver the services required of them. Most street-level providers deal with situations that are far more complex than policies and guidelines can account for and that involve many human dimensions. Provider discretion is therefore necessary (Lipsky 1980). In addition, providers are usually dealing with high caseloads and a lack of resources. Providers therefore develop their own routines and simplifications as necessary coping behaviours (Lipsky 1980).

Street-level bureaucrats are often described in negative terms. Some may use their discretion to limit client's access to services, or to negatively impact the client's experience in other ways (Lipsky 1980). However, recent applications of the theory have emphasised how this discretion can be exercised in a variety of ways as providers attempt to serve a variety of needs, including those of the clients, the providers themselves, the health system, and the broader setting (Buchely 2015; Finlay 2009; Harris 2013). For instance, Lavee's studies of Israeli public sector workers illustrates how their discretional decisions and behaviour are also guided by ideas of professional commitment, personal values and social norms (Lavee 2021; Lavee2022).

Healthcare workers' willingness and ability to meet the needs of their patients is also key to the delivery of humanised care. The 'humanisation of care' concept involves the delivery of healthcare services that acknowledge a person's values, beliefs, feelings and emotions, as well as their biological needs (Backes 2007). This concept focuses not only on the well-being of the patient but also on other stakeholders, including family members, healthcare professionals and policymakers (Backes 2007; Busch 2019). A systematic review that explored how these stakeholders understand this concept concluded that relational aspects such as empathy and fairmindedness towards patients are seen as central to the achievement of humanised care (Busch 2019). However, organisational and structural aspects are also seen as playing a key role in achieving or preventing this type of care. These aspects include the negative influence that fragmentation of work processes and excessive bureaucratic activities can play, and the importance of sufficient human and material resources, effective interdisciplinary teamwork and proper vertical and horizontal communication within the institution (Busch 2019). This suggests that while well-resourced and well-organised healthcare systems are important, humanised care also relies on the healthcare worker's freedom to make context-specific decisions that consider their own needs and the needs of their patients and colleagues.

OBJECTIVES

To explore the views, experiences, and practices of healthcare workers, managers and other professionals working in healthcare services regarding their informal, innovative uses of mobile devices to support their work.

METHODS

When preparing this review, we used Cochrane Effective Practice and Organisation of Care (EPOC's) Protocol and Review Template for Qualitative Evidence Synthesis (Glenton 2023).

Stakeholder involvement

We collaborated with a range of stakeholders during the preparation of this review. To inform these processes, we used guidance from the Cochrane training resources on involving people (Pollock 2022), and the TRANSFER approach (Munthe-Kaas 2020).

To inform the scope of the review and the broader mHEALTH-INNOVATE project, we organised a stakeholder discussion on the Healthcare Information For All (HIFA) online forum on health workers' informal use of mobile devices (Glenton 2022). Twenty-five healthcare workers and other stakeholders from Africa, Asia, Europe and North America took part in the discussions. We also discussed the scope of the review with the broader mHEALTH-INNOVATE project's international advisory group. This group is made up of researchers and government employees in the field of mHealth from Africa, Europe and North America. These discussions allowed us to explore the topic further before finalising the scope of the review.

To identify relevant research, we asked HIFA forum participants, international advisory group members, and mHEALTH-INNOVATE project group members to share studies on the topic of informal mHealth.

To develop our working definition of health workers' informal mobile device use, we used the results of the HIFA discussion, published research on the topic, and input from experts within our project group and our international advisory group.

To inform the design of the review, we invited members of our international advisory group to participate in a structured discussion using the TRANSFER conversation guide (Munthe-Kaas 2020). During this discussion, we asked them to identify contextual factors they believe are likely to influence healthcare workers' views, experiences and practices regarding their informal use of mobile phones and other mobile devices. Their responses informed our data analysis and our assessments of the 'relevance' component of our GRADE-CERQual assessment (see section below on 'Assessing our confidence in the review findings').

When developing the 'Implications for practice' section (see below), we also involved HIFA forum participants and members of the international advisory group.

Criteria for considering studies for this review

Types of studies

Qualitative studies

- We included primary studies that used qualitative study designs and epistemologies such as ethnography, phenomenology, case studies, grounded theory studies, and qualitative process evaluations. We included studies that used both qualitative methods for data collection (e.g. focus group discussions, individual interviews, observation, diaries, document analysis, open-ended survey questions) and qualitative methods for data analysis (e.g. thematic analysis, framework analysis,

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grounded theory). We excluded studies that collected data using qualitative methods but did not analyse these data using qualitative analysis methods (e.g. open-ended survey questions where the response data were analysed using descriptive statistics only).

- We included mixed-methods studies where it was possible to extract data that were collected and analysed using qualitative methods.

- We included both published and unpublished studies; we included studies published in any language.

- We did not exclude studies based on our assessment of methodological limitations. We used information about methodological limitations to assess our confidence in the review findings.

Topic of interest

Healthcare workers' views, experiences and practices regarding informal use of mobile devices

- We included studies that focus on healthcare workers' views, experiences, and practices regarding mobile phones and other mobile devices, and that include data about healthcare workers' informal use of these devices. (See 'Population of interest' below for definition of healthcare workers.)

- For the purposes of this review, we define informal mobile phone use as healthcare workers' use of mobile phones and other mobile devices to support their work, using approaches that are initiated by the healthcare workers themselves and that are not initially standardised, regulated, or endorsed by the health system or organisation to which they belong. (See section on 'Stakeholder involvement' above for more information on how this definition was developed and the discussion section for further comments about this definition.)

- We included studies that describe informal use of mobile devices that fall under the category of '**shadow IT**'. In a 'shadow IT' approach (Wikipedia 2022), healthcare workers use devices, software, or applications instead of or in addition to those provided to them by their workplace. This could include, for instance, use of the healthcare workers' own mobile phones or the use of digital programs or apps that are not initially standardised, regulated, or endorsed by their workplace.

- We also included studies that describe informal use of mobile devices that fall under the category of '**non-prescribed use**'. In a 'non-prescribed use' approach, healthcare workers use devices, software, or applications provided to them by their workplace, but in ways that have not been standardised, regulated, or endorsed.

- In both cases, we included studies where healthcare workers use these tools and channels:
  - to communicate with any other person about service delivery or service management, including, for instance, the exchange of information or decision support about patient treatment or care, work processes, or resources needs;
  - to manage data related to service delivery or service management, including the collection, storage, or analysis of patient information, logistical information, or any other information regarded as relevant for performing their work;
  - for any other task in ways that are self-initiated, and not standardised, regulated, or endorsed by the health system or organisation.

Types of mobile device

We included any type of mobile device.

- We included studies of any type of mobile device, including mobile phones of any kind (but not analogue landline telephones) in addition to, for example, laptops and tablets.

- We included studies that explored healthcare workers' use of their own private mobile devices as well as mobile devices provided by their workplace, as long as they used the device informally to support their work.

Types of participants

We included any type of healthcare worker.

- We included studies that focused on any type of healthcare worker, including lay or community health workers, and health facility administrators or managers.

- We included studies that focused on students in training to be healthcare workers if the study described their use of mobile devices while delivering healthcare.

In the rest of this review, we will use the term 'healthcare workers' when referring to data that includes both healthcare workers, health-facility administrators or managers and students in training. Where the data only describe one of these groups, we will make this clear.

Types of setting

We included studies from any country, and in any setting where health care is delivered.

Exclusion criteria

We excluded studies that focused on:

- healthcare workers' use of mobile devices for personal and non-work-related activities (e.g. healthcare workers using their phones for personal conversations with friends or lending their work phones to their children);

- the use of mobile devices to support pre-service training or continuing professional development. These studies focus in general on formal training activities and include very little or no reference to informal activities;

- healthcare workers' use of social media for activities that are not directly linked to service delivery and management. This included studies where the main aim was to analyse the contents of social media accounts and studies and where the focus was on exploring how health workers use social media in general. These studies generally focus on healthcare workers' descriptions of activities outside their professional work (e.g. descriptions of leisure activities); and on behaviour that is of professional relevance (e.g. posting comments about the healthcare sector, sharing information about new research) but that is not directly linked to service delivery or management. These studies often focus on the extent to which healthcare providers' behaviour on social media, including their descriptions of leisure activities, is 'appropriate' or 'inappropriate' but include very little data on informal behaviour linked specifically to service delivery and management.

Search methods for identification of studies

Electronic searches

An information specialist (MJ) developed the search strategies in consultation with CG and EP. Our search strategy used search terms specifically linked to the most common type of mobile device, which is the mobile phone (Appendix 1). We also used search terms linked to mobile devices and mobile health more generally. These search terms are also likely to identify studies of other types of mobile devices such as laptops and tablets, in which case these studies were included.

We searched the following electronic databases on 11 August 2022.

- MEDLINE (Ovid) (2008 to 11 August 2022)
- Embase (Ovid) (2008 to 11 August 2022)
- CINAHL Ebsco (Cumulative Index to Nursing and Allied Health Literature; 1981 to 11 August 2022)
- Scopus (Elsevier) (11 August 2022).

We did not apply any language limits. We limited the strategies to studies published in 2008 and onwards as this date reflects when mobile phones became widely used in many settings worldwide. The International Telecommunication Union calculates that low- and middle-income countries had a roughly 50% mobile phone coverage rate by 2008 (ITU 2022). We included a methodological filter for qualitative studies. See Appendix 1 for all search strategies used.

Searching other resources

We conducted a search in citationchaser (estech.shinyapps.io/citationchaser/) for all included studies and carried out a backward and forward search for citations (searched 16 August 2022).

We screened all records included in Odendaal 2020.

We contacted the authors of included studies to clarify published information and to seek unpublished data.

Selection of studies

We uploaded the results of our search into EPPI-Reviewer (Thomas 2010). We then removed any duplicate records. Two review authors (CG, EP) independently assessed the titles and abstracts of the identified records to evaluate eligibility. We retrieved the full text of all papers identified as potentially relevant by one or both review authors. Two review authors (CG, EP) then independently assessed these papers. Any disagreements regarding the full text of papers were resolved by discussion or by involving a third review author if required (SL). Where appropriate, we contacted the study authors for further information.

Studies that we assessed as possibly relevant based on the title and abstract, but where we were unable to find the full text, we have listed awaiting classification.

Where the same study, using the same sample and methods, was presented in different reports, we collated these reports so that each study (rather than each report) is the unit of interest in the review.

Machine learning

To maximise efficiency, we used machine learning functions in the systematic review software EPPI-Reviewer (Thomas 2010), in the screening and study selection processes.

- We initiated priority screening in EPPI-Reviewer. Priority screening is a ranking algorithm that learns continuously from researcher decisions on screening based on title and abstract text, and pushes relevant studies to the front of the screening queue. It allows relevant studies to be identified and included almost immediately by researchers in the screening process; conversely, studies reserved for the end of the queue are very likely to be irrelevant (Gates 2019; Muller 2021).
- We screened titles and abstracts until the priority screening graph reached a plateau where no new included records had been identified for a significant period of time. When we had screened 900 records without identifying any new relevant records, we stopped screening.

We have included a PRISMA flow diagram to illustrate our search results and the process of screening and selecting studies for inclusion, including any machine-assisted decisions (Page 2021a; Page 2021b).

Language translation

For titles and abstracts published in a language in which none of the review team are proficient (i.e. languages other than English, Norwegian, Swedish, Danish, French, Afrikaans, Ugandan languages and Persian), we carried out an initial translation through a freely available online translation service (Google Translate). If this translation indicated inclusion, or if the translation was inadequate to permit a decision, we planned to retrieve the full text and to ask members of Cochrane networks or other individuals who are proficient in that language to assist us in assessing the full text for inclusion in the review. If this could not be done, we planned to list the paper as a study awaiting classification to ensure transparency in the review process. However, none of the titles and abstracts that we brought forward for full text assessment were written in languages other than English.

Sampling of studies

Qualitative evidence synthesis aims for variation in concepts rather than an exhaustive sample, and large amounts of study data can impair the quality of the analysis. Once we identified all eligible studies, we assessed whether their number or data richness was likely to represent a problem for the analysis, and considered selecting a sample of studies (EPOC 2017). We decided that the number of eligible studies was manageable and decided not to select a sample of studies, but instead to extract data from all included studies.

Data extraction

We used an Excel-based data extraction form designed specifically for the review (Microsoft Excel 2022). We extracted descriptive information about first author, publication date, study language, country, study aim, healthcare setting (e.g. nursing home or primary healthcare clinic), type and number of healthcare workers, and type of mobile device and informal use. We also extracted descriptive information about how and when the study was designed, conducted, and funded and any reported conflicts

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of interest. We used Word to extract all data relevant to the review objective (Microsoft Word 2022), including author interpretations as well as illustrative quotes (see further details in 'Data synthesis' section below). Finally, we extracted suggestions and recommendations made by the study authors to inform our 'Implications for practice' section.

One review author (CG) extracted data from all the included studies. An additional review author (EP, SA, SL, RN) double-checked the data extraction performed by the first review author and verified that all relevant data had been extracted. Any differences of opinion were resolved by including all data assessed by one of the review authors as relevant. None of the review authors were co-authors of any of the included studies.

Assessing the methodological limitations of included studies

Our inclusion criteria specify that studies need to use qualitative methods both for data collection and analysis. This criterion also constitutes a basic quality threshold. In addition, at least two review authors (CG, EP, SA, SL and RN) independently assessed methodological limitations for each study using a list of criteria used in previous Cochrane reviews (Glenton 2021). This list was originally based on the Critical Appraisal Skills Programme (CASP) tool (CASP 2018), but has since gone through several iterations. For instance, we did not include questions about the appropriateness of qualitative methodology or the specific research design used, as this is already covered in our inclusion criteria.

We assessed methodological limitations according to the following domains.

- Were the settings and context described adequately?
- Was the sampling strategy described, and was this appropriate?
- Was the data collection strategy described and was this appropriate?
- Was the data analysis described, and was this appropriate?
- Were the claims made/findings supported by sufficient evidence?
- Was there evidence of reflexivity?
- Did the study demonstrate sensitivity to ethical concerns?
- Any other concerns?

Any disagreements were resolved by discussion or by involving a third review author (either CG, EP, SA, SL or RN) when required.

We reported our assessments in a Methodological Limitations table. We used these assessments to support our GRADE-CERQual (Confidence in the Evidence from Reviews of Qualitative research) assessment of our confidence in the review findings.

Data synthesis

Most of the included studies were largely descriptive as opposed to highly theorised or conceptual. In addition, the topic of informal mobile phone use is relatively novel and unexplored. We therefore decided to analyse and synthesise the data from the studies using a thematic analysis approach.

Approaches to thematic analysis vary, but generally involve the same broad stages that include familiarisation with the data, coding the data, and developing themes (Braun 2006; Green

2018). Some approaches to thematic analysis also involve using these themes as a basis for the development of some type of conceptual model, often guided by existing theories (Naeem 2023). A similar approach specifically adapted for the context of qualitative evidence syntheses has been described by Thomas and Harden (Thomas 2008).

Thematic analysis can also be broadly inductive, deductive or a combination of both (Braun 2006; Naeem 2023). Our own analysis used a combination. We began by applying a broadly inductive approach where we familiarised ourselves with the data, coded the data and organised our findings into descriptive themes. When developing the findings, we also applied a more deductive approach, exploring the role of contextual factors previously identified by stakeholders. Once the findings and themes were developed, we again applied a broadly deductive approach, using existing theories to develop a line of argument. We describe these stages in more detail below.

Step 1: Familiarisation with the data

As for all qualitative evidence syntheses, our familiarisation with the data started at the full text screening stage and continued during the data extraction stage. Once we had extracted data, two review authors (CG and EP) continued this process by reading and rereading the extracted data and discussing the data with each other.

Step 2: Coding the data and developing findings

One review author (CG) then coded the extracted data. CG began by coding the data extracted from a group of articles that CG and EP judged to have objectives that were most similar to those of our review (Abane 2021; Hampshire 2017; Hampshire 2021; Mariwah 2022). CG then coded the remaining articles, making additions where new codes emerged from the subsequent articles. She repeated this process until she had extracted and coded data from all the articles. CG and EP then grouped data that had been given the same codes from across the studies and discussed and synthesised these data to create review findings.

Stage 3: Exploring the role of contextual factors

At an earlier stage of the review, and based on the TRANSFER approach, we invited international advisory group members to identify contextual factors they believed might influence healthcare workers' views, experiences and practices regarding informal mHealth. They suggested that a country's income level, the type of healthcare setting and type of healthcare worker, and the year of the study might all play a role. We therefore explored each review finding to assess whether the studies it was based on were primarily from high- or low- and middle-income countries; from primary or secondary healthcare settings; or from specific types of healthcare workers. We also assessed whether the data had primarily been gathered in the last five, 10 or 15 years.

Where the data supporting a finding were primarily based on data from one specific context (i.e. type of income setting, healthcare setting, healthcare worker or time period), we discussed whether this context could help explain the finding or whether it could be a coincidental result of the studies we had included. Where we agreed that this could help explain the finding, we specified the context in the review finding (for instance, "healthcare workers *in low- and middle -income countries* describe….."). Where we were unsure, we

noted this and used this information at a later stage when assessing the 'relevance' component of GRADE-CERQual.

Step 4. Developing descriptive themes

Two review authors (CG, EP) discussed the findings and how these could be organised into meaningful groups. This led to the development of four themes:

- Theme 1: 'What are healthcare workers using informal mobile-phone based approaches for?'
- Theme 2: 'Why are healthcare workers using informal mobile phone based strategies?'
- Theme 3: 'What are the impacts of informal mobile phone-based strategies?' and
- Theme 4: 'How is personal mobile phone use currently regulated?'

Step 5: Reviewing the findings and descriptive themes

We then shared the findings and descriptive themes with the other co-authors of the review through a series of meetings and through circulation of written drafts. We edited the findings and themes in response to their feedback.

Step 6: Developing a line of argument

Finally, we considered our review findings in light of different theoretical perspectives and used these perspectives to help us develop a line of argument. A line of argument in the context of a systematic review has been described as an interpretation or 'synthesising argument' that both links and explains a set of parts (Barnett-Page 2009), and that is comprised of a network of constructs and the relationships between them (Dixon-Woods 2006).

At the protocol stage of our review, we had identified several perspectives that we considered relevant that could help us to explore and understand the topic of our review. These included social innovation theory (Phills 2008), normalisation process theory (May 2007), and 'street-level bureaucracy' (Lipsky 1980). During the review process, we also identified the 'humanisation of care' concept as relevant to the topic (Backes 2007). Our development of codes and themes had been broadly inductive, although we were likely influenced by our knowledge of specific theoretical perspectives, as no analysis is completely inductive. When developing our line of argument, however, we consciously considered these theoretical perspectives and how they could help us link our findings into a coherent framework.

When we had finalised the individual review findings, we organised a series of meetings with some of the review authors (CG, EP, SL, RN, UG, SMD). After discussion, we decided that the concepts of 'street-level bureaucracy' and 'humanisation of care' were the theoretical and conceptual perspectives that most closely resonated with the findings we had developed. We then re-examined these findings and discussed their relationship to each other in light of these perspectives. After several rounds of discussions and iterations, we agreed on a line of argument that linked the review findings into a coherent framework.

Developing the 'Implications for practice' section

Once we finished preparing the review findings, we examined each finding, identified factors that decision makers at national, regional and local levels should consider when considering informal uses of mobile devices, and presented these as prompts (Glenton 2019). These prompts were also informed by suggestions and recommendations made by the authors of the included studies and their study participants. We have presented these prompts in the 'Implications for practice' section. These prompts are not intended to be recommendations, but have been phrased as questions to help implementers consider the implications of the review findings within their context. We shared and discussed this section with stakeholders identified at the beginning of the review process to gather their feedback about the relevance of these prompts and the manner in which they are phrased and presented, and edited the prompts in response to their feedback (see 'Review co-production with relevant stakeholders' section above).

Assessing our confidence in the review findings

As mentioned above, we developed individual review findings as well as a line of argument. We applied GRADE-CERQual to the individual review findings in the following way, and at least two review authors (CG, EP, SL, RN) used the GRADE-CERQual approach to assess our confidence in each finding (Lewin 2018). GRADE-CERQual is a tool that assesses confidence in the evidence based on the following four key components.

- Methodological limitations of included studies: the extent to which there are concerns about the design or conduct of the primary studies that contributed evidence to an individual review finding.
- Coherence of the review finding: an assessment of how clear and cogent the fit is between the data from the primary studies and a review finding that synthesises those data. By cogent, we mean well-supported or compelling.
- Adequacy of the data contributing to a review finding: an overall determination of the degree of richness and quantity of data supporting a review finding.
- Relevance of the included studies to the review question: the extent to which the body of evidence from the primary studies supporting a review finding is applicable to the context (perspective or population, phenomenon of interest, setting) specified in the review question.

After assessing each of the four components, we made a judgement about the overall confidence in the evidence supporting the review finding. We judged confidence as high, moderate, low, or very low. Our final assessment was based on consensus among the review authors. All findings started as high confidence, and were then downgraded if there were important concerns regarding any of the GRADE-CERQual components. We used the interactive Summary of Qualitative findings (iSoQ) tool when managing the data needed to make an assessment of confidence in the evidence, undertaking the final GRADE-CERQual assessments and preparing summary of qualitative findings tables and evidence profiles GRADE-CERQual 2022).

We also applied GRADE-CERQual to the line of argument. As described above, we developed the line of argument by examining the 24 individual findings and applying the 'street-level bureaucracy' and 'humanisation of care' concepts to these findings.

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The line of argument consisted of seven interlinked statements, and we also assessed our confidence in each of these statements.

We based the line-of-argument statements on one or more of the individual findings, but merged or rephrased, or both, these findings with reference to our conceptual lens. We used the GRADE-CERQual assessments from the individual findings as the starting point for our assessment of confidence in each statement. In a few instances, we only used *parts* of the individual findings when creating line-of-argument statements. In these cases, we considered whether we needed to adjust the original GRADE-CERQual assessment.

We applied GRADE-CERQual's coherence component to all of the statements, assessing whether there was still a reasonable fit between the underlying data in the individual findings and the statement. In particular, we assessed whether the link we had made between the empirical data in the findings and the theoretical or conceptual lens was clear and plausible. Where we decided that other equally plausible descriptions, interpretations or explanations could be used to synthesise the underlying data, we downgraded our confidence in the statement.

Summary of qualitative findings tables and evidence profile(s)

We have presented summaries of the findings and assessments of our confidence in these findings in the Summary of qualitative findings tables. We have presented detailed descriptions of our confidence assessment in an evidence profile.

Integrating the review findings with Cochrane intervention reviews

There are no Cochrane reviews assessing the effectiveness of informal mobile health (mHealth) interventions, nor are we aware of other non-Cochrane reviews on this topic. (This is perhaps not surprising, as it would be challenging to develop and assess the effectiveness of 'informal' interventions.)

Review author reflexivity

At the beginning of the review process, the review team shared the same broad views regarding healthcare workers' informal use of mobile devices. We saw these approaches first and foremost as a response to gaps and weaknesses in the formal healthcare system. We believed that many healthcare workers find themselves 'between a rock and a hard place', committed to meeting the needs of their patients and their workplace while working with the often limited resources available to them, particularly in low-income settings. Several of the co-authors had experienced healthcare workers' informal uses of mobile phones in these settings. One co-author with clinical experience from a high-income setting had also experienced how healthcare workers turn to informal systems because they lack formal systems for communicating with colleagues or because formal systems are overly cumbersome and time-consuming.

We were sympathetic to the challenges that healthcare workers face and their efforts to overcome these challenges through informal, unregulated approaches. We believed that these approaches can help healthcare workers address some of the immediate needs of their patients and may help relieve healthcare worker stress. We suspected that these approaches may be particularly well-suited to healthcare workers' local needs and settings, in contrast to solutions that have been developed elsewhere or that are developed commercially. We also admired approaches that we believed illustrated healthcare workers' creativity and ingenuity.

At the same time, we were concerned about the possible harms and disadvantages of informal digital approaches. One of our main concerns was the possibility of harm to patients through breaches in patient privacy and confidentiality. We were also concerned about the cost of informal approaches to healthcare workers who may feel under pressure to use their own personal phones, airtime, and data. Finally, we were concerned that healthcare workers who access, collect, and share information through informal channels may inadvertently undermine the formal healthcare system's opportunity to learn, co-ordinate, and improve.

By exploring healthcare workers' informal behaviour in relation to mobile digital technology, we discussed how we might be inadvertently encouraging government authorities to regulate this behaviour. We agreed that some level of regulation may be necessary, for instance, to protect patient confidentiality. At the same time, we believed that regulation alone is not the answer, and that health system gaps that may explain this behaviour also need to be addressed. Even where these gaps have been addressed, we believed that healthcare workers need some level of independence and flexibility in order to develop locally relevant solutions, to thrive and feel empowered, and to deliver quality healthcare services.

The views we held at the start of this review were largely the same at the end of the review process, although our understanding of the issues described above are now more nuanced. For instance, our understanding of patient privacy and confidentiality has shifted slightly, as some patients may in fact prefer to contact healthcare workers on their personal phones to keep their sensitive information out of the formal system. Overall, the review process has given us a greater appreciation of how healthcare workers' informal solutions can, in some circumstances, help humanise healthcare by offering personalised solutions to their patients' needs as well as their own and other healthcare workers' needs. At the same time, we are even more aware of a tension between the need for context-specific, flexible solutions and the need for systems that are fair and equitable for patients and healthcare workers. Future strategies need to consider this tension.

R E S U L T S

Results of the search

We identified a total of 14,913 records from electronic databases and 1101 from other sources. We removed 11,241 records before screening (4625 duplicates and 6616 marked as ineligible by automation tools).

We screened a total of 4773 records (3672 titles and abstracts using priority screening in EPPI-Reviewer and 1101 records from other sources). We excluded 4625 records and assessed 148 full-text articles for eligibility. We excluded 110 study articles for reasons already specified in our inclusion/exclusion criteria and these were therefore not described in the Characteristics of excluded studies table. Our reasons for exclusion included:

- focus was not on informal mobile phone use (50 studies)

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- focus was on social media behaviour (41 studies);
- focus was on student learning (9);
- ineligible study design (7) and;
- focus was not on health workers (3).

Seven studies were only available as abstracts; we have listed these under 'Studies awaiting classification'.

We included 30 studies in our review, published in 31 papers (Figure 1). All of the studies were published in English. With very few exceptions, study participants described mobile phone use as opposed to the use of other mobile devices, such as tablets. We therefore refer to 'mobile phones' rather than 'mobile devices' throughout the results section. The studies were from high-, middle- and low-income countries and covered a range of healthcare settings and healthcare-worker cadres. Where we assessed findings as only being of relevance for certain settings, we have made this clear in the finding.

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Figure 1. PRISMA flow diagram

14,913 records identified through database searching before duplicates removed

1101 records identified through other sources

Citation searches (n = 929)
Related reviews (n = 168)
Other sources (n = 4)

11,241 records removed before screening

Duplicate records removed prior to uploading to EPPI (n = 2120)

Duplicate records removed in EPPI (n = 2505)

Records marked as ineligible by automation tools (n=6616)

4773 records screened

Records screened using priority screening (EPPI-Reviewer) (n = 3672)

Records screened from other sources (n = 1101)

4625 records excluded

148 full-text

110 full-text articles excluded

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Figure 1.   (Continued)

```
        ┌──────────────────┐          ┌──────────────────┐
        │ 148 full-text    │          │ 110 full-text    │
        │ articles assessed│─────────▶│ articles excluded│
        │ for eligibility  │          │ (did not meet our│
        └──────────────────┘          │ inclusion        │
                 │                     │ criteria)        │
                 ▼                     └──────────────────┘
        ┌──────────────────┐
        │ 30 studies       │
        │ reported in 31   │
        │ papers met review│
        │ eligibility      │
        │ criteria         │
        │                  │
        │ 7 abstracts were │
        │ not available as │
        │ full-text and are│
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        │ 30 studies       │
        │ included in      │
        │ qualitative      │
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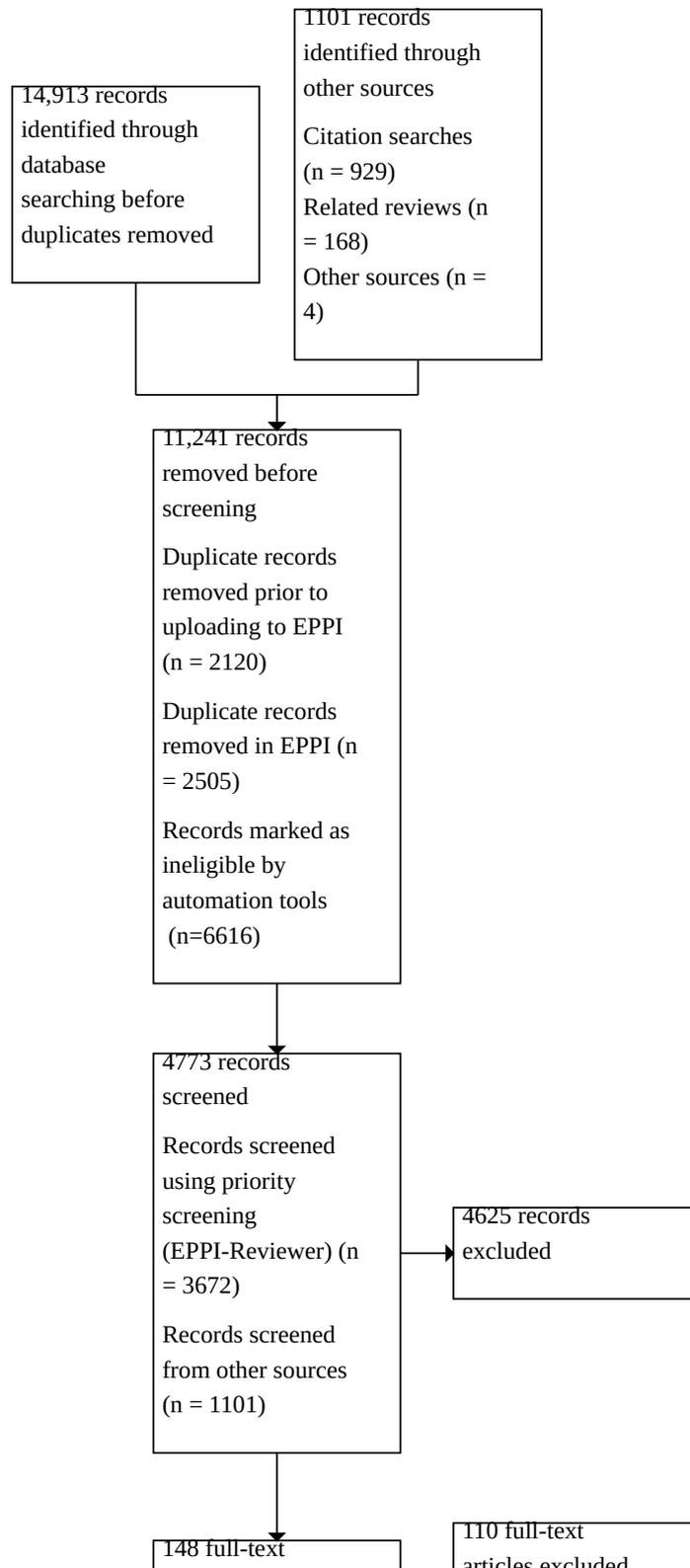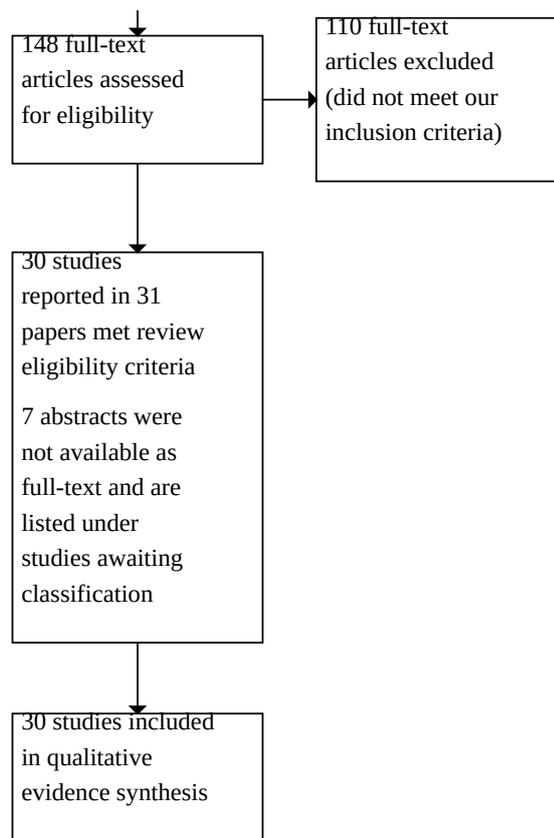## Description of the studies

In this section, we describe the included studies. For a more detailed description of each included study, see the Characteristics of included studies table.

Study methods

In most cases, the study authors gathered qualitative data through individual, semi-structured interviews, although some used focus groups, open-ended questions in surveys (Bhat 2021; Brandt 2016; Pimmer 2018), observation (Ismail 2019; Karusala 2020; Moyer 2014; Ologeanu-Taddei 2019; Schwartz 2013; Tran 2014) and document analysis (Ismail 2019; Rathbone 2020; Schwartz 2013; Spink 2020). Study authors analysed the data using various qualitative thematic analysis approaches.

Funding sources

In 16 of the studies, authors declared that they had received funding and support from national research councils and other government agencies, universities, academic institutions and hospitals. Authors of two studies declared that they received no funding (Mather 2018; Rathbone 2020), while 12 of the studies provided no information about funding.

Age of studies

The studies were published between 2013 and 2022. Eight of the studies did not specify when the data were collected, but in the remaining studies the data were collected between 2008 and 2020.

Study countries

Eighteen of the 30 studies were set in low- or middle-income countries in Asia (India, the Philippines, Thailand, Indonesia and China) and Africa (Ethiopia, Ghana, Kenya, Malawi and South Africa). One of the studies took place in several countries, but mostly in sub-Saharan Africa and Asia (Pimmer 2018). Eleven of the 30 studies were set in high-income countries (Australia, Canada, USA, UK, France and Taiwan).

Study settings and participants

Around half of the studies explored the views and experiences of nurses or doctors. Other cadres included lay health workers, pharmacists and managers. Studies from low- and middle-income countries covered primary and community healthcare settings as well as clinic and hospital settings, while studies from high-income countries were all based in clinics and hospitals.

Type of informal mobile phone use

We included studies where healthcare workers used mobile phones and other mobile devices informally, that is, using approaches that were self-initiated and unregulated. However, this lack of

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regulation was often implied in the included studies rather than stated explicitly.

In all but one of the included studies (Schwartz 2013), healthcare workers' informal mobile phone-based approaches fell under the category of 'shadow IT'. Here, healthcare workers used their personal mobile phones, for instance, to communicate and to seek and store information, and this personal phone use was unregulated, although the lack of regulations was often implied in the studies rather than stated explicitly. In addition to healthcare workers' use of the personal mobile phone itself, this 'shadow IT' behaviour also involved the use of their personal phones to communicate with people in their informal networks for work purposes; to communicate with members of their formal networks through informal messaging app-based groups; and to search for unendorsed online clinical information. Healthcare workers described using their personal phones to make phone calls; send text messages; and use commercial messaging apps including Viber, Line, WhatsApp, Facebook Messenger, Blackberry Messenger, and in one case, a self-designed app (Anstey 2018). They also referred to the use of their phones to connect with online social networks, including Facebook groups; and for email.

One study also described 'non-prescribed use' where healthcare workers used formal work phones informally (Schwartz 2013). This study explored two sites where Indian community healthcare workers ('ASHAs') had been given formal phones and tablets with a mobile-based work application ('CommCare') pre-installed. Through this app, ASHAs were expected to carry out specific tasks related to service delivery, monitoring and evaluation. However, instances of what was referred to as 'non-prescribed use' were also observed where ASHAs used the phones for informal, self-initiated work activities.

Methodological limitations of the studies

Most of the studies gave some description, even if very brief, of the context, participants, sampling, methods and analysis. However, we found poor reporting of researcher reflexivity across many of the studies. Most of the studies relied on individual and focus group interviews to gather data. This may have limited healthcare workers' willingness to describe their own informal, unregulated behaviour, and may have led to some degree of social desirability bias. We suggest that collecting data through observation of healthcare worker behaviour would have been a valuable addition to the study of informal behaviour. Some of the studies used snowball or convenience sampling approaches or recruited participants with the help of senior staff. While this may have been the most feasible approach when recruiting participants, it may have limited the sample variation. Finally, while most studies applied for ethics approval or in other ways addressed ethical issues, some studies only appear to have applied for ethics approval in their own country rather than in the country where data were collected.

An overview of our assessments is presented in the Methodological limitations table (Appendix 2).

Confidence in the review findings

For six of the findings, where the data only or mainly came from low- and middle-income countries, we had minor to serious concerns about the relevance of these findings to other settings

and downgraded our confidence in them. For one other finding, where the data only came from low- and middle-income settings, we assessed it as likely that this finding was not relevant to high-income settings. We specified this in the review finding and did not downgrade our confidence in the finding.

We had minor to serious concerns about 10 of the findings because they were only supported by a small number of studies or by studies with insufficient data. These concerns contributed to our decision to downgrade our confidence in these findings.

Our explanation of the GRADE-CERQual assessment for each review finding is shown in the Evidence Profiles (Appendix 3).

Review findings

We developed 24 review findings and organised these into four broader themes. These themes describe:

- what healthcare workers are using informal mobile-phone-based approaches for;
- why they are doing this;
- what the impacts of this informal behaviour are; and
- how informal mobile phone use is currently regulated.

We then developed a line of argument that links and explains these individual review findings. Below we present the line of argument, followed by the underpinning review findings and themes.

Where we have assessed that a review finding is only applicable to a specific context (for instance, a specific income setting, or healthcare setting for a specific type of healthcare worker), we have specified this in the review finding.

Line of argument

The following line of argument is based on the individual findings that are presented further down in the results section. When developing this line of argument, we were influenced by 'street-level bureaucrat' theory as originally presented by Lipsky 1980, but also as applied by later researchers, including Lavee 2021, Dubois 2010, and Tummers 2015, as well as by the 'humanisation of care' concept (Busch 2019). This line of argument and an explanation of the GRADE-CERQual assessments can also be found in Summary of findings 2.

The healthcare workers in this review, like other 'street-level bureaucrats' such as police officers and social workers (Lipsky 1980), face a gap between what is expected of them and the resources available to them. To plug this gap, healthcare workers develop their own strategies (Tummers 2015), including using their own mobile phones, data and airtime. They also use other personal resources (Dubois 2010; Lavee 2022), including their personal time when taking and making calls outside working hours and their personal networks when contacting others for help and advice (high-confidence statement).

In some settings, healthcare workers' personal phone use, although unregulated, has become a normal part of many work processes. Some healthcare workers therefore experience pressure or expectations from colleagues and managers to use their personal phones (high-confidence statement). **Some healthcare workers also feel driven to use their personal phones at work and at home because of feelings of obligation towards their**

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patients and colleagues. Although early work described street-level bureaucrats' coping strategies as "a functional response to bureaucratic necessities" (Lipsky 1980), our review supports more recent literature showing that street-level bureaucrats are also driven by professional commitment, personal values and social norms in their discretional decisions and behaviour (Lavee 2021; Lavee2022) (moderate-confidence statement).

At best, healthcare workers' use of their personal phones, time and networks helps humanise healthcare. It allows healthcare workers to be more flexible, efficient and responsive to the needs of the patient. It can give patients access to individual healthcare workers rather than generic systems and can help them to keep their sensitive information out of the formal system. It also allows healthcare workers to communicate with each other in more personalised, socially appropriate ways than formal systems allow. All of this can strengthen healthcare workers' relationships with community members and colleagues (moderate-confidence statement).

However, these informal approaches can also replicate existing social hierarchies and deepen existing inequities among healthcare workers. Personal phone use costs healthcare workers money. This is a particular problem for lower-level healthcare workers and healthcare workers in low-income settings as they are likely to be paid less and may have less access to work phones or compensation. Out-of-hours use may also be more of a burden for lower-level healthcare workers as they may find it harder to ignore calls when they are at home. Healthcare workers with poor access to electricity and the internet are less able to use informal mobile phone solutions, while healthcare workers who lack skills and training in how to appraise unendorsed online information are likely to struggle to identify trustworthy information. Informal digital channels can help healthcare workers expand their network. But healthcare workers who rely on personal networks to seek help and advice are at a disadvantage if these networks are weak (moderate-confidence statement).

Healthcare workers' use of their personal resources can also lead to problems for patients and can benefit some patients more than others. For instance, when healthcare workers store and share patient information on their personal phones, the confidentiality of this information may be broken. In addition, healthcare workers may decide to use their personal resources on some types of patients but not others. Healthcare workers sometimes describe using their personal phones and their personal time and networks to help patients and clients whom they assess as being particularly in need. These decisions are likely to reflect their own values and ideas, for instance, about social equity and patient 'worthiness' (Lavee 2022). However, these may not necessarily reflect the goals, ideals and regulations of the formal healthcare system (moderate-confidence statement).

Finally, informal mobile phone use plugs gaps in the system but can also weaken the system. Storing and sharing of information on personal phones and through informal channels can represent a 'shadow IT' system where information about patient flow, logistics, etc., is not recorded in the formal system. Healthcare workers may also be more distracted at work, for instance by calls from colleagues and family members or from social media use. These types of challenges may be particularly difficult for weak healthcare systems (moderate-confidence statement).

Individual review findings

The line of argument presented above is based on the following individual findings. Summaries of the individual findings and an explanation of their GRADE-CERQual assessment can be found in the Summary of findings 1.

Theme 1: What are healthcare workers using informal mobile-phone based approaches for?

Communicating with colleagues and with patients

Finding 1.1 Healthcare workers describe using their personal mobile phones at work to seek advice, information and support from other healthcare workers regarding patient management, for instance when making referrals and during clinical emergencies (high-confidence finding).

The purpose of communicating with other healthcare workers informally via their personal mobile phones was often to seek advice, information and support, and exchange information regarding patient management (Abane 2021; Anstey 2018; Barnor-Ahiaku 2016; Bautista 2016; Bautista 2017; Bautista 2020; Chib 2013; Hampshire 2017; Hampshire 2021; Hussain 2022; Ling 2020; Mariwah 2022; Moyer 2014; Nerminathan 2017; Pimmer 2018; Shenouda 2018; Spink 2020; Tran 2014; Venkataraghavan 2022). For instance, several healthcare workers described using their phones to facilitate referrals or to seek help during clinical emergencies (Abane 2021; Anstey 2018; Barnor-Ahiaku 2016; Bautista 2020; Hampshire 2017; Hampshire 2021; Ling 2020; Mariwah 2022; Pimmer 2018; Venkataraghavan 2022).

"If the patient undergoes code blue [cardiopulmonary arrest], we just text or call doctors instead of looking for them" (Staff nurse, the Philippines) (Bautista 2016: page 74).

Finding 1.2 Healthcare workers describe using their personal mobile phones to socialise and exchange emotional support with other healthcare workers and to air work grievances, although some are annoyed by messages that are not directly related to work (moderate-confidence finding).

Some healthcare workers also used their personal mobile phones informally to socialise and offer each other emotional support (Bautista 2017; Pimmer 2018):

"Several participants noted that they rarely socialise face-to-face with their colleagues, as they worked in shifts or they are too tired after work. To overcome these communication barriers, they used MIM [mobile instant messaging] applications as a means for socialization. '…our Facebook Messenger group, it is not only for professional use where our schedules get updated. It is also for personal purposes because we use that to catch up with our colleagues and ask how are they doing'" (Study author and staff nurse, the Philippines) (Bautista 2017: page 5).

Informal messaging app-based groups also allowed healthcare workers to create arenas where work grievances could be discussed and that were inaccessible to senior staff or to the government (Bautista 2017; Ismail 2019).

"We cannot convey our complaints in that [Viber] group chat because our [nurse] manager is in there. We can't do any complaints. But we can discuss those complaints in our own [Viber] group chat where we

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are only five staff nurses inside that" (Staff nurse, the Philippines) (Bautista 2017: page 6).

"From our interviews, we learned that WhatsApp was used to circulate information such as the list of demands from the government, headway made with the government, organized strikes and meetings, news articles, and other updates. [...]. P3 shared that WhatsApp was used for communication not only because it was pervasive but because it was a secure platform. It was guaranteed that messages would remain private and inaccessible to the government" (Study authors describing Accredited Social Health Activists ("ASHAs"), India) (Ismail 2019: page 8).

However, others were annoyed when work-related messaging-app-based groups included content about activities that were not directly work-related (Ismail 2019; Rathbone 2020).

Finding 1.3 Senior staff describe using informal mobile phone channels to co-ordinate, oversee and manage healthcare workers' work. Healthcare workers also describe using these channels to send reports to supervisors and to share practical information such as staffing schedules (moderate-confidence finding).

In some studies, senior staff used informal mobile phone-based groups and channels to co-ordinate, oversee and manage other staff members' work (Anstey 2018; Bautista 2017; Karusala 2020; Pimmer 2018; Spink 2020; Venkataraghavan 2022; Watkins 2018). In one study from a hospital in India, WhatApp groups were established by senior staff to enable communication within the organisation (Karusala 2020). While these groups were not officially sanctioned, they were well-integrated into the daily management of the hospital and reflected existing staff hierarchy. For instance, each ward had a 'floor group' that included all staff nurses and their superiors. Other Whatsapp groups gathered staff at higher levels of leadership, cross-departmental management groups, Information Technology and Operations groups. Senior nurses used 'floor groups' actively to manage and oversee staff, for instance, by monitoring wards when off-shift, collating daily reports, reminding nurses of best practice and following up incidents. Nurses were expected to join and utilise the groups, but as they were not permitted to bring their phones onto the floor, they were expected to check the group when off-duty:

"Critical information is communicated over chat, and they have little choice but to be part of the chat ecosystem. None of the nurses we spoke to objected to this nor really discussed it. Nonetheless, it adds a different tint to the idea of chat adoption as worker-driven, especially as nurses said that if they were told to use a different organisational chat app, they would simply have to do it. It is clear that WhatsApp, as a mobile phone-based chat app, supported the work of the hospital, but once it was endemic, individual workers have little choice but to use it" (Study authors describing hospital nurses, India) (Karusala 2020: page 9).

In another study from India (Venkataraghavan 2022), medical officers used mobile phone systems to monitor community-based healthcare workers, including Accredited Social Health Activists (ASHA) and Auxiliary Nurses and Midwives (ANMs). For instance:

"The ASHAs are asked to send selfies from the field or photographs of the data collected or of the site they visited as proofs of

completed field visits" (Study authors describing 'ASHAs', India) (Venkataraghavan 2022: page 187).

Most ANMs owned and used smartphones for work and had also recently been supplied with android tablets as a job tool:

"The ASHAs, on the other hand, being honorarium workers and from very low socioeconomic backgrounds mostly use basic feature phones." "One MO [medical officer] revealed that he persuades ASHAs and others in the PHC [public health center] to buy smartphones and install WhatsApp on the device as he felt that he could easily pass on work-related instructions easily" (Study authors describing 'ASHAs', India) (Venkataraghavan 2022: page 188).

Similarly, in the Philippines, doctors used Viber to send orders to nurses, while head nurses used Viber and Facebook messenger to announce meetings, staffing schedules, and information regarding patient incidents (Bautista 2017).

Senior staff as well as lower-level healthcare workers also reported using these informal mobile phone channels to: send reports, for instance to supervisors; co-ordinate and share staffing schedules and meeting announcements; and manage supplies and logistics (Abane 2021; Barnor-Ahiaku 2016; Bautista 2017; Hampshire 2017; Ismail 2019; Mariwah 2022; Venkataraghavan 2022).

Finding 1.4 Healthcare workers' descriptions of informal mobile phone communication usually involve colleagues at the same workplace. Far fewer healthcare workers describe using their phones to contact healthcare workers from outside their workplace or linked facilities or that are not already known to them (high-confidence finding).

As described above, healthcare workers in the included studies often used their personal mobile phones to communicate with other healthcare workers. These healthcare workers were usually colleagues at the same workplace or at healthcare facilities organised directly below or above them and were mainly contacted with the aim of managing routine work tasks (Abane 2021; Anstey 2018; Barnor-Ahiaku 2016; Bautista 2016; Bautista 2017; Bautista 2020; Brandt 2016; Hampshire 2017; Hampshire 2021; Hussain 2022; Ismail 2019; Karusala 2020; Ling 2020; Mariwah 2022; Nerminathan 2017; Pimmer 2018; Rathbone 2020; Shenouda 2018; Spink 2020; Tran 2014; Venkataraghavan 2022; Watkins 2018).

"Keep track of doctors. So, if I need a doctor for anything, rather than having to go to a computer and log on to the paging system and send them a page, I will just send a text message or just call them directly and they will call me back. Usually, text message" (Hospital nurses, Australia) (Spink 2020: page 3514).

"Sometimes I call other facilities to check for vaccines when we do not have adequate stock ... I can borrow some and replace it later. We even call the District office for assistance when other health facilities do not have enough stock" (Community health nurse, Ghana) (Hampshire 2017: page 38).

In some of these studies, healthcare workers made use of their informal networks when contacting colleagues. In Ghana, hospital-based healthcare workers referring patients to another department contacted colleagues who were previous classmates (Barnor-Ahiaku 2016). In Thailand, community-based healthcare workers referring patients to hospital contacted specific personal contacts there to hasten or ease these referrals (Ling 2020).

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Fewer studies described healthcare workers' use of informal communication channels to contact people working *outside* their own workplace or the facilities directly linked to it. One exception was the case of this Malawian Medical Assistant:

"I was on Facebook and found a cardiac professor and sent him a friend request. I communicate with him about drugs for patients … I have about 7 or 8 other Facebook contacts who are medical professionals in Malawi and abroad" (Medical Assistant, Malawi) (Hampshire 2017: page 38).

Other examples of communication between healthcare workers that were not from the same workplace mainly included online groups of healthcare workers with similar backgrounds and positions and from the same country. In Zimbabwe, nurses were part of a WhatsApp group that had originally been established while they were students after the end of training and that was now used as a forum for peer-based discussion and learning (Pimmer 2018). In China, village doctors made use of existing social networks to contact other doctors, including other local doctors or alumni from the same medical college, to seek advice and information (Chib 2013). In India, lay health workers used WhatsApp to contact other lay health workers from other areas of the country and used this partly to organise a movement for a salary raise and other benefits (Ismail 2019).

Finding 1.5 Healthcare workers describe using their personal mobile phones to communicate with patients, clients and their families (low-confidence finding)

Healthcare workers also used their mobile phones informally to communicate with patients, clients and their families (Bautista 2016; Brandt 2016; Hampshire 2021; Watkins 2018). This included providing teleconsultations, follow-up, monitoring, advice and support Bhat 2021; Chiang 2016; Chib 2013; Hampshire 2017; Moyer 2014; Pimmer 2018; Venkataraghavan 2022); contacting patients to remind them of appointments (Mariwah 2022; Venkataraghavan 2022); using translation apps to communicate with patients in a different language (Bautista 2016); showing patients test results during face-to-face contact and using pictures, audio and video to inform, educate and persuade community members about health issues (Venkataraghavan 2022); contacting family members during emergencies, for instance when the patient is dying (Bautista 2016); and offering family members emotional support (Chiang 2016).

"Sometimes family members find that the patient has shortness of breath and feels strange, so they videotape it and send it to us … then we can ask the family members to follow our instructions to solve [the problem] step-by-step … we can show the caregiver how to do it, and we can also observe if the caregiver has done it correctly … Because of this, they feel more assured and do not feel the need to immediately visit the emergency room" (Community nurse, Taiwan) (Chiang 2016: page 2011).

Searching for, retrieving, recording and storing information

Finding 1.6 Healthcare workers describe using their personal mobile phones to take photos. This includes images of patient-specific information such as images of X-rays and test results as well as non-patient-specific information such as reports and schedules (high-confidence finding).

Many studies described healthcare workers' use of their personal mobile phones to take photos. Healthcare workers described taking images of patient-specific information, including images of patients' symptoms as well as patients' electrocardiograms, X-ray images, monitoring screens, test results, charts and admission sheets (Anstey 2018; Barnor-Ahiaku 2016; Bautista 2016; Brandt 2016; Burns 2013; Hampshire 2021; Hussain 2022; Mather 2018; Nerminathan 2017; Ologeanu-Taddei 2019; Shenouda 2018; Venkataraghavan 2022).

"I will take pictures of the X-rays and send them to whoever is on [duty] at the tertiary hospital, they will read the pictures and that is how we will communicate" (Doctor, South Africa) (Anstey 2018: page 143).

Sometimes these images were used by the individual healthcare worker only, for instance to help monitor patients' blood results or wound progression over time (Barnor-Ahiaku 2016). In other cases, they were shared with colleagues to inform them of patient progress or seek advice (Anstey 2018; Barnor-Ahiaku 2016; Bautista 2016; Hampshire 2021; Mather 2018; Ologeanu-Taddei 2019). In some cases, patients themselves sent images, for instance of their symptoms and conditions or of relevant documents such as medical reports and prescriptions to healthcare workers (Bhat 2021; Chiang 2016; Pimmer 2018). Some doctors also used patient images in scientific publications or for teaching purposes (Ologeanu-Taddei 2019):

"When I have […….] an interesting case that would allow me to illustrate a course or something like that, I take a picture anyway with my personal camera at that moment" (Doctor, France) (Ologeanu-Taddei 2019: page 11).

"I'll take pictures of things, so if I'm going to do any teaching sessions, I'll take pictures of x-rays or EKGs [electrocardiograms], obviously leaving out any patient-identifying data. I think the three biggest apps that I use are the camera, the drug apps and then some med [calculation] apps …" (Doctor, Canada) (Hussain 2022: page 8).

In addition to these patient-specific images, healthcare workers sometimes used their personal mobile phones to take images of documents such as reports, weekly schedules or organisational practice (Abane 2021; Bautista 2017; Karusala 2020), to share with colleagues via messaging apps (Abane 2021). In addition, healthcare workers used their phone cameras to document and provide evidence to their superiors of tasks performed (Karusala 2020; Venkataraghavan 2022).

In addition to the camera, healthcare workers used a range of 'basic' functions on their personal mobile phones to assist their work, including the diary, calendar and notes functions (Nerminathan 2017), the calculator, stopwatch and torch (Hampshire 2021).

Finding 1.7 In addition to taking photos of patient-specific information, healthcare workers describe using their personal mobile phones to retrieve, record and store patient information (low-confidence finding).

Healthcare workers also used their personal mobile phones to retrieve, record and store patient data, for instance, downloading patients' test results directly to their phones (Anstey 2018); monitoring patients by tracking their data over time on their phones (Barnor-Ahiaku 2016); storing patients' phone numbers

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(Hampshire 2017); and in other ways storing patient information on their phones (Mariwah 2022).

Finding 1.8 Healthcare workers describe using their personal mobile phones to search for general clinical and practical information in officially endorsed information sources but also in sources that are not formally endorsed (high-confidence finding).

Healthcare workers also used their personal mobile phones to search for work-related information, either through internet searches (Anstey 2018; Barnor-Ahiaku 2016; Bautista 2016; Bautista 2020; Chib 2013; Hampshire 2021; Hussain 2022; Mather 2019; Nerminathan 2017; Venkataraghavan 2022), or via apps they had downloaded to their phones (Brandt 2016; Hampshire 2021; Hussain 2022; Shenouda 2018; Spink 2020). They searched for both clinical information, for instance about specific diseases or treatments (Anstey 2018; Barnor-Ahiaku 2016; Bautista 2016; Bautista 2020; Chib 2013; Hampshire 2021; Hussain 2022; Nerminathan 2017; Shenouda 2018), and sometimes for practical information such as hospital locations (Bautista 2016).

"So now you have a device in your hand that you carry around at work and you can connect to the Internet and do a search on any topic you want. You can download advanced medical apps that will tell you how to adjust a dose of antibiotic. It can tell you [algorithms] for procedures. You've got a calculator. You've got a map. You've got a stopwatch. You have everything available in the palm of your hand" (Doctor, Canada) (Hussain 2022: page 9).

"I did a survey of about 10 [city] hospitals, [specialty] departments, and less than half the staff had Internet access and when you take out the senior staff in that survey, there was, you know, most of the staff, the direct care nurses didn't have Internet access. So, people are using their mobile phones for Internet access and to find evidence and to source, you know, information, which is just terrible" (Senior nurse, Australia) (Mather 2018: page 4).

In some cases, they used their phones to search officially endorsed information sources, such as digital versions of official clinical guidelines (Anstey 2018; Shenouda 2018). This included an app which allowed clinicians to access local antimicrobial guidelines for a specific hospital trust (Shenouda 2018). In other cases, the sources they mentioned were not formally endorsed by their workplace or healthcare authorities' and ranged from Google to medical sites such as UpToDate, WebMD and Medscape (Anstey 2018; Bautista 2016; Hampshire 2021; Nerminathan 2017), and various medical apps (Brandt 2016).

Theme 2: Why are healthcare workers using informal mobile-phone-based strategies?

Finding 2.1 Healthcare workers and managers explain that they use personal mobile phones because formal tools and systems are not available or functional, or because their personal phones have better functionality and are more user-friendly (high-confidence finding).

Healthcare workers and managers described turning to their personal mobile phones because the formal systems did not offer other reliable means of communication, information seeking, storage or exchange (Anstey 2018; Bautista 2016; Bautista 2020; Hampshire 2021; Moyer 2014; Ologeanu-Taddei 2019).

One main limitation of the formal system was a lack of work phones. In Ghana, Ethiopia and Malawi, donor programmes had distributed mobile phones to lay health workers but these were no longer funded, lacked infrastructural support or no longer worked, and healthcare workers relied instead on their personal phones (Hampshire 2021). In Australia, hospital clinicians used their personal phones to take photos because the medical photographer or the hospital-owned camera was not always available (Burns 2013). Similarly, in the Philippines, hospital nurses used their personal phones because the number of work phones provided was insufficient:

"We need to use our own [mobile] phone for urgent referrals because we only have one unit phone and there are so many of us. . .like 28 to 30 nurses per shift" (Staff nurse, the Philippines) (Bautista 2016: page 75).

Where work phones or other formal resources were available, these sometimes lacked functionality. Hospital nurses and managers in the Philippines described a range of limitations with these resources including work phones that: were feature phones with limited functionality; were subscribed to one telecom company and where text messages and calls to numbers with other subscriptions were prohibited due to additional costs; were landlines and could only be used to contact other landlines within the hospital; and ran out of credit (Bautista 2016; Bautista 2020).

In addition, formal systems were not always user-friendly. In France, doctors took photos with their personal phones and shared these using informal channels such as WhatsApp because the formal systems were seen as time-consuming and unfeasible to use during consultations with patients (Ologeanu-Taddei 2019). In addition, doctors reported that the quality of the pictures in the formal systems was too poor to be used as a basis for medical decisions and scientific publications (Ologeanu-Taddei 2019). Nurses in the Philippines complained of an intercom system that was difficult to use, often slow and sometimes busy, and a desktop-based text-messaging software for sending patient referrals that had difficulties in receiving replies (Bautista 2016; Bautista 2020). In India, doctors used WhatsApp via their personal mobile phones for teleconsultations because patients found it easier and more comfortable to use than official platforms (Bhat 2021).

Other challenges with formal systems that led healthcare workers to turn to their personal phones included insufficient or inaccessible formal information sources. In South Africa, a nurse described using her phone to search Google because of a lack of well-resourced libraries (Anstey 2018), while Chinese rural doctors turned to their informal online networks because of a lack of formal information resources, training and advice (Chib 2013). In Australia, hospital nurses used their personal phones to seek information because they were not given internet access at work (Mather 2019).

Finding 2.2 Healthcare workers, including senior staff and managers, describe how the informal use of personal phones at work has become normalised and how senior staff sometimes expect it of healthcare workers (high-confidence finding).

For many healthcare workers, mobile phones were seen as a normal part of everyday life and of work (Barnor-Ahiaku 2016; Brandt 2016; Hussain 2022; Mather 2018). Personal mobile phone use was therefore often integrated into daily work routines, despite

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the informal status of these phones (Bautista 2016; Ling 2020; Moyer 2014), and, in some cases, despite formal policies directly prohibiting their use (Bautista 2016; Mather 2018; Ologeanu-Taddei 2019). The widespread use of personal mobile phones among peers or senior colleagues also helped create a normalising effect (Bautista 2016; Nerminathan 2017; Shenouda 2018).

"What they have now, so we're living in a bit of a fantasy world at the moment where people say there's no mobile phones allowed, when in fact everyone has a mobile phone in their pocket" (Senior nurse, Australia) (Mather 2018: page 5).

"It's like normal. Nowadays, everyone, like doctors and nurses, use their [personal mobile] phone anytime and anywhere [in the hospital]" (Staff nurse, the Philippines) (Bautista 2016: page 73).

This 'quasi-formalisation' of personal phone use meant that superiors did not only allow it, but sometimes actively encouraged or expected it from their staff members (Bautista 2016; Bautista 2017; Bautista 2020; Karusala 2020; Venkataraghavan 2022):

"One [Medical Officer] revealed that he persuades ASHAs and others in the [public health center] to buy smartphones and install WhatsApp on the device as he felt that he could easily pass on work-related instructions easily. 'If I put any information on WhatsApp group, they cannot say the information has not reached me. Information is put up in Kannada and gets communicated very fast'" (Study authors and medical officer, India) (Venkataraghavan 2022: page 187).

"Some doctors want to see the patient's heart rate and rhythm through the cardiac monitor. I am not able to do that with our unit phone because it is not a smartphone. It is only a feature phone. Using my own smartphone, I can do that by taking a picture of the cardiac monitor screen and sending the image [to the doctors] via Viber [a mobile instant messaging application] because that's what doctors want" (Staff nurse, the Philippines) (Bautista 2016: page 75).

Finding 2.3 Healthcare workers describe how the use of their personal phones is driven by feelings of obligation towards their patients (moderate-confidence finding).

Healthcare workers also described how their use of their personal phones was driven by feelings of obligation towards and concern for their patients (Abane 2021; Anstey 2018; Bautista 2016; Hampshire 2017). Some described the use of their personal mobile phones not as a choice but as a necessity for work (Bautista 2016; Hampshire 2017; Hampshire 2021), and expressed strong moral imperatives to help their patients, even at personal costs (Abane 2021; Hampshire 2017; Hampshire 2021):

"A 32-year-old male [Community Health Nurse] working in a peri-urban settlement in the Savannah zone had this to say when asked why he used his own airtime and data bundles to perform official duties: 'You cannot be in the system without saying that you don't want to use your own credit to call somebody. It is part of our work … you know that you are there to save lives so whatever you will do to save lives, you don't care about that (i. e. cost of airtime and data bundle)'" (Study authors and Community Health Nurse, Ghana) (Abane 2021: page 7).

"One Malawian [Health Surveillance Assistant] described health-workers as 'Good Samaritans', adding, 'professionally, you do not feel good to see a patient die or feeling great pain while you can help even

with the little resources at your disposal'. Likewise, a Ghanaian CHN said, 'we have taken an oath to serve no matter the circumstance … We feel we owe a duty to serve people', while another told us, 'it is not good in the sight of God not to do [my job] well and so I sacrifice to do it well … What motivates me is the passion for the profession"' (Study authors, Health Surveillance Assistant, Malawi and Community Health Nurse, Ghana) (Hampshire 2017: page 39).

In Thailand, community-based healthcare workers used their mobile phones to call personal contacts at the hospital when referring patients (Ling 2020). This could help patients bypass portions of the hospital system and could make them feel that they were given special care, which was also sometimes expected in local communities (Ling 2020).

Theme 3 – What are the impacts of informal mobile phone-based strategies?

Finding 3.1 Healthcare workers report that the use of their personal mobile phones makes it easier and faster to communicate with patients and colleagues, prevents unnecessary journeys, and can lead to better quality care (high-confidence finding).

Healthcare workers described how mobile phones and messaging apps allowed them to work more efficiently by making it easier and faster to communicate with colleagues and with patients and their families (Anstey 2018; Bautista 2016; Bautista 2017; Bautista 2020; Hampshire 2017; Hampshire 2021; Ling 2020; Pimmer 2018; Tran 2014; Venkataraghavan 2022); making it easier and faster to find information (Bautista 2016; Bautista 2017; Brandt 2016; Chib 2013; Mather 2018; Nerminathan 2017; Rathbone 2020); helping prevent unnecessary journeys for patients and healthcare workers (Chiang 2016; Hampshire 2017; Hampshire 2021; Hussain 2022); giving healthcare workers, patients or their family members more flexibility as they could reply to messages when they found it convenient (Chiang 2016); allowing healthcare workers to offer better quality services (Chiang 2016; Venkataraghavan 2022); and ultimately improving patient outcomes (Anstey 2018; Bautista 2016; Chiang 2016; Hampshire 2017; Hampshire 2021; Mather 2018).

"… to be able to put it on WhatsApp, 'Is anybody still at the bases to dispense anything or check anything?' like, it's just a bit quicker and it gives the answer quicker" (Pharmacist, UK) (Rathbone 2020: page 508).

"I think cell phone use should be okay. Especially when looking up medications and diagnosis. I have a drug book and I.V. calculator application on my phone that come in handy at times. It's just so much quicker and easier" (Nurse, USA) (Brandt 2016: page 25).

Finding 3.2 Healthcare workers describe how the exchange of personal phone numbers between healthcare workers and patients allows patients to contact healthcare workers who are already known to them and enables bidirectional communication. In contrast, many formal systems tend to be unidirectional and do not include ways of contacting a specific healthcare worker (low-confidence finding).

In several studies, healthcare workers and their patients or clients contacted each other directly via the healthcare workers' personal mobile phones; either through phone calls, text messages or messaging apps (Bautista 2016; Bhat 2021; Brandt 2016; Chiang

2016; Chib 2013; Hampshire 2017; Hampshire 2021; Ismail 2019; Mariwah 2022; Moyer 2014; Venkataraghavan 2022; Watkins 2018).

"… peer mentors at Kenyatta [National Hospital] went to extraordinary lengths to make themselves available to their clients, including giving out their private phone numbers to clients they met at the hospital and when visiting patients in their homes" (Study author describing peer mentors, Kenya) (Moyer 2014: page 155).

"In turn, patients regularly call health-workers, who generally gave out their phone numbers freely. Interviewees' estimates of how many patients had their personal numbers ranged from 10 to more than 40. Most reported receiving frequent calls from patients seeking reassurance, advice and sometimes emotional support (e.g. queries about how to take medication, worries about side effects or anxiety about test results)" (Study authors describing community-based healthcare workers, Ghana and Malawi) (Hampshire 2017: page 37).

The exchange of personal phone numbers allowed patients and clients to contact healthcare workers who were already known to them and also enabled bidirectional communication, as opposed to many formal systems that tend to be more generic and unidirectional (Moyer 2014). This ease of access to healthcare workers was believed to give patients and their families reassurance, support self-care, and foster greater understanding and trust between them and the community (Chiang 2016; Hampshire 2017; Hampshire 2021; Ismail 2019). For instance, Indian ASHAs struggling to build relationships with clients living in slums used WhatsApp and exchanged their personal phone numbers to strengthen this relationship and improve communication (Ismail 2019).

Finding 3.3 Healthcare workers describe how their personal phone use can help them manage their relationships with other healthcare workers, for instance by providing additional information to justify a patient referral and protect themselves against criticism about their decisions but also to support colleagues who need their assistance out of hours (low-confidence finding).

Some healthcare workers described how their personal phone use helped them meet social norms and expectations and maintain their relationships with patients and other healthcare workers. In a study from Thailand (Ling 2020), community-based healthcare workers used their mobile phones to call hospital staff already familiar to them when referring patients and saw a number of advantages to this approach. They described how direct communication with hospital staff could be seen as a courtesy to them to warn them of an incoming patient. This also allowed them to give additional information about the patient for which there was no room on the referral cards, or that was sensitive and that may not have been culturally appropriate to write on the card, such as information about the patient's mental health or family situation. Calling colleagues directly also gave them an opportunity to justify their referrals in situations where they had had to deviate from formal guidelines, for instance when they had run out of medication or other resources, thereby protecting them from criticism from hospital staff. And it allowed them to check up on the patients they had referred:

"In some cases, community healthcare workers such as Top simply wanted to ensure that the patient had indeed arrived at the hospital. 'I was not sure whether the patient that I treated did go [to the hospital] … I would call to check whether his condition has improved,' said Top" (Study authors and community-based healthcare worker, Thailand) (Ling 2020: page 367).

In the UK, pharmacists who participated in informal WhatsApp groups and responded to queries from colleagues out of hours despite no financial compensation were driven by feelings of obligation towards their colleagues:

"I don't need to be on [the WhatsApp group] at all, I don't do on-call but I was asked, 'What do you think?' and to be perfectly honest I would hate to think that I knew something and was sitting there ignoring it because I wouldn't want to see anybody stuck …" (Pharmacist, UK) (Rathbone 2020: page 508).

Finding 3.4 Healthcare workers complain that the use of their personal phones for work blurs the boundaries between personal and professional life as they are sometimes contacted by patients and colleagues at home, outside of working hours, and this could be a significant disruption to their personal lives (high-confidence finding).

Healthcare workers complained about a blurring of boundaries between work and home as patients and colleagues contacted them outside working hours, sometimes late at night (Bhat 2021; Chiang 2016; Hampshire 2017; Hampshire 2021; Mariwah 2022; Moyer 2014; Nerminathan 2017; Rathbone 2020; Shenouda 2018; Watkins 2018), and healthcare workers could find it difficult to ignore these calls and messages:

"One time during the holidays a patient had a nasogastric tube fall out after it was inserted … The patient's family continued sending me Line messages, asking me to visit them. This was during my nonworking hours, but it seemed that I had to go … I felt a little conflicted. They can find you anytime. Once they know you have read the message, you have to respond. After you read it, you will hesitate about how to answer them" (Community Nurse, Taiwan) (Chiang 2016: page 2014).

"Usually it is women who call but, one time, a man called me at night because his wife was going into labour. My husband was angry and accused me of having an affair with man because he called me in the night" (Health Extension Worker, Ethiopia) (Hampshire 2021: page 18).

"The concept of just doing work when you are physically at work evaporate[s] when you have access to devices, and when communication is part of what your job entails" (Consultant, Australia) (Nerminathan 2017: page 294).

In workplaces where the use of healthcare workers' personal phones had become "quasi-formalised", it could become particularly difficult to ignore these calls and messages. In one study from a hospital in India, charge nurses used WhatsApp groups to contact staff nurses after their shift had finished to follow up on tasks and check that these had been done correctly (Karusala 2020). A number of factors made it difficult for staff nurses to ignore these messages at home, including the fact that they were not allowed to use their phones at work, that messages were often about tasks that needed to be done before the next shift, and that these tasks were sometimes difficult to focus on at work:

"Since staff nurses cannot use their phones on-shift, they necessarily have to keep up with the chat after work. Further, since messages are

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often about tasks that need to be done before the next shift, such as looking over training materials or showing up to a training session, nurses were obligated to check these messages not just "at some point" but sooner rather than later. This raises questions around when staff nurses are not on call in some way, or when they can be sure they do not need to check work-related messages. However, even if phones were allowed on-shift, work would still carry off-shift, in part because one of the most useful aspects of chat for charge nurses and others is bridging the temporal mismatches between shift work and management work" (Study authors describing hospital nurses, India) (Karusala 2020: page 9).

This study author suggested that it may be easier for people higher up in the hierarchy to ignore messages at home (Karusala 2020).

Another practical problem was the volume of messages taking up space on personal phones, and healthcare workers reported that they frequently deleted messages to free up space (Karusala 2020).

Finding 3.5 Healthcare workers describe how the use of their personal phones at work can lead to distraction at work, both because of other work calls to their personal phones and because of personal calls. However, some healthcare workers also appreciate the ability to stay connected to their home lives during working hours. Some managers complain that healthcare workers are distracted by their use of social media, games and videos (moderate-confidence finding).

The blurring of boundaries between work and home was also noticeable at work. Some nurses and doctors described how personal messages and calls at work could be distracting (Bautista 2016), and sometimes found these difficult to ignore (Nerminathan 2017).

Managers and other leaders were also concerned that healthcare workers were being distracted from their work by personal calls (Bautista 2020; Brandt 2016; Mariwah 2022; Venkataraghavan 2022). Some of them also complained about distraction due to social media use, games and videos (Bautista 2016; Bautista 2020; Brandt 2016), and study authors in one study observed community volunteers in the Ebola response using WhatsApp as a dating service (Pimmer 2018).

However, healthcare workers' access to personal calls at work was also described in positive terms. One study author suggested that healthcare workers' personal phone use allowed for increased connectivity to personal lives, although acknowledging the potential for distractions and a blurring of the work-life boundary (Tran 2014). In another study, a senior nurse emphasised how mobile phones enabled nurses to stay in touch with their own families while at work:

"The nurses feel more comfortable when their children call and say they are home safe and sound. New mothers can view live video of their child's first words, steps, etc. One of my nurses was able to view and communicate with her son who was having chemotherapy on the days that her husband was with their son. I can go on and on about the advantages. This is a way of life for certain ages and as long as the phone doesn't distract from patient care, I feel the advantages outweigh… I say let it be with the understanding by all that the phone never distracts from patient care." (Nurse leader, USA) (Brandt 2016: page 25).

In addition, healthcare workers complained about being distracted at work by colleagues who contacted them on their personal mobile phones (Hampshire 2021; Karusala 2020; Nerminathan 2017; Venkataraghavan 2022).

Finding 3.6 Healthcare workers are concerned about privacy and confidentiality issues when storing and sharing patient information on their personal mobile phones. However, in some cases, healthcare workers also use their personal phones to keep sensitive patient information *out* of the formal system (moderate-confidence finding).

Many healthcare workers and their managers were aware of and raised concerns about privacy and confidentiality issues when healthcare workers used their personal mobile phones to take photos, store and share patient information (Bautista 2016; Brandt 2016; Burns 2013; Chiang 2016; Hampshire 2021; Hussain 2022; Mariwah 2022; Nerminathan 2017; Rathbone 2020; Shenouda 2018; Spink 2020; Tran 2014). However, healthcare workers in one study were described by study authors as having "*little idea about the potential privacy issues around having work information on personal phones*" (Karusala 2020: page 8).

Some healthcare workers developed their own approaches to address these concerns. For instance, some avoided taking pictures of patients all together (Shenouda 2018). Others left out patient-identifiable information such as names or dates of birth (Hussain 2022; Rathbone 2020; Shenouda 2018; Tran 2014). Some also deleted images and information after use (Bautista 2016; Shenouda 2018; Spink 2020). In one study, patients themselves used WhatsApp's "Delete for everyone" feature to delete images they had shared during teleconsultations (Bhat 2021). However, some healthcare workers, although aware of privacy and confidentiality issues, continued to gather and store patient information on their personal phones, apparently because of convenience and efficiency and the need to save information for future reference (Mariwah 2022; Nerminathan 2017; Tran 2014):

"I would rather use my personal device. I realize there's confidentiality issues, but I would much rather" (Doctor, Canada) (Tran 2014: page 817).

While many healthcare workers had concerns about privacy and confidentiality, some described how the opportunity to share information via the healthcare worker's private phone could offer more privacy than using the formal system:

"If someone has a sexually transmitted disease, they wouldn't feel comfortable to come to a clinic because they would feel exposed; it won't be confidential. So they can call the [Health Surveillance Assistant] directly" (Health Surveillance Assistant, Malawi) (Hampshire 2021: page 14).

"But sometimes there was a need to communicate culturally-sensitive information about the patient to the hospital. Nit, a community healthcare worker, reported using her mobile phone to communicate about an outcast patient, telling a hospital nurse that, 'this patient had been rejected by his family … [the patient had] no relatives to take care of him [at the hospital].' In practice, this meant if the patient was to be admitted to a hospital, no relatives would attend to him. Hence, the hospital nurse would have to make special arrangement in the care of this patient. This type of secondary but highly relevant information was not culturally appropriate to enter

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onto the referral card. The use of such extra-systemic and a culturally sensitive back channel provided by mobile phones was found to be particularly useful when there was concern that the patients would be negatively affected by the content written in the referral card (e.g. mental illness, a risk of attempting suicide, etc.)" (Study authors describing community healthcare workers and hospital nurses in Thailand) (Ling 2020: page 366).

Finding 3.7 Healthcare workers are concerned about the legal implications of offering advice to patients and colleagues through informal channels (moderate-confidence finding).

Some healthcare workers were concerned about the legal aspects of communicating with patients or colleagues through informal channels. For instance, while Indian doctors in one study thought the patient's ability to record Whatsapp-based consultations could increase accountability and transparency, they were also concerned that patients would use these recordings as evidence against them (Bhat 2021). Nurses in Taiwan communicating with patients via the messaging app 'Line' were uncertain about their legal responsibility if they failed to receive or respond to patients' messages about emergencies (Chiang 2016). Similarly, pharmacists exchanging advice with colleagues on a Whatsapp group were uncertain of the legal implications if wrong advice was given (Rathbone 2020).

"If we consider this as a medical practice, we need to be more cautious. If a practitioner tells patients that he [she] will provide them with Line communication and is unable to respond when patients send messages, the practitioner will be reprimanded. Offering this innovative service needs planning and a standard operating procedure, including details about who should handle it, and how long there is to respond" (Community nurse, Taiwan) (Chiang 2016: page 2012).

"… someone answered and that was the wrong answer, but no-one corrected you, and if something had gone wrong with the hospital and the case, who would take the responsibility for that because officially you weren't on-call on that day, you were just helping and this is the way you would have done it" (Pharmacist, UK) (Rathbone 2020: page 507).

Finding 3.8 Healthcare workers describe how sharing and storing information through informal digital channels and groups can lead to a loss of information in formal records, which can cause problems when managing patient care (low-confidence finding).

The sharing and storing of information through personal mobile phones or informal messaging-app based groups sometimes implied that information was not formally registered:

"Because of lack of simple tools, photos are taken with out smartphones and are not indexed into the [electronic medical record system]" (Doctor, France) (Ologeanu-Taddei 2019: page 10).

This could lead to problems for the formal system. In one study from Thailand, staff at community healthcare centres often managed patient referrals by calling personal contacts at the referral hospital. This informal exchange of patient information was sometimes done in addition to, but often instead of, the formal, paper-based referral system (Ling 2020). While this had a number of advantages, it also led to a lack of formal patient records, which became an issue

when trying to manage patient care and the flow of patients in the system, both during the hospital stay and when the patient was later discharged:

"Tang, a hospital nurse, explained that if the community healthcare worker only called without sending referral cards, 'there will be no record of how many patients have been referred to us. Sometimes we [the hospital staff] did not keep track. … It would be good to get both a call and a referral card." … Various hospital-based informants recalled having to call a community healthcare worker to ask for the patient's medical history; whether the patient had any drug allergies; and what medication the patient had received at the community health center." (Study author and community-based and hospital staff, Thailand) (Ling 2020: page 369).

Finding 3.9 Healthcare workers who use their mobile phones to search for health information online are concerned about the quality and legitimacy of unendorsed online information and ask for more training and guidance in how to search for and assess this information (moderate-confidence finding).

Healthcare workers searched for health information via the internet, including Google, apps, and social media. However, some pointed out that many of these sources are not endorsed by their workplace or by government structures, and questioned or discussed the extent to which the information they found here was reliable and credible (Barnor-Ahiaku 2016; Chib 2013; Nerminathan 2017; Watkins 2018).

Some healthcare workers emphasised the need to critically appraise the information they found online (Nerminathan 2017). However, they sometimes found it difficult to distinguish reliable and unreliable information and wanted more guidance on how to do this (Barnor-Ahiaku 2016). They also lacked skills in what to search for and how to search (Anstey 2018).

Finding 3.10 Healthcare workers' use of their personal mobile phones for work has cost implications, including the costs of the phone, data, airtime and electricity. Healthcare workers in low- and middle-income settings, particularly healthcare workers on lower salaries and volunteer lay health workers, describe these costs as a significant financial burden, and call for some form of compensation (high-confidence finding).

Healthcare workers' use of their personal mobile phones had cost implications related to the phone itself, its maintenance, purchase of airtime, data, chargers and electricity (Abane 2021; Anstey 2018; Barnor-Ahiaku 2016; Bautista 2016; Bautista 2020; Hampshire 2017; Hampshire 2021; Ismail 2019; Mariwah 2022; Moyer 2014).

For healthcare workers in low and middle-income settings, including volunteers and healthcare workers on lower salaries, these personal costs could represent a significant expense (Abane 2021; Bautista 2020; Hampshire 2017; Hampshire 2021; Ismail 2019; Mariwah 2022; Moyer 2014). These costs sometimes prevented them from using their personal mobile phones as frequently as they wished for work purposes or from using these types of solutions at all (Anstey 2018; Chib 2013; Hampshire 2017; Moyer 2014). Some reported making sacrifices, sometimes skimping on food or other 'essentials' to cover these expenses (Hampshire 2017; Hampshire 2021):

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"The card price is expensive. But, since it is very hard to work without a phone, we are spending money from our salary to buy phone card. Sometimes we minimize our monthly food expenditure to buy airtime" (Ethiopia, Urban Health Extension Worker) (Hampshire 2021: page 16).

In some studies, healthcare workers received monetary compensation or credit for using their own mobile phones although they described this compensation as inadequate (Abane 2021; Mariwah 2022; Spink 2020; Venkataraghavan 2022). Higher-ranking members of staff in some settings were more likely to have access to formal work phones or data packs or receive compensation for their personal phone expenses than healthcare workers with less pay (Bautista 2016; Hampshire 2021; Venkataraghavan 2022):

"Sometimes it happens that there's no relish [an important component of the daily meal] at home but you need to make several communications and you only have 200 Kwacha. You would force your wife to look for anything and use the 200 Kwacha to buy airtime ... In offices, I believe that bosses [receive free] airtime even though they get huge sums on their pay-slips compared to us" (Health Surveillance Assistant, Malawi) (Hampshire 2021: page 16).

Some healthcare workers suggested that healthcare workers should be offered some form of compensation or credit for their personal phone expenses (Abane 2021; Hampshire 2021). This could help combat the burden these expenses placed on them and was potentially more cost-effective than the provision of work phones (Hampshire 2021; Mariwah 2022). Giving healthcare workers airtime or data, or both, was put forward as a possible solution by some (Mariwah 2022; Venkataraghavan 2022). However, others suggested that monetary compensation would be more appreciated and more flexible than non-monetary compensation (Abane 2021; Hampshire 2021):

"In some cases, this could be achieved with relatively low-cost interventions; for example, providing support for [community health workers] to use their current phones rather than handing out new ones. When asked about possible 'ways forward', by far the most popular suggestion from focus group participants was some financial support to offset phone related expenditure: either through direct credit transfers or by small supplements to monthly salaries. The latter is more in keeping with the spirit of informal mhealth, and was generally preferred as it would enable [community health workers] to choose networks with good local coverage and to take advantage of current 'deals'; it would also allow for expenditure on phone charging and other maintenance costs. Study participants generally agreed that relatively modest sums (equivalent of GBP 2–3 per month) could make a difference for those struggling with hardship; others talked about the symbolic value in recognising [community health workers'] 'hidden sacrifice'" (Study authors describing community health workers, Ghana, Ethiopia, Malawi) (Hampshire 2021: page 20).

Finding 3.11 Healthcare workers describe how the use of their mobile phones to access informal digital communication channels can help them extend their networks and cross geographical and professional boundaries. But they also describe how these channels can replicate existing social and professional structures and hierarchies, thereby limiting healthcare workers' access or participation (low-confidence finding)

As previously described, healthcare workers in the included studies primarily communicated informally via their personal phones with healthcare workers at their own workplace or in facilities directly below or above them. In some cases, however, informal digital communication channels could give healthcare workers an opportunity to extend their networks and contact people that may otherwise have been out of reach through formal channels (Chib 2013; Ismail 2019; Pimmer 2018). In India, lay health workers ('ASHAs') described how they used informal WhatsApp groups to contact ASHAs from other areas of the country and used this partly to organise a movement for a salary raise and other benefits (Ismail 2019). In Pimmer's multi-country study, participants described how online groups that were often self-organised, and generated from the bottom up, gathered healthcare workers, students and patients who were part of the global and digital health field (Pimmer 2018). Membership in these groups bridged geographical boundaries, both within and across countries; as well as professional boundaries, as group members could include a range of professions and levels of the professional hierarchy (Pimmer 2018). In China, informal online groups were also used to bridge professional boundaries. Here, rural doctors described how they used these groups to connect not only with other local doctors but also with doctors based in urban centres who had higher medical qualifications and better access to updated information (Chib 2013).

However, healthcare workers' access to these wider groups could also replicate existing social structures and professional hierarchies (Chib 2013; Pimmer 2018). Pimmer notes that healthcare workers' access to online communities could be restricted by factors such as lower levels of literacy and lower access to mobile phones or network connectivity and also mentions that access to groups was protected by gatekeeping (Pimmer 2018). In the online groups used by Chinese rural doctors, they explained how membership was often determined by existing social relationships ('quanxi' networks), including with colleagues, alumni, and experts with whom one had interacted professionally. This limited the contacts that older, rural doctors with lower levels of education could access through these groups.

"A rural doctor remarked that '[village doctors] and [urban doctors] have very little communication with one another. If we [the village doctors] do not know all these [urban] physicians, it is almost impossible to have any correspondence at all'" (Doctor, China) (Chib 2013: page 73).

Older rural doctors were also described as less attractive as potential members of new online groups, as they had less to offer and were less likely to be able to return favours in terms of knowledge and connections:

"One rural doctor mentioned that he 'seldom interacts with the village doctors here because their standard is limited'" (Doctor, China) (Chib 2013: page 73).

"We find it difficult to imagine what resources aged, less-educated rural doctors who are technological neophytes could bring to bear upon ICT [information and communication technologies]-enabled relationships with their advanced counterparts, in order for the interaction to be viewed as a balanced exchange" (Study authors describing doctors, China) (Chib 2013: page 76).

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Within informal online groups, existing social norms and structures and professional hierarchies could also influence healthcare workers' *participation* in these groups. Pimmer mentions that factors such as gender or the presence of more senior members could limit members' online participation (Pimmer 2018). Similar issues were seen in studies of workplace-based informal online groups. In the Philippines, hospital nurses describe how they created their own Facebook groups as this gave them an opportunity to be informal and to complain about work, which was not possible in groups where their nurse managers were present (Bautista 2017). Similarly, junior pharmacists' fear of looking 'stupid' could influence their decisions about whether to share queries in workplace-based Whatsapp groups where senior staff were present (Rathbone 2020). While this fear sometimes dissipated over time, some of them preferred to use WhatsApp groups that only included other junior pharmacists or to contact colleagues privately via WhatsApp:

"… we used to call it the group of shame … it was kind of mentioned when you put something on there everybody looks down on you but, and they don't, but it was just that feeling initially" (Pharmacist, UK) (Rathbone 2020: page 507).

Finding 3.12 Healthcare workers in low- and middle-income settings who use their personal mobile phones for work purposes describe many of the same practical and infrastructural challenges encountered in formal systems, including lack of electricity and internet (high-confidence finding).

Healthcare workers using their personal phones also described many of the same practical and infrastructural challenges that formal systems struggle with, particularly healthcare workers in low- and middle-income settings. This included poor or unreliable access to electricity and the internet, both in the community, in rural clinics and in hospitals (Anstey 2018; Barnor-Ahiaku 2016; Chib 2013; Hampshire 2017; Hampshire 2021;Mariwah 2022; Pimmer 2018; Spink 2020; Venkataraghavan 2022).

''More than the cost of mobile cards, what makes difficult for us is battery life of the mobile. We don't have electricity access for charging, and the battery becomes depleted within 24 h. It becomes difficult to communicate with clients and office staff'' (Community-based healthcare worker, Ethiopia) (Hampshire 2021: page 16).

Theme 4: How is personal mobile phone use currently regulated?

Finding 4.1 In some workplaces, policies and guidelines regulating the use of personal mobile phones in the workplace do not exist or healthcare workers are unaware of them. Where these policies do exist, healthcare workers explain that their aim is to protect patient confidentiality and data security and avoid healthcare worker distraction. However, some healthcare workers and their managers perceive these policies as unclear or as unrealistic and difficult to enforce (high-confidence finding).

Healthcare workers did not always know if policies or guidelines regulating personal phone use existed (Nerminathan 2017; Spink 2020). Where policies and regulations were mentioned, either by study authors or the healthcare workers themselves, these ranged from not allowing healthcare workers to carry or use personal mobile phones at all (Bautista 2016; Bautista 2020; Brandt 2016;

Mather 2018); to not allowing them to store or share sensitive patient data on their personal phones (Ologeanu-Taddei 2019); allowing them to use personal mobile phones for work purposes, particularly when there was an urgent need to communicate with colleagues (Bautista 2020); or only allowing senior staff to use personal mobile phones (Karusala 2020).

Healthcare workers and study authors explained that policies were in place because of concerns about patient confidentiality and data security (Karusala 2020; Mather 2018; Ologeanu-Taddei 2019), or to avoid healthcare workers from being distracted at work, for instance by social media use (Bautista 2016; Karusala 2020; Mather 2018).

Where guidelines did exist and healthcare workers were aware of them, they sometimes perceived them as unclear, vague or confusing, unrealistic and difficult to enforce (Bautista 2016; Bautista 2020; Brandt 2016; Mather 2018). In two studies from the Philippines, hospital nurses and their managers argued that as long as workplaces did not provide healthcare workers with relevant work-related technologies, such as mobile phones, a total ban was not realistic, and managers allowed staff to use personal phones despite these policies (Bautista 2016; Bautista 2020):

"Overall, there was a consensus among participants that the only time that they can implement a blanket ban on the use of mobile devices is when hospitals can provide sufficient technologies for staff nurses. An indication for this is when staff nurses need not use their smartphones completely for work purposes: 'We need more [unit] phones so that they [nurses] can avoid using their personal phone. That is the time that they can fully implement a policy about no use of personal phone in the unit during duty hours'" (Head Nurse, the Philippines) (Bautista 2020: page 11).

In a study from the USA, there was a resignation among managers that staff would not relinquish their personal phones:

"While the policy is 'enforced' to a point, most nurses still have their cell phones in their pockets" (Nurse leader, USA) (Brandt 2016: page 24).

DISCUSSION

Our review suggests that healthcare workers' informal use of their personal mobile phones as well as their personal time and networks, can help them provide more efficient and 'humanised' healthcare by allowing them to be more flexible and responsive to patients' particular needs and circumstances as well as their own and other healthcare workers'. Research has often portrayed 'street-level bureaucrats' as 'state agents', charged with carrying out the plans and policies of government agencies (Maynard-Moody 2000), and often using their discretion to *limit* clients' access to services (Lipsky 1980). More recently, researchers have taken a different perspective, describing how street-level providers use this discretion, and in some cases their own resources, to *ensure* clients' access to services (Lavee 2021; Lavee2022; Maynard-Moody 2000; Neumark 2020). In this narrative, 'street-level bureaucrats' view themselves as 'citizen agents', acting in response to individual citizen clients in specific circumstances (Maynard-Moody 2000). Our review supports this narrative, illustrating how healthcare workers actively search to find solutions that can improve and increase people's access to healthcare, including the use of their personal phones, time and networks. Research has also highlighted

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the importance of organisational and structural factors, including well-functioning vertical and horizontal communication, for the delivery of humanised care (Busch 2019). Our review highlights how healthcare workers work around poorly functioning formal systems to achieve these goals, and to consider not only the patient's biological needs but also the values, beliefs, feelings and emotions of patients, family members and other healthcare workers (Backes 2007).

However, our review also suggests that healthcare workers may favour certain patient groups over others when distributing their personal resources, basing their decisions on the perceived worth of the individual patient or client (Maynard-Moody 2000). This use of discretion can also strengthen existing inequities. Relying on personal phones and other personal resources can also have equity implications for the healthcare workers themselves. Their informal personal phone use can be labelled as a type of 'invisible work', defined by Hatton as "labour that is economically devalued through cultural, legal and spatial mechanisms of invisibility" (Hatton 2017). Although personal phone use is sometimes expected by colleagues and managers, it can still be unacknowledged and economically devalued in the sense that healthcare workers are not compensated for the costs linked to phones, data, airtime or personal time. Healthcare workers may also not be protected legally in relation to these uses. For instance, healthcare workers in our review were concerned about the potential legal implications of giving advice through informal channels or out of hours. These disadvantages are likely to be unevenly distributed. Much informal use also relies on healthcare workers' existing social networks, replicating potential social inequities among healthcare workers.

Informal mobile phone use can also have both benefits and harms for the broader health system, and thereby the individual patient. Sharing and storing information, for instance about patient referrals, staff schedules and stock level reports via healthcare workers' personal phones has data security and patient privacy implications. And, while it may be cheaper for the health system and more efficient for the healthcare worker in the short term, this is a case of cost shifting rather than cost saving, as the expenses are covered by the healthcare worker. In addition, if informal phone use takes information out of the formal system, it can threaten continuity of patient care and weaken the health system's oversight and control. Individual healthcare workers' efforts to plug health system gaps could also lead to complacency at higher levels of the system in relation to fixing these gaps.

When addressing informal phone use, implementers should consider how to achieve realistic policies and guidelines, sufficient material resources and efficient work processes, while still ensuring some level of discretion and humanised care. Our review indicates that policies and guidelines regulating personal phone use are lacking in many workplaces. Where healthcare workers are aware of them, they may regard them as unrealistic, for instance, because of poor access to work phones or because existing communication and information systems and processes are time-consuming and impractical. A lack of resources, complex work processes and excessive bureaucratic activities can slow healthcare workers down and make it difficult for them to deliver humanised care (Busch 2019). In many settings, however, an increase in resources such as functional work phones is probably unrealistic, and the 'public service gap' between demands and resources is always likely to be present to some extent (Hupe 2014). Suggestions for ways forward

made by authors of the included studies and their participants are therefore based around the continued use of personal mobile phones and focus on ways in which to maximise the benefits of this use, while minimising the disadvantages (Abane 2021; Anstey 2018; Bautista 2016; Hampshire 2021; Mariwah 2022; Venkataraghavan 2022). This includes the development of policies and guidelines that formalise the use of personal mobile phones.

Public institutions use formal policies and processes to limit provider discretion, or at least to encourage provider behaviour that is consistent with the institution's aims and commitments (Blavatnik 2020). By formally acknowledging and regulating healthcare workers' personal phone use rather than ignoring it, healthcare systems could improve staff awareness of, and compliance with, regulations concerning privacy and confidentiality. This acknowledgement could also lead to formal compensation for personal costs, could regulate healthcare workers' use of personal time, and could help clarify healthcare workers' legal responsibilities and liabilities.

However, the shedding of light on informal, 'invisible' work practices can also bring new challenges. For instance, healthcare workers may view formal systems as organisation-centred accountability tools that are primarily designed for reporting and monitoring rather than tools that aim to help healthcare workers in their everyday work (Gillingham 2010). In addition, overly formalised systems can remove the flexibility and responsiveness of informal phone use. As Lipsky describes (Lipsky 1980), street-level bureaucrats' work is characterised by situations far more complex than any rules or guidelines will ever be able to fully account for, and with many human dimensions. Some level of discretion is therefore necessary if healthcare workers are to be able to make context-specific and humanised decisions.

When discussing the classification of nursing activities, the Bowker 1995 paper describes the perfect system as one that "preserves common sense control, enhances comparability in the right places, and makes visible what is wrongly invisible, leaving justly invisible discretionary judgment". A similar balance is needed with regard to healthcare workers' informal phone use. We suggest in our 'Implications for practice' section that implementers should work together with healthcare workers in their setting to better understand the extent of informal phone use and the reasons behind this use. This type of contextual understanding should help them to develop solutions that can balance the benefits and harms of this practice.

Defining informal mHealth

Healthcare workers' informal mobile phone-based behaviour is still a relatively under-researched topic and we spent much time developing a workable definition. In this review, we defined informal mobile phone use as healthcare workers' use of mobile phones and other mobile communication devices to support their work, using approaches that are *initiated* by the healthcare workers themselves and that are not initially standardised, regulated, or endorsed by the health system or organisation to which they belong. However, our review indicates that in some settings, healthcare workers' personal phone use, although unregulated, has become a normal part of many work processes and some healthcare workers are *expected* to use their personal phones. Our current definition may therefore exaggerate the role of self-initiation and mask the pressure that healthcare workers may

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experience in their workplace to use their personal phones. We will continue to discuss and potentially revise this definition of informal mobile phone use as part of the broader mHealth-Innovate project.

Limitations of the review

The lack of established terminology with regard to informal mobile phone use could mean that we missed studies that described this phenomenon using other terms.

We may also have missed studies that were relevant but where the *informal* aspect of mobile phone use was not the main focus. In the studies that we assessed for inclusion, it was often difficult to assess whether healthcare workers' phone use was formal or informal. Many of these studies aimed to explore healthcare workers' use of mobile phones and apps in general, rather than informal and unregulated mobile phone use specifically. We included studies where we determined that the healthcare workers were using mobile phones in ways that were self-initiated and unregulated. However, this was often implied rather than stated explicitly. This lack of distinction from the study authors may also reflect a lack of distinction made by healthcare workers themselves.

We decided to exclude a large body of studies that explored healthcare workers' use of social media to discuss personal information, including information about leisure activities. The studies focused on the blur between professional and social identities online and discussed the need for guidance on how healthcare workers should behave on social media. However, by excluding these studies, it is possible that we missed information regarding healthcare workers' use of these types of networks for work purposes.

Our review aimed to explore two types of informal mobile phone use. These were 'shadow IT', typically where healthcare workers use their own mobile phones informally for work; and 'non-prescribed use', where healthcare workers use phones, software, or applications provided to them by their workplace, but in ways that have not been standardised, regulated, or endorsed. However, only one of the studies we identified described this second type of informal behaviour. This may have been a result of our search strategies and the lack of established terminology when describing informal mobile phone use, as it is highly likely that 'non-prescribed use' of work phones is also common.

Our review aimed to explore healthcare workers' informal, *innovative* uses of mobile devices. 'Innovation' can refer to a new idea, method or device (Merriam-Webster 2023), but is also often used to refer specifically to product development. Healthcare workers in the included studies were being innovative in small ways in their use of mobile devices to plug gaps in the formal systems. However, we identified very few instances where healthcare workers developed their own products, such as apps, to solve workplace challenges. This may reflect a lack of time and resources among healthcare workers to develop such products but may also reflect our search strategy.

While we did not apply any language limitations, all of the included studies were published in English. In addition, this review was unable to identify any studies from Latin American countries. While this could reflect a gap in the literature, it could also reflect our search strategies. These strategies focused on databases that were likely to provide good access to qualitative studies. However, the inclusion of databases such as LILACs could have increased our chances of identifying studies from Latin American countries.

We searched for studies up to 2022. However, few of the studies explored healthcare workers' behaviour during the COVID pandemic. It is likely that restrictions placed on people's movements during the pandemic led to an increase in healthcare workers' informal use of mobile phones.

Implications for research

When studying informal, unregulated behaviour, researchers should consider collecting data through observing healthcare workers' behaviour rather than relying solely on healthcare workers' own descriptions. While individual and group interviews with healthcare workers are key methods, it is possible that healthcare workers may not be willing in these situations to report their own informal, unregulated behaviour, or they may be influenced by social desirability bias when justifying this behaviour. The use of observation may therefore bring additional insights. In addition, longer-term studies, where rapport and trust are developed, are also likely to be an advantage when studying informal behaviour.

The documentation of informal, unregulated behaviour could have negative consequences for study participants. Future studies should consider how best to protect the anonymity of healthcare worker participants while creating an environment in which healthcare workers are willing to discuss this type of behaviour and the reasons behind it. Where researchers are not based in the study country, they should also ensure that they obtain ethics approval from the study country, even if it is not required by the government in that country, in order to better understand local ethical and cultural issues.

Researchers should also to a greater extent report and consider their own perspectives and positions and how this may have influenced the planning and conduct of the research.

Some of the informal behaviour we have identified in this review appears to be more common in low- and middle-income countries than in high-income countries. This includes findings tied to the use of personal phones to communicate with patients and their families or to retrieve, record and store patient information. Future research should consider exploring whether these findings reflect healthcare workers' better access to formal resources in high-income countries or whether healthcare workers in these countries may be under-reporting this type of behaviour, particularly in settings with strict regulations regarding data protection and patient privacy.

All but one of the included studies in this review focused on 'shadow IT' where healthcare workers used their personal mobile phones for work purposes. Future studies should also consider exploring 'non-prescribed use' where healthcare workers use formal work phones (as opposed to personal phones) informally. In addition, future studies should consider exploring different types of policies for informal phone use, how these policies are interpreted in practice, and the impact of these policies.

Implications for practice

Healthcare workers' informal use of their own mobile phones for work purposes can help plug gaps in the healthcare system, but it

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can also create new problems for patients, healthcare workers and the healthcare system itself.

Different settings deal with healthcare workers' personal phone use in different ways. Some healthcare authorities or workplaces prohibit all personal phone use, while others tacitly accept it. Some allow certain types of personal phone use for work-related purposes and provide guidance or regulations to manage this use.

The following questions aim to help national, regional and local decision makers think about how to address healthcare workers' personal mobile phone use. The questions are based on the findings in this systematic review. They consider the problems of personal phone use as well as its advantages.

Working with healthcare workers to map the current situation and develop a way forward

- Consider how to *work with healthcare workers in your setting* to understand the extent of their informal phone use. What do they think are the advantages and disadvantages as well as possible ways forward? Remember that healthcare workers may not always be willing to describe their informal, unregulated phone use at work if they think it could lead to problems for them. Think about how to create a trusting environment when discussing these issues.
- *What policies or guidelines currently exist* at local or national level regarding healthcare workers' use of their personal phones at work? Are healthcare workers aware of them? And do they think they are relevant, understandable and realistic?
- Where healthcare workers say that they use their personal phones because of deficiencies in the formal system, *consider how you can address these problems.* For instance, can you provide more work phones? Can you make sure that work phones have sufficient functionality, subscriptions and credit? Can you make formal systems and processes for seeking, storing and exchanging information more efficient and easier to use?

Ensuring appropriate information management

- Where healthcare workers use their personal phones, are they able to communicate with and exchange information about patients while still protecting *patient confidentiality and data security*? For instance, do they know how to anonymise and store patient information safely?
- When healthcare workers use their personal phones to gather and store information, this can take information out of formal health system records and cause problems, for instance, for continuity of care. Where healthcare workers use their personal phones, do they have easy ways of ensuring that *information is made available to others who may need it?* For instance, when discussing patient referrals, stock-outs, or staffing schedules on their personal phones, can they easily add this information to formal records?
- Patients may prefer to contact healthcare workers on their personal phones because they want to *keep sensitive information out of the formal system.* Do healthcare workers have the skills they need to decide which information they should add to formal records and which they can safely omit? Also, are there better ways of protecting sensitive information within the formal system?

Separating work life and personal life

- Healthcare workers who use their personal phones for work purposes may struggle to *separate their work life and personal life*. Where healthcare workers use their personal phones, are there clear rules and expectations that protect their free time? For instance, are they expected to answer work calls when they come home? If they do so, will they be compensated for their time? If they offer clinical advice in their free time, do they have the same legal responsibilities and protection as they do at work?
- Healthcare workers who use their personal phones for work purposes may be distracted by personal calls and social media use. On the other hand, workplaces that expect staff to use their personal phones for work purposes may need to accept some level of personal use. Are there clear but reasonable rules and expectations regarding healthcare workers' use of their phones for *personal use while at work*?

Covering healthcare workers' personal costs

- Healthcare workers who use their personal phones for work purposes also have *personal costs*. This can include costs for the phone itself as well as for data, airtime and electricity. Are all healthcare workers receiving sufficient compensation for these costs? Healthcare workers in different settings are likely to have different views about how they would like to be compensated. Explore whether money, free airtime and/or data is most useful to them. Consider collaborating with telecommunication companies to provide phone credits to healthcare workers as part of corporate social responsibility.

Ensuring access to reliable information, support and supervision

- Healthcare workers turn to their personal phones to *search for health information online* but are concerned about the quality and trustworthiness of this information. Do healthcare workers have free and easy access to reliable information sources? Do they have training in how to search for and assess the trustworthiness of the clinical information that they find online? This may be particularly important for healthcare workers with less education or poor digital literacy.
- Healthcare workers use their personal phones and networks to *seek advice, information and support from other healthcare workers*. What can you learn from these informal networks? Are there ways of using these informal app-based groups within the formal system?
- While healthcare workers use their personal phones and networks to seek help, *healthcare workers with weak personal networks are at a disadvantage*. Collaborate with these healthcare workers, particularly lower-level or rural healthcare workers, to find out where they most often need advice and support. Can you offer them additional training and guidance in these areas? Can you help them create networks of colleagues and experts outside their setting to whom they can turn?
- When healthcare workers exchange their personal numbers with colleagues and with patients, this lets them *contact people who are already known to them*. How can formal systems make it easier for patients to contact healthcare workers already known them? For instance, could each patient be assigned a long-term primary care provider to whom they are allocated when they need an appointment? And are there ways of making it easier

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for healthcare workers who need clinical advice, or who are planning a referral, to have a regular group of healthcare workers that they can contact (for example, by supplying referring health facilities with a short list of contact people)?

AUTHORS' CONCLUSIONS

Healthcare workers' informal use of mobile phones is one of the strategies that is used to overcome limitations in existing formal communication and information systems. By finding their own informal solutions to workplace challenges, healthcare workers can be more efficient and more responsive to the needs of patients, colleagues and themselves. But these solutions also have several drawbacks for patients, healthcare workers and the health system. Efforts to strengthen formal health systems should consider how to retain the benefits of informal solutions and to reduce their negative effects.

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- Editorial Assistant (conducted editorial policy checks, collated peer-reviewer comments and supported editorial team): Sara Hales-Brittain, Central Editorial Service;
- Copy Editor (copy editing and production): Elizabeth Royle, Production Manager, Cochrane Central Production Service;
- Peer-reviewers (provided comments and recommended an editorial decision):
  - Han Zhang, Department of Global Health and Population, Harvard University, Cambridge, Massachusetts, USA (clinical/content review);
  - Dr Katy Sutcliffe, EPPI Centre, UCL Social Research Institute, University College London (methods review); and
  - Jo Platt, Editorial Information Specialist (search review).
  - Two additional peer reviewers provided clinical/content and consumer peer review but chose not to be publicly acknowledged.

When preparing this review, we used EPOC's Protocol and Review Template for Qualitative Evidence Synthesis (Glenton 2023).

Conditions for use

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Abane 2021

Study characteristics	
Country	Ghana

Healthcare workers' informal uses of mobile phones and other mobile devices to support their work: a qualitative evidence synthesis (Review)

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Abane 2021 *(Continued)*

Study aim	"..the main objective of this paper was to measure and interrogate unintended financial and related psychological costs on Community Health Nurses using their personal mobile phones in delivering healthcare across Ghana."
When were the data collected?	2018-2019
Types and numbers of healthcare worker participants	Community Health Nurses (9 focus group discussions with 6 to 10 participants each)
Healthcare setting	Urban, peri-urban and rural areas in three regions of Ghana. The Community Health Nurses worked in community-based health planning and services compounds, health centres, district hospitals and community/private hospitals.
Methods of data collection and analysis	• Focus group discussions • Thematic analysis
Funding sources for the study	This research project was funded by the Medical Research Council (MRC), UK (Grant Ref: MR/R003963/1).
Conflict of interest	"Declaration of Competing Interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper."
Notes	This study is from the same research project as Mariwah 2022 and Hampshire 2021. The focus groups were the same for the Abane 2021 paper and the Mariwah 2022 paper but each paper draws on data relevant for their topic.

Anstey 2018

Study characteristics	
Country	South Africa
Study aim	"Our research question was as follows: How are mobile phones being currently used from the bottom-up by patients and healthcare workers to enhance the delivery of primary healthcare within rural South Africa? Our study had the following objectives: • To investigate the current uses of mobile phones to enhance health; • To determine how patients engage with a clinic-initiated mHealth intervention; • To understand how bottom-up mHealth practices can be developed to improve healthcare in similar rural areas in South Africa in future."
When were the data collected?	2014
Types and numbers of healthcare worker participants	32 nurses and 11 doctors

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Anstey 2018 *(Continued)*

Healthcare setting	Healthcare clinics and one district hospital in the rural north eastern part of Mpumalanga province, South Africa
Methods of data collection and analysis	• Semi-structured in-depth interviews • Thematic analysis
Funding sources for the study	This paper was written during a PhD studentship funded by the UK's Economic and Social Research Council (ESRC ES/J500203/1) and GE Healthcare Ltd. and was a collaboration between The University of Warwick, UK and the University of the Witwatersrand, South Africa.
Conflict of interest	The study authors declared no competing interests.
Notes	

Barnor-Ahiaku 2016

Study characteristics

Country	Ghana
Study aim	"...the aim of this research was to explore the experience of Medical House Officers to the use of smartphones and tablets in medical practice in Korle-Bu Teaching Hospital."
When were the data collected?	Not specified
Types and numbers of healthcare worker participants	12 House Officers
Healthcare setting	Korle-Bu Teaching Hospital in Accra
Methods of data collection and analysis	• Semi-structured interviews • Thematic analysis
Funding sources for the study	No information
Conflict of interest	"Conflict of interest: None declared"
Notes	

Bautista 2016

Study characteristics

Country	Philippines
Study aim	"Overall, this study aims to answer the following research question: How do the interactions of sociotechnical components (users, technology and policy) affect staff nurses use of personal mobile phones at work?"

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Bautista 2016 *(Continued)*

When were the data collected?	2015
Types and numbers of healthcare worker participants	23 staff nurses, 4 charge nurses and 3 nurse managers. "To obtain variation in responses, we interviewed nurses working in various hospital areas, such as operating theaters, medical wards, emergency departments, and so on."
Healthcare setting	6 government and 7 private tertiary hospitals in Metro Manila
Methods of data collection and analysis	• In-depth interviews • Sociotechnical analysis
Funding sources for the study	"This study was supported by a research grant from the Wee Kim Wee School of Communication and Information, Nanyang Technological University (M4081244.060)."
Conflict of interest	"The authors declare that there are no conflicts of interest."
Notes	

Bautista 2017

Study characteristics	
Country	Philippines
Study aim	"To explore how and why mobile instant messaging applications are used by Filipino nurses as part of their work."
When were the data collected?	2015
Types and numbers of healthcare worker participants	20 staff nurses
Healthcare setting	Tertiary hospitals (4 private and 5 public hospitals) in Metro Manila
Methods of data collection and analysis	• In-depth interviews • Thematic analysis
Funding sources for the study	"This study was supported by a research grant from the Wee Kim Wee School of Communication and Information, Nanyang Technological University (M4081244.060)."
Conflict of interest	"The authors declare no conflict of interest."
Notes	

Bautista 2020

Study characteristics	
Country	Philippines

Healthcare workers' informal uses of mobile phones and other mobile devices to support their work: a qualitative evidence synthesis (Review)

Bautista 2020 *(Continued)*

Study aim	"Drawing from the Organizational Support Theory (OST), this study aimed to identify organizational issues that influence nurse administrators' support to staff nurses' use of smartphones for work purposes."
When were the data collected?	2017
Types and numbers of healthcare worker participants	43 nurse administrators (22 head nurses, 10 supervisors, 9 nurse managers, and 2 infection control nurses). "[T]he participants represented several general (eg, wards and outpatient department) and specialty (eg, intensive care, operating theater, and emergency department) areas."
Healthcare setting	Tertiary-level general hospitals in Metro Manila (six private and 3 government hospitals)..
Methods of data collection and analysis	• Focus groups • Qualitative data analysis
Funding sources for the study	"This study was supported by a research grant from the Wee Kim Wee School of Communication and Information, Nanyang Technological University (M4081905.060)."
Conflict of interest	"None declared"
Notes	

Bhat 2021

Study characteristics	
Country	India
Study aim	"We conducted a survey and interview study to investigate doctors' and patients' perceptions, experiences, and expectations around teleconsultations, and how these contribute towards supplementing healthcare infrastructures in India, focusing on the changes brought about by the COVID19 pandemic."
When were the data collected?	2020
Types and numbers of healthcare worker participants	Survey of 58 doctors, surgeons, and other healthcare professionals who conduct patient consultations and interviews with 8 doctors.
Healthcare setting	A range of healthcare settings in both urban and rural areas
Methods of data collection and analysis	• Surveys with closed and open-ended questions • Semi-structured interviews • Inductive interpretive coding
Funding sources for the study	No information
Conflict of interest	No information
Notes	

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Brandt 2016

Study characteristics

Country	USA
Study aim	"We surveyed nurse leaders with the aim to document current policy governing cell phone use in the in-patient setting and issues surrounding such use."
When were the data collected?	2011
Types and numbers of healthcare worker participants	217 respondents, all working in acute care. Most were mid-level nurse managers such as department and patient care directors, supervisors, and other nurse administrators. Some were senior nurse directors. A small number were clinical nurses.
Healthcare setting	Range of healthcare institutions
Methods of data collection and analysis	• Survey with closed and open-ended questions • Content analysis
Funding sources for the study	No information
Conflict of interest	"The authors and planners have disclosed no potential conflicts of interest, financial or otherwise."
Notes	

Burns 2013

Study characteristics

Country	Australia
Study aim	"This paper recognises and seeks to clarify the possibility of widespread clinician-taken medical photography in a tertiary hospital in northern Australia, examining the legal and ethical implications of this practice."
When were the data collected?	Not specified
Types and numbers of healthcare worker participants	8 medical and nursing staff
Healthcare setting	Tertiary hospital ("The anaesthetic department, emergency department, high-risk foot service, intensive care unit, division of surgery, ophthalmology, all surgical wards, all general medical wards, rehabilitation ward, obstetrics and gynaecology division, maternity unit and the renal ward, were purposive research sites based on known, or suspected clinician-taken medical photography.")
Methods of data collection and analysis	• In-depth interviews • Theme and content analysis
Funding sources for the study	No information

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Burns 2013 *(Continued)*

Conflict of interest	"Competing interests: Kara Burns is employed as a medical photographer."
Notes	

Chiang 2016

Study characteristics

Country	Taiwan
Study aim	"To examine nurses' experiences regarding the benefits and obstacles of using a smart mobile device application in home care."
When were the data collected?	Not specified
Types and numbers of healthcare worker participants	17 community nurses
Healthcare setting	6 home-care facilities (2 regional hospital-affiliated home-care facilities and 4 community home-care facilities)
Methods of data collection and analysis	• Semi-structured in-depth interviews • Qualitative content analysis
Funding sources for the study	"We acknowledge the funding support received from Tainan Sin-Lau Hospital…."
Conflict of interest	"The authors declare no conflict of interest."
Notes	

Chib 2013

Study characteristics

Country	China
Study aim	"We investigated the effective use of information and communication technologies (ICTs) to develop a healthcare model within the rural healthcare system. We investigated information needs, existing healthcare structure, and the use of informal networks – guanxi – to acquire health information mediated by technology."
When were the data collected?	2009-2010
Types and numbers of healthcare worker participants	50 doctors, 2 pharmacists, 3 health officials, 10 patients, 2 village chiefs, 5 health-information system officials, 2 telecommunication suppliers
Healthcare setting	Rural and urban healthcare facilities in the Shaanxi province

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Chib 2013 *(Continued)*

Methods of data collection and analysis	• In-depth interviews • Thematic coding
Funding sources for the study	No information
Conflict of interest	No information
Notes	

Hampshire 2017

Study characteristics

Country	Ghana and Malawi
Study aim	"This article draws on interviews from Ghana and Malawi to ask whether/how health-workers are using their phones informally and with what consequences."
When were the data collected?	2012-2015
Types and numbers of healthcare worker participants	Malawi: 18 healthcare workers, including private doctors, clinic administrators, medical assistant midwife nurses, community health nurses, health surveillance assistants (HSA), and Village Health Committee (VHC) members; these were mostly "lower-paid HSAs and unpaid volunteers (mostly men)". Ghana: 16 healthcare workers, including clinic-based nurses, community health nurses (CHN), and health assistants (HA). Here "there were more qualified nurses (mostly women) working at community level, reflecting health systems differences outlined earlier."
Healthcare setting	Primary healthcare facilities and village health committees in urban, peri-urban and rural settings
Methods of data collection and analysis	• In-depth, semi-structured interviews • Thematic analysis
Funding sources for the study	"This research was funded by the UK Economic and Social Research Council and the Department for International Development (Grant ES/J018082/1)."
Conflict of interest	"None declared"
Notes	

Hampshire 2021

Study characteristics

Country	Ghana, Ethiopia, Malawi
Study aim	• What is the relative reach of 'formal' and 'informal' mhealth among community health-workers (CHWs) across the three countries? • How do CHWs use mobile phones informally in their work? • What are the perceived impacts of 'informal mhealth'?

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Hampshire 2021 *(Continued)*

	• How are these practices and perceived impacts distributed, between and within countries?
When were the data collected?	2018-2019
Types and numbers of healthcare worker participants	The qualitative parts of the study included 235 lay health workers, 214 clients and volunteers, and 27 higher-level stakeholders from public, private and voluntary-sector organisations (national/local representatives from Ministries of Health and other major healthcare providers, non-governmental organisations and donors implementing mhealth programmes, and health-workers' associations).
Healthcare setting	Urban and rural healthcare facilities and communities
Methods of data collection and analysis	• Focus group discussions and individual semi-structured interviews with community health-workers (CHWs) + interviews with higher level stakeholders (18 focus group discussions in Ghana and 18 focus group discussions in Malawi, with an average of 7–8 participants per group. In Ethiopia, geographical dispersion of CHWs made focus group discussions impractical and 36 individual semi-structured interviews were conducted instead.) • Comparative thematic analysis
Funding sources for the study	This work was funded under the Health Systems Research Initiative, a joint UK funding scheme involving the Medical Research Council (MRC), the Economic and Social Research Council (ESRC), the Department for International Development (DFID) and the Wellcome Trust (Grant reference: MR/R003963/1).
Conflict of interest	"The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper."
Notes	This study is from the same research project as Abane 2021 and Mariwah 2022

Hussain 2022

Study characteristics

Country	Canada
Study aim	"This qualitative, phenomenological study offers not only a deep and contextually sensitive discussion of how emergency physicians use mobile technologies in their day-to-day work, but also extends this discussion to the practice of ongoing professional learning in the workplace."
When were the data collected?	Not specified
Types and numbers of healthcare worker participants	18 resident physicians representing all years of postgraduate residency; and 15 attending physicians representing both early, mid and late career.
Healthcare setting	Adult emergency medicine department at a tertiary care hospital in a Canadian city
Methods of data collection and analysis	• Interviews • Thematic analysis
Funding sources for the study	No information
Conflict of interest	"No potential conflict of interest was reported by the author(s)."

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Hussain 2022 *(Continued)*

Notes	

Ismail 2019

Study characteristics

Country	India
Study aim	"Our research objective was to ascertain ASHAs' [Accredited Social Health Activists'] technology, internet, and social media practices to identify opportunities for designing technologies to assist in their day-to-day workflows."
When were the data collected?	2016 and 2018
Types and numbers of healthcare worker participants	51 Accredited Social Health Activists ("ASHAs").
Healthcare setting	Community-based services linked to a primary healthcare centre in the Jogabai region of South-East Delhi; this area is occupied by illegal settlements with poor infrastructure.
Methods of data collection and analysis	• Semi-structured interviews • Observations of WhatsApp groups • Participant observations • Interviews with 5 owners of mobile phone recharge shops to get some background understanding • Content analysis of promotional offers, advertisements, and newspaper articles
Funding sources for the study	No information
Conflict of interest	No information
Notes	

Karusala 2020

Study characteristics

Country	India
Study aim	"In this paper, we examine WhatsApp use by nurses in India."
When were the data collected?	Not specified
Types and numbers of healthcare worker participants	Interviews with 5 charge nurses, 1 shift senior, 3 floor managers, 4 people in human resources, the nursing director, the chief technology officer, and chief innovation officer. Focus groups with 1 group of 10 shift seniors, and 2 groups of 5 staff nurses and 1 shift senior
Healthcare setting	Shraddha, a 450-bed multi-specialty hospital in South India

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Karusala 2020 *(Continued)*

Methods of data collection and analysis	• Observations of wards • Semi-structured interviews and focus groups • Thematic analysis
Funding sources for the study	No information
Conflict of interest	No information
Notes	

Ling 2020

Study characteristics

Country	Thailand
Study aim	"Our research question seeks to understand how existing institutional properties, such as the paper-based referral system practiced in Uttaradit, Thailand, interacts with the informal use of mobile phones by community healthcare workers and hospital staff as they go through the process of patient referral. Further, we examine how the actors' responses to these opportunities and constraints have shaped, or have the potential to shape, the existing routines and eventually form part of future institutional practices."
When were the data collected?	Not specified
Types and numbers of healthcare worker participants	8 nurses from each of the 8 district hospitals, 1 nurse from the provincial hospital, and 22 community healthcare centre staff; ("We refer to the staff at community health centers as community healthcare workers. Most were not trained to diagnose illnesses, nor did they have the authority to prescribe prescription drugs. They could distribute prescriptive drugs for patients with chronic illnesses (e.g., diabetes, tuberculosis, HIV, and mental illnesses), but only after patients had seen a doctor at a hospital who prescribed the medication.")
Healthcare setting	9 district hospitals and 22 community healthcare centres in rural Thailand
Methods of data collection and analysis	• Face-to-face interviews • Thematic analysis
Funding sources for the study	The study was supported by the Strengthening Information Society Research Capacity Alliance (SIRCA) Graduate Award (Research), which was presented by the Singapore Internet Research Center.
Conflict of interest	"No potential conflict of interest was reported by the authors."
Notes	

Mariwah 2022

Study characteristics

Country	Ghana

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Mariwah 2022 *(Continued)*

Study aim	"[T]his paper explores some strategies for integrating 'informal mHealth' in the healthcare delivery of Ghana, by highlighting some opportunities and challenges."
When were the data collected?	2018-2019
Types and numbers of healthcare worker participants	Community Health Nurses (CHNs): 9 focus group discussions with 6-10 participants each + interviews with 18 CHNs
	5 key national stakeholders from Christian Health Association of Ghana (CHAG); National Youth Employment Agency (NYEA); The Ghana Health Service (GHS), Millennium Promise (implementers of the One Million CHWs Project) and the Community Health Nurses Association of Ghana
Healthcare setting	Urban, peri-urban and rural areas in 3 regions of Ghana. The Community Health Nurses worked in community-based health planning and services compounds, health centres, district hospitals and community/private hospitals.
Methods of data collection and analysis	• Focus group discussions and interviews with CHNs • Key informant interviews with key stakeholders • Focus group discussions with patients/clients • Thematic analysis
Funding sources for the study	"This research project was funded by the UK Medical Research Council (grant number MR/R003963/1), the Economic and Social Research Council (ESRC), the Wellcome Trust, and the UK Foreign, Commonwealth & Development Office (formerly Department for International Development), under the Health Systems Research Initiative (HSRI)"
Conflict of interest	"Disclosure statement: No potential conflict of interest was reported by the author(s)."
Notes	This study is from the same research project as Abane 2021 and Hampshire 2021. The focus groups were the same for the Abane 2021 paper and the Mariwah 2022 paper but each paper draws on data relevant for their topic.

Mather 2018

Study characteristics	
Country	Australia
Study aim	"The purpose of this study was to understand the factors influencing mobile learning policy development from the perspective of professional nursing organisations"
When were the data collected?	2016-2017
Types and numbers of healthcare worker participants	6 senior registered nurses holding executive positions who through their careers had a broad range of nursing experiences in a variety of healthcare settings; they were paid employees or were volunteers within Australian nursing specialty organisations that were members of the Coalition of National Nursing and Midwifery Organisations.
Healthcare setting	A variety of healthcare settings
Methods of data collection and analysis	• Semi-structured interviews • Inductive thematic analysis

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Mather 2018 *(Continued)*

Funding sources for the study	"No grant funding was obtained for the conduct of this research."
Conflict of interest	"The authors declare that they have no competing interests."
Notes	This study is presented in 2 papers (Mather 2018 and Mather 2019)

Moyer 2014

Study characteristics

Country	Kenya
Study aim	"This paper [....] examines how HIV-positive peer mentors encourage and track adherence to treatment regimens within and beyond the clinic walls using mobile phones and computer technology"
When were the data collected?	Conducted intermittently between 2008 and 2014
Types and numbers of healthcare worker participants	10 peer mentors; additional staff were also interviewed, including nurses, social workers, administrators, and doctors.
Healthcare setting	Kenyatta National Hospital, Nairobi
Methods of data collection and analysis	• Interviews and observations • Data analysis methods not described
Funding sources for the study	"Research for this paper was funded by the Netherlands Organization for Scientific Research (NWO) as part of the Integrated Program 'Filling the Gap: Social institutions and AIDS in Kenya, Tanzania, and Zambia'."
Conflict of interest	"Conflict of interest: none."
Notes	

Nerminathan 2017

Study characteristics

Country	Australia
Study aim	"To explore how doctors use mobile devices in the clinical setting and understand drivers for use."
When were the data collected?	2013
Types and numbers of healthcare worker participants	Paediatric and adult doctors

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Nerminathan 2017 *(Continued)*

Healthcare setting	A paediatric and adult teaching hospital in Sydney (The Children's Hospital at Westmead and Westmead Hospital)
Methods of data collection and analysis	• Free-text survey responses that then informed questions used in 2 focus groups • Thematic analysis
Funding sources for the study	The Children's Hospital at Westmead Clinical School contributed towards private transcription services and catering for focus groups.
Conflict of interest	"Conflict of interest: None."
Notes	

Ologeanu-Taddei 2019

Study characteristics

Country	France
Study aim	"In times when employees increasingly use private [information systems] in their workplaces, organizations need to bring into balance use of authorized with non-authorized systems. We entered the field with the aim to understand how this is possible but ended up seeing a paradox: Doctors in a French hospital continued to use WhatsApp and other technologies to share sensitive patient data and management let them proceed despite the fact that this practice violated the law and numerous organizational policies."
When were the data collected?	2014-2017
Types and numbers of healthcare worker participants	Interviews with 4 nurses, 1 nurse manager, 17 doctors, 1 'Delegation for Hospital Information' (DHI) manager; and observations of medical departments
Healthcare setting	French University Hospital with 2700 beds and about 10,800 employees that provides primary, intensive, and emergency care, and offers all medical specialties.
Methods of data collection and analysis	• Interviews and observations • Grounded theory
Funding sources for the study	No information
Conflict of interest	No information
Notes	

Pimmer 2018

Study characteristics

Country	Many countries, but mostly countries in sub-Saharan Africa and Asia

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Pimmer 2018 *(Continued)*

Study aim	"Using the context of global health, this study seeks to examine the ways in which [mobile instant messaging] platforms are being used for learning and knowledge sharing and identify associated potentials and constraint"
When were the data collected?	2016
Types and numbers of healthcare worker participants	40 healthcare professionals, including nurses, midwives, doctors and students identified through digitally organized groups in the global and digital health realm (i.e. Health Information for All (HIFA), Global Digital Health Network, Social Media for Global Health, Information and Communications Technology for Development (ICT4D), and Social Media for Development)
Healthcare setting	A range of healthcare settings
Methods of data collection and analysis	• Survey with open-ended component • The qualitative data from the open-ended survey questions was analysed following principles of thematic analysis
Funding sources for the study	No information
Conflict of interest	No information
Notes	

Rathbone 2020

Study characteristics	
Country	UK
Study aim	"The aim of this research was to explore pharmacists' experiences of using WhatsApp to support delivery of out-of-hours pharmacy services."
When were the data collected?	2017-2018
Types and numbers of healthcare worker participants	26 participants were recruited, including 24 pharmacists and 2 pharmacy technicians. In addition, over 300 communication events (1580 messages) were analysed in the WhatsApp transcript.
Healthcare setting	A secondary-care organisation that provides pharmacy services across multiple sites
Methods of data collection and analysis	• Data collected from the content of the WhatsApp group transcript and from focus groups • Thematic analysis
Funding sources for the study	"This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors."
Conflict of interest	"The authors have no interests to declare."
Notes	

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Schwartz 2013

Study characteristics

Country	India
Study aim	"In this note we describe research in progress exploring how rules in the organizational setting influence use of a mobile device issued for community level or frontline social service work". [….] This work asks three questions. First, what policies are being implemented that affect the use of work-issued devices? Second, what is the rationale behind these policies? [...] Third, what are the consequences of these policies?"
When were the data collected?	2013
Types and numbers of healthcare worker participants	9 Accredited Social Health Activists ('ASHAs'), 12 CommCare Use Facilitators, 4 technical personnel, 2 monitoring and evaluation ('M&E') personnel, 8 programme managers, 1 government partner, 2 technology partners.
Healthcare setting	Communities in rural Kaushambi District and rural/urban Kishangarh District
Methods of data collection and analysis	• Document review • Semi-structured interviews • Observation • "This early analysis was conducted by inductively grouping utterances into themes as data were collected [3], probing later interviewees for comment on the most salient, and searching for relevant literature, to be discussed in future writing, on what emerged."
Funding sources for the study	No information
Conflict of interest	No information
Notes	

Shenouda 2018

Study characteristics

Country	UK
Study aim	"... this study sought to further explore the role of the smartphone for final year medical students and foundation trainee doctors in an attempt to appreciate how and why they are using their smartphones for work and for learning, especially during the process of 'responsibility transition'; and what issues, if any, require external support or intervention."
When were the data collected?	Not specified
Types and numbers of healthcare worker participants	7 medical students and 7 junior doctors
Healthcare setting	1 National Health Service (NHS) trust

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Shenouda 2018 *(Continued)*

Methods of data collection and analysis	• Focus groups and interviews • Thematic analysis
Funding sources for the study	No information
Conflict of interest	"The authors declare they have no competing interests."
Notes	

Spink 2020

Study characteristics

Country	Australia
Study aim	"This study aims to shed some light on the use of mobile technology by a [multidisciplinary health care team]"
When were the data collected?	Not specified
Types and numbers of healthcare worker participants	4 multidisciplinary teams including a total of 7 physicians, 6 nurses, and f5 allied professionals (radiation therapists, pathologist, pharmacist, dietitian)
Healthcare setting	A large Australian public hospital providing specialist leading-edge services as well as tertiary teaching
Methods of data collection and analysis	• Semi-structured interviews and document analysis • Thematic analysis
Funding sources for the study	"This research was partly supported by Australian Research Council (ARC) funding, Discovery Program Project Number DP140100047."
Conflict of interest	No information
Notes	

Tran 2014

Study characteristics

Country	Canada
Study aim	"The objective of this study is to describe the uses of institutional and personal smartphones on General Internal Medicine wards and highlight potential consequences of their use."
When were the data collected?	2009-2011

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Tran 2014 *(Continued)*

Types and numbers of healthcare worker partici-pants	100 medical students, residents, attending physicians and allied health professionals of General Internal Medicine
Healthcare setting	General Internal Medicine wards across 4 academic teaching hospitals in Toronto (Toronto General Hospital, Toronto Western Hospital of the University Health Network, Sunnybrook Health Sciences Centre and St. Michael's)
Methods of data collection and analysis	• Work shadowing observations and semi-structured interviews • Thematic analysis
Funding sources for the study	No direct information, but this was part of a larger study that says the following (Wu 2011): "We would like to thank the Ontario Ministry of Health and Long Term Care Alternate Funding Proposal Innovation Grant for providing funding."
Conflict of interest	"The authors declare that they have no conflicts of interest in the research."
Notes	

Venkataraghavan 2022

Study characteristics

Country	India
Study aim	"The purpose of this study is to examine the perceptions of rural medical officers (MOs) (rural physicians) regarding the benefits and challenges of mobile phone use by community health workers (CHWs)."
When were the data collected?	2020
Types and numbers of healthcare worker partici-pants	15 rural medical officers with a minimum of 5 years' experience
Healthcare setting	Public health centres in Udupi district of Karnataka
Methods of data collection and analysis	• Individual face-to-face in-depth interviews, and then telephone interviews with the onset of the COVID-19 pandemic • Thematic analysis
Funding sources for the study	"The authors would like to extend their gratitude to Transdisciplinary Centre for Qualitative Methods (TCQM), Manipal Academy of Higher Education (MAHE), Manipal, for permitting us to use their lab and resources for data analysis."
Conflict of interest	"The authors declare no conflict of interest."
Notes	

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Watkins 2018

Study characteristics

Country	Indonesia
Study aim	"Specifically, we investigated how [community health workers - 'CHWs'] have integrated mobile phones and social networking into their daily professional and personal routine—not as a result of a formal mHealth development initiative but rather through personal choice, organisational preference and/or in response to localised factors."
When were the data collected?	2013
Types and numbers of healthcare worker participants	19 HIV/AIDS community health workers or administrators
Healthcare setting	2 community health non-governmental organisations that mediate between local health departments and hard-to-reach, high-risk segments such as commercial sex workers and intravenous drug users living with HIV/AIDS in the regional capitals of Denpasar and Makassar
Methods of data collection and analysis	• Questionnaires • Group surveys • Communicative ecology (CE) mapping (connects a respondent's self-reported activity over a 'normal' 24-h to their communication behaviours during the same period) as part of an in-depth interview • Focus groups • Thematic analysis
Funding sources for the study	"This research was funded by the Australian Research Council Discovery Project scheme Mobile Indonesians, DP130102990."
Conflict of interest	No information
Notes	

Characteristics of studies awaiting classification *[ordered by study ID]*

Anderson 2013

Notes	Possibly eligible, but could not obtain full text.

Kundasamy 2019

Notes	Possibly eligible, but could not obtain full text.

Lee 2015

Notes	Possibly eligible, but could not obtain full text.

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Negarandeh 2022

Notes	Possibly eligible, but main author confirmed that the full text has not yet been published.

Patel 2011

Notes	Possibly eligible, but could not obtain full text.

Simeonov 2012

Notes	Possibly eligible, but could not obtain full text.

Williams 2013

Notes	Possibly eligible, but could not obtain full text.

A P P E N D I C E S

Appendix 1. Search strategies

Ovid MEDLINE(R) ALL (1946 to 10 August 2022; searched 11 August 2022)

1	Cell Phone/	9718
2	Cell Phone Use/	352
3	Smartphone/	8080
4	Mobile Applications/	10415
5	Medical Informatics Applications/	2550
6	Text Messaging/	4191
7	Internet-Based Intervention/	996
8	Social Media/	13940
9	(mobile device* or mobile phone* or mobile telephone* or cellphone* or cell* phone* or smartphone* or smart phone*).ti,ab,kf.	38403
10	(mobile adj (app or apps or application*)).ti,ab,kf.	8418
11	(mobile technolog* or short messag* or text messag* or texting or electronic messag* or social media*).ti,ab,kf.	33168

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12	(mobile health or mhealth or m-health or electronic health or ehealth or e-health or digital health).ti,ab,kf.	49626
13	or/1-12 **[Mobile device]**	123504
14	health personnel/ or allied health personnel/ or community health workers/ or dental auxiliaries/ or dental assistants/ or dental hygienists/ or dental technicians/ or denturists/ or emergency medical technicians/ or home health aides/ or licensed practical nurses/ or medical record administrators/ or medical secretaries/ or medical receptionists/ or nursing assistants/ or psychiatric aides/ or operating room technicians/ or pharmacy technicians/ or physical therapist assistants/ or physician assistants/ or ophthalmic assistants/ or pediatric assistants/ or anatomists/ or anesthetists/ or anesthesiologists/ or nurse anesthetists/ or audiologists/ or caregivers/ or case managers/ or "coroners and medical examiners"/ or dental staff/ or dental staff, hospital/ or dentists/ or dentists, women/ or endodontists/ or "oral and maxillofacial surgeons"/ or orthodontists/ or doulas/ or emergency medical dispatcher/ or epidemiologists/ or health facility administrators/ or hospital administrators/ or chief executive officers, hospital/ or infection control practitioners/ or medical laboratory personnel/ or medical staff/ or medical staff, hospital/ or hospitalists/ or nurses/ or nurse administrators/ or nurse practitioners/ or family nurse practitioners/ or pediatric nurse practitioners/ or nurse specialists/ or nurse clinicians/ or nurse midwives/ or nurses, pediatric/ or nurses, neonatal/ or nurses, community health/ or nurses, international/ or nurses, male/ or nurses, public health/ or nursing staff/ or nursing staff, hospital/ or nutritionists/ or occupational therapists/ or optometrists/ or personnel, hospital/ or hospital volunteers/ or pharmacists/ or physical therapists/ or physician executives/ or physicians/ or allergists/ or cardiologists/ or dermatologists/ or endocrinologists/ or gastroenterologists/ or general practitioners/ or geriatricians/ or nephrologists/ or neurologists/ or occupational health physicians/ or oncologists/ or radiation oncologists/ or ophthalmologists/ or osteopathic physicians/ or otolaryngologists/ or pathologists/ or pediatricians/ or neonatologists/ or physiatrists/ or physicians, family/ or physicians, primary care/ or physicians, women/ or pulmonologists/ or radiologists/ or rheumatologists/ or surgeons/ or barber surgeons/ or neurosurgeons/ or orthopedic surgeons/ or urologists/ or psychotherapists/ [Omitted MeSH: animal technicians/ - faculty, dental/ - faculty, medical/ - faculty, nursing/ - foreign medical graduates/ - health educators/ - medical chaperones/ - veterinarians/]	557519
15	Health Workforce/	14214
16	((health* or health care or medical) adj (personnel* or practitioner* or professional* or provider* or staff or worker*)).ti,ab,kf.	226922
17	((health* or health care or medical) adj (administrator* or assistant* or auxiliar* or manager* or receptionist* or technician* or technologist* or secretar*)).ti,ab,kf.	8547
18	(dental adj (personnel* or practitioner* or professional* or provider* or staff or worker*)).ti,ab,kf.	9734
19	(dental adj (administrator* or assistant* or auxiliar* or hygienist* or manager* or receptionist* or technician* or technologist* or secretar*)).ti,ab,kf.	6034
20	(laboratory adj (assistant* or personnel* or staff or technician* or technologist* or worker*)).ti,ab,kf.	5653

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21	((hospital or health facility) adj (administrator* or manager* or officer* or personnel* or staff or volunteer* or worker*)).ti,ab,kf.	13407
22	((health* or health care or medical) adj (manpower or man power or workforce or work force)).ti,ab,kf.	7356
23	(case manager* or clinical officer* or chief executive officer*).ti,ab,kf.	5034
24	(physician* or doctor* or clinician* or practitioner* or hospitalist*).ti,ab,kf.	948606
25	(nurse or nurses or nursing assistant* or nursing staff).ti,ab,kf.	303669
26	(midwife or midwives or doula* or birth attendant* or childbirth attendant* or birth assistant* or childbirth assistant*).ti,ab,kf.	22681
27	(paraprofessional* or paramedic or paramedics or paramedical worker* or paramedical personnel* or emergency medical dispatcher*).ti,ab,kf.	8656
28	(allergist* or anatomist* or anesthetist* or anesthesiologist* or audiologist* or cardiologist* or caregiver* or coroners examiner* or dentist* or denturist* or dermatologist* or endocrinologist* or endodontist* or epidemiologist* or gastroenterologist* or geriatrician* or gyn?ecologist* or h?ematologist* or home health aide* or medical examiner* or medical record administrator* or neonatologist* or nephrologist* or neurologist* or neurosurgeon* or nutritionist* or obstetrician* or oncologist* or operating room technician* or ophthalmic assistant* or ophthalmologist* or optometrist* or orthodontist* or otolaryngologist* or pathologist* or paediatric assistant* or pediatric assistant* or paediatrician* or pediatrician* or pharmacist* or pharmacy technician* or psychiatric aide* or physiatrist* or psychiatrist* or psychologist* or physiotherapist* or pulmonologist* or radiologist* or rheumatologist* or surgeon* or therapist* or urologist*).ti,ab,kf.	828515
29	or/14-28 **[Health personnel]**	2238108
30	(((("semi-structured" or semistructured or unstructured or informal or "in-depth" or indepth or "face-to-face" or structured or guide*) adj3 (discussion* or questionnaire*)) or (focus group* or qualitative or ethnograph* or fieldwork or "field work" or "key informant" or interview*)).ti,ab,kf. or interviews as topic/ or focus groups/ or narration/ or qualitative research/ [Based on a **Qualitative filter** from University of Texas]	689441
31	13 and 29 and 30	6899
32	limit 31 to yr="2008 -Current"	6775

Embase Ovid (1974 to 10 August 2022; searched 11 August 2022)

1	mobile phone/	20456
2	cell phone use/	1468
3	smartphone/	21416

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4	text messaging/	6818
5	mobile application/	18558
6	web-based intervention/	1877
7	social media/	37746
8	(mobile device* or mobile phone* or mobile telephone* or cellphone* or cell* phone* or smartphone* or smart phone*).ti,ab,kf.	48278
9	(mobile adj (app or apps or application*)).ti,ab,kf.	10122
10	(mobile technolog* or short messag* or text messag* or texting or electronic messag* or social media*).ti,ab,kf.	41777
11	(mobile health or mhealth or m-health or electronic health or ehealth or e-health or digital health).ti,ab,kf.	62589
12	or/1-11	169455
13	exp health care personnel/	1815750
14	((health* or health care or medical) adj (personnel* or practitioner* or professional* or provider* or staff or worker*)).ti,ab,kf.	298340
15	((health* or health care or medical) adj (administrator* or assistant* or auxiliar* or manager* or receptionist* or technician* or technologist* or secretar*)).ti,ab,kf.	10694
16	(dental adj (personnel* or practitioner* or professional* or provider* or staff or worker*)).ti,ab,kf.	10025
17	(dental adj (administrator* or assistant* or auxiliar* or hygienist* or manager* or receptionist* or technician* or technologist* or secretar*)).ti,ab,kf.	5302
18	(laboratory adj (assistant* or personnel* or staff or technician* or technologist* or worker*)).ti,ab,kf.	8028
19	((hospital or health facility) adj (administrator* or manager* or officer* or personnel* or staff or volunteer* or worker*)).ti,ab,kf.	16956
20	((health* or health care or medical) adj (manpower or man power or workforce or work force)).ti,ab,kf.	7965
21	(case manager* or clinical officer* or chief executive officer*).ti,ab,kf.	6747
22	(physician* or doctor* or clinician* or practitioner* or hospitalist*).ti,ab,kf.	1312150
23	(nurse or nurses or nursing assistant* or nursing staff).ti,ab,kf.	367369
24	(midwife or midwives or doula* or birth attendant* or childbirth attendant* or birth assistant* or childbirth assistant*).ti,ab,kf.	26094
25	(paraprofessional* or paramedic or paramedics or paramedical worker* or paramedical personnel* or emergency medical dispatcher*).ti,ab,kf.	11933

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26	(allergist* or anatomist* or anesthetist* or anesthesiologist* or audiologist* or cardiologist* or caregiver* or coroners examiner* or dentist* or denturist* or dermatologist* or endocrinologist* or endodontist* or epidemiologist* or gastroenterologist* or geriatrician* or gyn?ecologist* or h?ematologist* or home health aide* or medical examiner* or medical record administrator* or neonatologist* or nephrologist* or neurologist* or neurosurgeon* or nutritionist* or obstetrician* or oncologist* or operating room technician* or ophthalmic assistant* or ophthalmologist* or optometrist* or orthodontist* or otolaryngologist* or pathologist* or paediatric assistant* or pediatric assistant* or paediatrician* or pediatrician* or pharmacist* or pharmacy technician* or psychiatric aide* or physiatrist* or psychiatrist* or psychologist* or physiotherapist* or pulmonologist* or radiologist* or rheumatologist* or surgeon* or therapist* or urologist*).ti,ab,kf.	1267559
27	or/13-26	3453214
28	((("semi-structured" or semistructured or unstructured or informal or "in-depth" or indepth or "face-to-face" or structured or guide*) adj3 (discussion* or questionnaire*)) or (focus group* or qualitative or ethnograph* or fieldwork or "field work" or "key informant" or interview*)).ti,ab,kf. or interview/ or exp qualitative research/ [Based on Qual-filter University of Texas]	870195
29	12 and 27 and 28	10219
30	limit 29 to yr="2008 -Current"	10096
31	limit 30 to conference abstract status	3335
32	limit 30 to conference abstracts	3335
33	limit 30 to conference proceeding	8
34	limit 30 to conference abstract	3314
35	limit 30 to conference paper	38
36	or/31-35	3374

Cinahl Ebsco (1981 to 11 August 2022)

#	Query	Results
S37	S34 AND S35 [Limiters - Exclude MEDLINE records]	2,528
S36	S34 AND S35	3,806
S35	EM 2008-	5,811,827
S34	S11 AND S27 AND S33	4,293
S33	S28 OR S29 OR S30 OR S31 OR S32	483,458

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S32	TI (focus W0 group* or qualitative or ethnograph* or fieldwork or "field work" or "key informant" or interview*) OR AB ((focus group* or qualitative or ethnograph* or fieldwork or "field work" or "key informant" or interview*))	350,341
S31	TI (("semi structured" or semistructured or unstructured or informal or "in depth" or indepth or "face-to-face" or structured or guide*) N3 (discussion* or questionnaire*)) OR AB (("semi structured" or semistructured or unstructured or informal or "in depth" or indepth or "face-to-face" or structured or guide*) N3 (discussion* or questionnaire*))	18,465
S30	(MH "Focus Groups")	48,845
S29	(MH "Interviews+")	243,622
S28	(MH "Qualitative Studies+")	171,791
S27	S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26	1,514,343
S26	TI (allergist* or anatomist* or anesthetist* or anesthesiologist* or audiologist* or cardiologist* or caregiver* or coroners W0 examiner* or dentist* or denturist* or dermatologist* or endocrinologist* or endodontist* or epidemiologist* or gastroenterologist* or geriatrician* or gynecologist* or gynaecologist* or hematologist* or haematologist* or "home health" W0 aide* or medical W0 examiner* or "medical record" W0 administrator* or neonatologist* or nephrologist* or neurologist* or neurosurgeon* or nutritionist* or obstetrician* or oncologist* or "operating room" W0 technician* or ophthalmic W0 assistant* or ophthalmologist* or optometrist* or orthodontist* or otolaryngologist* or pathologist* or paediatric W0 assistant* or pediatric W0 assistant* or paediatrician* or pediatrician* or pharmacist* or pharmacy W0 technician* or psychiatric W0 aide* or physiatrist* or psychiatrist* or psychologist* or physiotherapist* or pulmonologist* or radiologist* or rheumatologist* or surgeon* or therapist* or urologist*)) OR AB (allergist* or anatomist* or anesthetist* or anesthesiologist* or audiologist* or cardiologist* or caregiver* or coroners W0 examiner* or dentist* or denturist* or dermatologist* or endocrinologist* or endodontist* or epidemiologist* or gastroenterologist* or geriatrician* or gynecologist* or gynaecologist* or hematologist* or haematologist* or "home health" W0 aide* or medical W0 examiner* or "medical record" W0 administrator* or neonatologist* or nephrologist* or neurologist* or neurosurgeon* or nutritionist* or obstetrician* or oncologist* or "operating room" W0 technician* or ophthalmic W0 assistant* or ophthalmologist* or optometrist* or orthodontist* or otolaryngologist* or pathologist* or paediatric W0 assistant* or pediatric W0 assistant* or paediatrician* or pediatrician* or pharmacist* or pharmacy W0 technician* or psychiatric W0 aide* or physiatrist* or psychiatrist* or psychologist* or physiotherapist* or pulmonologist* or radiologist* or rheumatologist* or surgeon* or therapist* or urologist*))	331,86
S25	TI (paraprofessional* or paramedic or paramedics or paramedical W0 worker* or paramedical W0 personnel* or "emergency medical" W0 dispatcher*) OR AB (paraprofessional* or paramedic or paramedics or paramedical W0 worker* or paramedical W0 personnel* or "emergency medical" W0 dispatcher*)	6,589
S24	TI (midwife or midwives or doula* or birth W0 attendant* or childbirth W0 attendant* or birth W0 assistant* or childbirth W0 assistant*) OR AB (midwife or midwives or doula* or birth W0 attendant* or childbirth W0 attendant* or birth W0 assistant* or childbirth W0 assistant*)	27,877

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S23	TI (nurse or nurses or nursing W0 assistant* or nursing W0 staff) OR AB (nurse or nurses or nursing W0 assistant* or nursing W0 staff)	378,354
S22	TI (physician* or doctor* or clinician* or practitioner* or hospitalist*) OR AB (physician* or doctor* or clinician* or practitioner* or hospitalist*)	423,988
S21	TI (case W0 manager* or clinical W0 officer* or "chief executive" W0 officer*) OR AB (case W0 manager* or clinical W0 officer* or "chief executive" W0 officer*)	8,389
S20	TI ((health* or "health care" or medical) W0 (manpower or "man power" or workforce or "work force"))) OR AB ((health* or "health care" or medical) W0 (manpower or "man power" or workforce or "work force"))	5,034
S19	TI ((hospital or "health facility") W0 (administrator* or manager* or officer* or personnel* or staff or volunteer* or worker*)) OR AB ((hospital or "health facility") W0 (administrator* or manager* or officer* or personnel* or staff or volunteer* or worker*))	6,197
S18	TI (laboratory W0 (assistant* or personnel* or staff or technician* or technologist* or worker*)) OR AB (laboratory W0 (assistant* or personnel* or staff or technician* or technologist* or worker*))	1,319
S17	TI (dental W0 (administrator* or assistant* or auxiliar* or hygienist* or manager* or receptionist* or technician* or technologist* or secretar*)) OR AB (dental W0 (administrator* or assistant* or auxiliar* or hygienist* or manager* or receptionist* or technician* or technologist* or secretar*))	5,059
S16	TI (dental W0 (personnel* or practitioner* or professional* or provider* or staff or worker*)) OR AB (dental W0 (personnel* or practitioner* or professional* or provider* or staff or worker*))	3,836
S15	TI ((health* or "health care" or medical) W0 (administrator* or assistant* or auxiliar* or manager* or receptionist* or technician* or technologist* or secretar*)) OR AB ((health* or "health care" or medical) W0 (administrator* or assistant* or auxiliar* or manager* or receptionist* or technician* or technologist* or secretar*))	7,374
S14	TI ((health* or "health care" or medical) W0 (personnel* or practitioner* or professional* or provider* or staff or worker*)) OR AB ((health* or "health care" or medical) W0 (personnel* or practitioner* or professional* or provider* or staff or worker*))	182,772
S13	(MH "Health Manpower+")	631,263
S12	(MH "Health Personnel+")	625,422
S11	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10	79,391
S10	TI ("mobile health" or mhealth or m-health or "electronic health" or ehealth or e-health or "digital health") OR AB ("mobile health" or mhealth or m-health or "electronic health" or ehealth or e-health or "digital health")	25,545
S9	TI (mobile W0 technolog* or short W0 messag* or text W0 messag* or texting or electronic W0 messag* or social W0 media*) OR AB (mobile W0 technolog* or short W0 messag* or text W0 messag* or texting or electronic W0 messag* or social W0 media*)	21,498

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S8	TI (mobile W0 app or mobile W0 apps or mobile W0 application*) OR AB (mobile W0 app or mobile W0 apps or mobile W0 application*)	4
S7	TI (mobile W0 device* or mobile W0 phone* or mobile W0 telephone* or cellphone* or cell* W0 phone* or smartphone* or smart W0 phone*) OR AB (mobile W0 device* or mobile W0 phone* or mobile W0 telephone* or cellphone* or cell* W0 phone* or smartphone* or smart W0 phone*)	16,376
S6	(MH Social Media)	19,444
S5	(MH Internet-Based Intervention)	486
S4	MH "Mobile Applications")	11,071
S3	(MH Text Messaging)	3,885
S2	(MH Smartphone)	3,765
S1	(MH Cellular Phone)	2,173

Scopus, Elsevier (searched 11 August 2022)

((TITLE-ABS-KEY ((mobile PRE/0 device*) OR (mobile PRE/0 phone*) OR (mobile PRE/0 telephone*) OR (cellphone*) OR (cell* PRE/0 phone*) OR (smartphone*) OR (smart PRE/0 phone*))) OR (TITLE-ABS-KEY ((mobile PRE/0 app) OR (mobile PRE/0 apps) OR (mobile PRE/0 application*))) OR (TITLE-ABS-KEY ((mobile PRE/0 technolog*) OR (short PRE/0 messag*) OR (text PRE/0 messag*) OR (texting) OR (electronic PRE/0 messag*) OR (social PRE/0 media*))) OR (TITLE-ABS-KEY (("mobile health") OR (mhealth) OR (m-health) OR ("electronic health") OR (ehealth) OR (e-health) OR ("digital health")))) AND ((TITLE-ABS-KEY ((health* OR "HEALTH CARE" OR medical) PRE/0 (personnel* OR practitioner* OR professional* OR provider* OR staff OR worker*))) OR (TITLE-ABS-KEY ((health* OR "HEALTH CARE" OR medical) PRE/0 (administrator* OR assistant* OR auxiliar* OR manager* OR receptionist* OR technician* OR technologist* OR secretar*))) OR (TITLE-ABS-KEY ((dental) PRE/0 (personnel* OR practitioner* OR professional* OR provider* OR staff OR worker*))) OR (TITLE-ABS-KEY ((dental) PRE/0 (administrator* OR assistant* OR auxiliar* OR hygienist* OR manager* OR receptionist* OR technician* OR technologist* OR secretar*))) OR (TITLE-ABS-KEY ((laboratory) PRE/0 (assistant* OR personnel* OR staff OR technician* OR technologist* OR worker*))) OR (TITLE-ABS-KEY ((hospital OR "HEALTH FACILITY") PRE/0 (administrator* OR manager* OR officer* OR personnel* OR staff OR volunteer* OR worker*))) OR (TITLE-ABS-KEY ((health* OR "HEALTH CARE" OR medical) PRE/0 (manpower OR "MAN POWER" OR workforce OR "WORK FORCE"))) OR (TITLE-ABS-KEY ((case PRE/0 manager*) OR (clinical PRE/0 officer*) OR ("CHIEF EXECUTIVE" PRE/0 officer*))) OR (TITLE-ABS-KEY (physician* OR doctor* OR clinician* OR practitioner* OR hospitalist*)) OR (TITLE-ABS-KEY ((nurse) OR (nurses) OR (nursing PRE/0 assistant*) OR (nursing PRE/0 staff))) OR (TITLE-ABS-KEY ((midwife) OR (midwives) OR (doula*) OR (birth PRE/0 attendant*) OR (childbirth PRE/0 attendant*) OR (birth PRE/0 assistant*) OR (childbirth PRE/0 assistant*))) OR (TITLE-ABS-KEY ((allergist*) OR (anatomist*) OR (anesthetist*) OR (anesthesiologist*) OR (audiologist*) OR (cardiologist*) OR (caregiver*) OR (coroners PRE/0 examiner*) OR (dentist*) OR (denturist*) OR (dermatologist*) OR (endocrinologist*) OR (endodontist*) OR (epidemiologist*) OR (gastroenterologist*) OR (geriatrician*) OR (gynecologist*) OR (gynaecologist*) OR (hematologist*) OR (haematologist*) OR ("HOME HEALTH" PRE/0 aide*) OR (medical PRE/0 examiner*) OR ("MEDICAL RECORD" PRE/0 administrator*) OR (neonatologist*) OR (nephrologist*) OR (neurologist*) OR (neurosurgeon*) OR (nutritionist*) OR (obstetrician*) OR (oncologist*) OR ("OPERATING ROOM" PRE/0 technician*) OR (ophthalmic PRE/0 assistant*) OR (ophthalmologist*) OR (optometrist*) OR (orthodontist*) OR (otolaryngologist*) OR (pathologist*) OR (paediatric PRE/0 assistant*) OR (pediatric PRE/0 assistant*) OR (paediatrician*) OR (pediatrician*) OR (pharmacy PRE/0 technician*) OR (pharmacist*) OR (pharmacy PRE/0 technician*) OR (psychiatric PRE/0 aide*) OR (physiatrist*) OR (psychiatrist*) OR (psychologist*) OR (physiotherapist*) OR (pulmonologist*) OR (radiologist*) OR (rheumatologist*) OR (surgeon*) OR (therapist*) OR (urologist*)))) AND ((TITLE-ABS-KEY ((qualitative) OR (focus PRE/0 group*) OR (ethnograph*) OR (fieldwork) OR ("FIELD WORK") OR ("KEY INFORMANT") OR (interview*))) OR (TITLE-ABS-KEY ((("SEMI STRUCTURED") OR (semistructured) OR (unstructured) OR (informal) OR ("IN DEPTH") OR (indepth) OR ("FACE-TO-FACE") OR (structured) OR (guide*)) W/3 ((discussion*) OR (questionnaire*)))))) AND NOT INDEX (medline OR embase) AND (LIMIT-TO (SUBJAREA , "MEDI") OR LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "NURS") OR LIMIT-TO (SUBJAREA , "HEAL") OR LIMIT-TO (SUBJAREA , "DENT")) AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2011) OR LIMIT-TO (PUBYEAR , 2010) OR LIMIT-TO (PUBYEAR , 2009) OR LIMIT-TO (PUBYEAR, 2008)) 2236 records

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Appendix 2. Methodological limitations of included studies

Author(s), Year	Were the settings and context described adequately?	Was the sampling strategy described, and was this appropriate?	Was the data collection strategy described and was this appropriate?	Was the data analysis described, and was this appropriate?	Were the claims made/findings supported by sufficient evidence?	Was there evidence of reflexivity?	Did the study demonstrate sensitivity to ethical concerns?	Any other issues?
Abane 2021	Yes	Yes	Yes	Yes	Yes	No	Yes	This study is from the same project as the Hampshire 2021 study and the Mariwah 2022 study.
Anstey 2018	Yes	Yes	Yes	Yes	Yes	Yes	Yes	The mHealth intervention described in this paper was part of the Nkateko trial called 'Treating hypertension in rural South Africa: A clinicbased lay health-worker to enhance integrated chronic care' (Trial registration number: ISRCTN12128227). Thorogood M, Goudge J, Bertram M, Chirwa T, Eldridge S, Gomez-Olive FX, et al. The Nkateko health service trial to improve hypertension management in rural South Africa: study protocol for a randomised controlled trial. Trials. 2014; 15(1):435
Barnor-Ahiaku 2016	Partial	Yes	Yes	Yes	Yes	No	Partial	-
Bautista 2016	Yes	Partial/unclear	Yes	Yes	Yes	No	Yes	-
Bautista 2017	Partial	Partial/unclear	Yes	Yes	Yes	No	Yes	-
Bautista 2020	Yes	Yes	Yes	Yes	Yes	No	Yes	-
Bhat 2021	Yes	Partial/unclear	Yes	Yes	Yes	Partial	Partial	-
Brandt 2016	Yes.	Partial/unclear	Partial	Yes	Yes	No	No	-

Burns 2013	Partial	Unclear	Yes	Yes	Yes	No	No	-
Chiang 2016	Partial	Yes	Yes	Yes	Yes	Partial	Yes	-
Chib 2013	Partial	Partial/unclear	Yes	Yes	Yes	Partial	Yes	-
Hampshire 2017	Yes	Yes	Yes	Yes	Yes	No	Yes	The study was intended to be conducted in 3 countries but data collection was not completed in 1 country (South Africa)
Hampshire 2021	Yes	Yes	Yes	Yes	Yes	Yes	Yes	This is from the same project as the Mariwah 2022 paper and the Abane 2021 paper
Hussain 2022	Partial	Yes	Yes	Yes	Yes	No	Yes	-
Ismail 2019	Yes	Partial/unclear	Yes	Yes	Yes	Yes	Partial	-
Karusala 2020	Partial	Unclear	Yes	Yes	Yes	Partial	Yes	-
Ling 2020	Partial	Partial/unclear	Yes	Yes	Yes	No	Yes	-
Mariwah 2022	Yes	Yes	Yes	Yes	Yes	No	Yes	This is from the same project as the Hampshire 2021 paper and the Abane 2021 paper
Mather 2018	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	This study is described in two papers: Mather 2018 and Mather 2019
Moyer 2014	Yes	Unclear	Yes	No	Yes	No	Yes	-
Nerminathan 2017	Yes	Yes	Yes	Yes	Yes	No	Yes	-
Ologeanu-Taddei 2019	Yes	Partial/unclear	Yes	Yes	Yes	No	No	-
Pimmer 2018	Yes	Partial/unclear	Yes	Yes	Yes	No	No	-

Healthcare workers' informal uses of mobile phones and other mobile devices to support their work: a qualitative evidence synthesis (Review)

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Rathbone 2020	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-
Schwartz 2013	Yes	Unclear	Yes	Yes	Partial	No	No	-
Shenouda 2018	No	Partial/unclear	Yes	Yes	Yes	No	Yes	-
Spink 2020	Partial.	Partial/unclear	Yes	Yes	Yes	No	Yes	-
Tran 2014	Yes	Unclear	Yes	Yes	Yes	No	Yes	"The qualitative findings reported in this study resulted from a secondary analysis of a primary data set, which has been previously described in a study evaluating the benefits and drawbacks of different communication interventions on inpatient care delivery [...]. The entire qualitative data set was reanalyzed with a focus on the uses of personal smartphones in the clinical environment, which was not addressed in the primary analysis."
Venkataraghavan 2022	Yes	Partial/unclear	Yes	Yes	Yes	No	Yes	-
Watkins 2018	Yes	Yes	Yes	Yes	Yes	No	No	-

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Healthcare workers' informal uses of mobile phones and other mobile devices to support their work: a qualitative evidence synthesis (Review)

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Appendix 3. GRADE-CERQual evidence profile

#	Summarised review finding	Methodological limitations	Coherence	Adequacy	Relevance	GRADE-CERQual assessment of confidence	References
THEME 1: What are healthcareworkers using informal mobile-phone-based approaches for?							
1	**Finding 1.1** Healthcare workers describe using their personal mobile phones to seek advice and support and exchange information with other healthcare workers regarding patient management, for instance when making referrals and during clinical emergencies	**No/very minor concerns** **Explanation:** the data collection methods used were primarily focus groups and interviews, and it is possible that social desirability bias may have led participants to justify their informal, unregulated behaviour with reference to the needs of the patient. However, we do not consider this to be a very important concern. In addition, non-work uses are captured in other findings. 10 of the studies had used participant sampling strategies that may have limited the sample variation. However, the other 9 studies had used appropriate sampling strategies. Most of the studies had no evidence of reflexivity. However, it is difficult to assess how the study authors' positions may have influenced this finding. 10 of the studies had used participant sampling techniques that may have limited the sample variation, but the other 9 studies had used appropriate sampling techniques.	**No/very minor concerns**	**No/very minor concerns** **Explanation:** the finding is supported by 19 studies with sufficiently rich data.	**No/very minor concerns** **Explanation:** the studies are from high- and low- and middle-income countries, different types of healthcare settings and different healthcare worker cadres. The studies were carried out in different time periods, including during the last 5 years.	**High confidence** **Explanation:** no/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance	Abane 2021; Anstey 2018; Barnor-Ahiaku 2016; Bautista 2016; Bautista 2017; Bautista 2020; Chib 2013; Hampshire 2017; Hampshire 2021; Hussain 2022; Ling 2020; Mariwah 2022; Moyer 2014; Nerminathan 2017; Pimmer 2018; Shenouda 2018; Spink 2020; Tran 2014; Venkataraghavan 2022

(Continued)

2	**Finding 1.2** Healthcare workers describe using their personal mobile phones to socialise and exchange emotional support with other healthcare workers and to air work grievances, although some are annoyed by messages that are not directly related to work	**Minor concerns** **Explanation:** minor concerns regarding methodological limitations because 3 of the 4 studies supporting this finding had used participant sampling strategies that may have limited the sample variation.	**No/very minor concerns**	**Moderate concerns** **Explanation:** the finding is only supported by 4 studies, and some elements of the finding (airing grievances and frustration by non-work messages) are only supported by 2 of the studies. In addition, the data concerning this topic are thin.	**No/very minor concerns** **Explanation:** 3 of the studies are from LMICs and 1 is from an HIC but we do not have any reason to believe that this finding would not apply to HICs also. The studies are from a range of settings and include a range of healthcare worker cadres. The studies were carried out in different time periods, including in the last 5 years.	**Moderate confidence** **Explanation:** minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; moderate concerns regarding adequacy; and no/very minor concerns regarding relevance	Bautista 2017; Ismail 2019; Pimmer 2018; Rathbone 2020
3	**Finding 1.3** Senior staff describe using informal mobile phone channels to co-ordinate, oversee and manage healthcare workers' work. Healthcare workers also describe using these channels to send reports to supervisors and to share practical information such as staffing schedules.	**No/very minor concerns** **Explanation:** no or very minor concerns. 6 of the studies had used participant sampling strategies that may have limited the sample variation, but the other 7 studies had used appropriate sampling strategies. Most of the studies had no evidence of reflexivity. However, it is difficult to assess how the study authors' positions may have influenced this finding.	**No/very minor concerns**	**No/very minor concerns** **Explanation:** the finding is supported by 13 studies with sufficiently rich data.	**Moderate concerns** **Explanation:** moderate concerns regarding relevance because 12 of the studies are from LMICs, and only 1 study is from a HIC. It is possible that this use of personal phones is less likely to occur in high-income settings where healthcare workers may have better access to functional formal systems with which to perform these tasks. The studies are from a range of healthcare settings and healthcare cadres and were carried out in different time periods,	**Moderate confidence** **Explanation:** no/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and moderate concerns regarding relevance	Abane 2021; Anstey 2018; Barnor-Ahiaku 2016; Bautista 2017; Hampshire 2017; Hampshire 2021; Ismail 2019; Karusala 2020; Mariwah 2022; Pimmer 2018; Spink 2020; Venkataraghavan 2022; Watkins 2018;

#							
				including during the last 5 years.			
4	**Finding 1.4** Healthcare workers descriptions of informal mobile phone communication usually involve colleagues at the same workplace. Far fewer healthcare workers describe using their phones to contact healthcare workers from outside their workplace or linked facilities or who were not already known to them.	**No/very minor concerns** **Explanation:** 8 of the studies had used participant sampling strategies that may have limited the sample variation, but the other 10 studies had used appropriate sampling strategies. Most of the studies had no evidence of reflexivity. However, it is difficult to assess how the study authors' positions may have influenced this finding.	**No/very minor concerns**	**No/very minor concerns** **Explanation:** the finding is supported by 23 studies with sufficiently rich data.	**No/very minor concerns** **Explanation:** the studies are from high- and low- and middle-income countries, different types of healthcare settings and different healthcare worker cadres. The studies were carried out in different time periods, including during the last 5 years.	**High confidence** **Explanation:** no/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance	Abane 2021; Anstey 2018; Barnor-Ahiaku 2016; Bautista 2016; Bautista 2017; Bautista 2020; Brandt 2016; Chib 2013; Hampshire 2017; Hampshire 2021; Hussain 2022; Ismail 2019; Karusala 2020; Ling 2020; Mariwah 2022; Nerminathan 2017; Pimmer 2018; Rathbone 2020; Shenouda 2018; Spink 2020; Tran 2014; Venkataraghavan 2022; Watkins 2018;
5	**Finding 1.5** Healthcare workers describe using their personal mobile phones to communicate with patients, clients and their families	**Minor concerns** **Explanation:** minor concerns regarding methodological limitations because the data collection methods used were primarily focus groups and interviews, and it is possible that social desirability bias may have led participants to justify their informal, unregulated behaviour with reference to	**No/very minor concerns**	**No/very minor concerns** **Explanation:** the finding is supported by 12 studies with sufficiently rich data.	**Serious concerns** **Explanation:** serious concerns regarding relevance because 10 of the studies are from LMICs and only 2 studies are from HICs, and we are very uncertain about the relevance of this finding across all settings. It is possible that this use of personal phones is less	**Low confidence** **Explanation:** minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and serious	Bautista 2016; Bhat 2021; Brandt 2016; Chiang 2016; Chib 2013; Hampshire 2017; Hampshire 2021; Mariwah 2022; Moyer 2014; Pimmer 2018;

		the needs of the patient. 7 of the studies had also used participant sampling strategies that may have limited the sample variation. However, the other 5 studies had used appropriate sampling strategies.				likely to occur in high-income settings where healthcare workers may have better access to functional formal systems with which to perform these tasks as well as stricter regulations regarding communication with patients. The studies are from a range of healthcare settings and healthcare cadres and were carried out in different time periods, including during the last 5 years.	concerns regarding relevance	Venkataragha-van 2022; Watkins 2018;
6	**Finding 1.6** Healthcare workers describe using their personal mobile phones to take photos. This includes images of patient-specific information such as images of X-rays and test results as well as non-patient-specific information such as reports and schedules.	**No/very minor concerns** **Explanation:** 10 of the studies had used participant sampling strategies that may have limited the sample variation, but the other 8 studies had used appropriate sampling strategies. Most of the studies had no evidence of reflexivity. However, it is difficult to assess how the study authors' positions may have influenced this finding	**No/very minor concerns**	**No/very minor concerns** **Explanation:** the finding is supported by 18 studies with sufficiently rich data.	**No/very minor concerns** **Explanation:** the studies are from high and low-and middle-income countries, different types of healthcare settings and different healthcare worker cadres. The studies were carried out in different time periods, including during the last 5 years.	**High confidence** **Explanation:** no/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence' no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance	Abane 2021; Anstey 2018; Barnor-Ahi-aku 2016; Bautista 2016; Bautista 2017; Bhat 2021; Brandt 2016; Burns 2013; Chiang 2016; Hampshire 2021; Hussain 2022; Karusala 2020; Mather 2018; Nerminathan 2017; Ologeanu-Taddei 2019; Pimmer 2018; Shenouda 2018; Venkataragha-van 2022;
7	**Finding 1.7**	**No/very minor concerns**	**No/very minor concerns**	**Moderate concerns**	**Moderate concerns**	**Low confidence**	Anstey 2018; Barnor-Ahi-

#	Finding	Methodological limitations	Coherence	Adequacy	Relevance	Overall CERQual assessment	Studies
	In addition to taking photos of patient-specific information, healthcare workers describe using their personal mobile phones to retrieve, record and store patient information	**Explanation:** Most of the studies had no evidence of reflexivity. However, it is difficult to assess how the study authors' positions may have influenced this finding.		**Explanation:** moderate concerns regarding adequacy because the finding is only supported by 4 studies, and the data concerning this topic are thin. This finding describes informal behaviour that is controversial and it may therefore be under-researched or under-reported.	**Explanation:** moderate concerns regarding relevance because all of the 4 studies are from LMICs. It is possible that this use of personal phones is less likely to occur in better-resourced settings where healthcare workers may have better access to functional formal systems for sharing and storing information and stricter regulations regarding data management. The studies are from a range of healthcare settings and healthcare cadres and were carried out in different time periods, including during the last 5 years.	**Explanation:** no/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; moderate concerns regarding adequacy,;and moderate concerns regarding relevance	aku 2016; Hampshire 2017; Mariwah 2022;
8	**Finding 1.8** Healthcare workers describe using their personal mobile phones to search for general clinical and practical information in officially endorsed information sources but also in sources that are not formally endorsed.	**No/very minor concerns** **Explanation:** 6 of the studies had used participant sampling strategies that may have limited the sample variation, but the other 6 studies had used appropriate sampling strategies. Most of the studies had no evidence of reflexivity. However, it is difficult to assess how the study authors' positions may have influenced this finding.	No/very minor concerns	**No/very minor concerns** **Explanation:** the finding is supported by 13 studies with sufficiently rich data.	**No/very minor concerns** **Explanation:** the studies are from high- and low- and middle-income countries, different types of healthcare settings and different healthcare worker cadres. The studies were carried out in different time periods, including during the last 5 years.	**High confidence** **Explanation:** no/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance	Anstey 2018; Barnor-Ahiaku 2016; Bautista 2016; Bautista 2020; Brandt 2016; Chib 2013; Hampshire 2021; Mather 2019; Nerminathan 2017; Shenouda 2018; Spink 2020; Venkataraghavan 2022; Watkins 2018;

THEME 2: Why are healthcare workers using informal mobile-phone based approaches?

9	**Finding 2.1** Healthcare workers and managers explain that they use personal mobile phones because formal tools and systems are not available or functional or because their personal phones have better functionality and are more user-friendly.	**No/very minor concerns** **Explanation:** 6 of the studies had used participant sampling strategies that may have limited the sample variation, but the other 4 studies had used appropriate sampling strategies.	**No/very minor concerns**	**No/very minor concerns** **Explanation:** the finding is supported by 12 studies with sufficiently rich data.	**No/very minor concerns** **Explanation:** the studies are from high- and low- and middle-income countries, different types of healthcare settings and different healthcare worker cadres. The studies were carried out in different time periods, including during the last 5 years.	**High confidence** **Explanation:** no/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance	Anstey 2018; Bautista 2016; Bautista 2020; Bhat 2021; Burns 2013; Chib 2013; Hampshire 2021; Mather 2019; Moyer 2014; Ologeanu-Taddei 2019; Rathbone 2020; Venkataraghavan 2022;
10	**Finding 2.2** Healthcare workers, including senior staff and managers, describe how the informal use of personal phones at work has become normalised and how senior staff sometimes expect it of healthcare workers.	**No/very minor concerns** **Explanation:** 9 of the studies had used participant sampling strategies that may have limited the sample variation, but the other 6 studies had used appropriate sampling strategies. Most of the studies had no evidence of reflexivity. However, it is difficult to assess how the study authors' positions may have influenced this finding.	**No/very minor concerns**	**No/very minor concerns** **Explanation:** the finding is supported by 15 studies with sufficiently rich data.	**No/very minor concerns** **Explanation:** the studies are from high- and low- and middle-income countries, different types of healthcare settings and different healthcare worker cadres. The studies were carried out in different time periods, including during the last 5 years.	**High confidence** **Explanation:** no/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance	Abane 2021; Barnor-Ahiaku 2016; Bautista 2016; Bautista 2017; Bautista 2020; Brandt 2016; Hussain 2022; Karusala 2020; Ling 2020; Mather 2018; Moyer 2014; Nerminathan 2017; Ologeanu-Taddei 2019; Shenouda 2018; Venkataraghavan 2022
11	**Finding 2.3** Healthcare workers describe how the use of their personal phones is driven by feelings of oblig-	**Minor concerns** **Explanation:** Minor concerns regarding methodological limitations because the data collection methods used were primarily fo-	**No/very minor concerns**	**No/very minor concerns** **Explanation:** the finding is supported by 5 studies with	**Minor concerns** **Explanation:** All of the studies are from LMICs. It is possible that healthcare workers in other settings feel the same	**Moderate confidence** **Explanation:** minor concerns regarding methodological limita-	Abane 2021; Anstey 2018; Bautista 2016; Hampshire 2017; Hampshire 2021

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	ation towards their patients.	cus groups and interviews, and it is possible that social desirability bias may have led participants to justify their informal, unregulated behaviour with reference to the needs of colleagues and patients. 1 of the studies also had used participant sampling strategies that may have limited the sample variation. However, the other 4 studies had used appropriate sampling strategies.		sufficiently rich data.	level of obligation but have other means to address this than through personal phone use. The studies are from a range of healthcare settings and healthcare cadres and were carried out in different time periods, including during the last 5 years.	tions; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and minor concerns regarding relevance

THEME 3: What are the impacts of informal mobile phone based approaches?

| 12 | **Finding 3.1**

Healthcare workers describe how the use of their personal mobile phones makes it easier and faster to communicate with patients and colleagues, prevents unnecessary journeys, and can lead to better quality care. | **No/very minor concerns**

Explanation: the data collection methods used were primarily focus groups and interviews, and it is possible that social desirability bias may have led participants to justify their informal, unregulated behaviour with reference to increased efficiency. However, we do not consider this to be a very important concern. In addition, 8 of the studies had used participant sampling strategies that may have limited the sample variation. However, the other 9 studies had used appropriate sampling strategies. Several of the studies had no evidence of reflexivity. However, it is difficult to assess how the study authors' positions may have influenced this finding. | **No/very minor concerns** | **No/very minor concerns**

Explanation: the finding is supported by 17 studies with sufficiently rich data. | **No/very minor concerns**

Explanation: the studies are from high- and low- and middle-income countries, different types of healthcare settings and different healthcare worker cadres. The studies were carried out in different time periods, including during the last 5 years. | **High confidence**

Explanation: no/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance | Anstey 2018; Bautista 2016; Bautista 2017; Bautista 2020; Brandt 2016; Chiang 2016; Chib 2013; Hampshire 2017; Hampshire 2021; Hussain 2022; Ling 2020; Mather 2018; Nerminathan 2017; Pimmer 2018; Rathbone 2020; Tran 2014; Venkataraghavan 2022 |

#	Finding						
13	**Finding 3.2** Healthcare workers describe how the exchange of personal phone numbers between healthcare workers and patients allows patients to contact healthcare workers who are already known to them and enables bidirectional communication. In contrast, many formal systems tend to be unidirectional and do not include ways of contacting a specific healthcare worker.	**No/very minor concerns** **Explanation:** the data collection methods used were primarily focus groups and interviews, and it is possible that social desirability bias may have led participants to justify their informal, unregulated behaviour with reference to the needs of the patients. However, we do not consider this to be an important concern. 7 of the studies had used participant sampling strategies that may have limited the sample variation. However, the other 5 studies had used appropriate sampling strategies. Several of the studies had no evidence of reflexivity. However, it is difficult to assess how the study authors' positions may have influenced this finding.	**No/very minor concerns**	**Minor concerns** **Explanation:** minor concerns regarding the adequacy of the data for the part of the finding that described how the informal system compares to the formal system	**Serious concerns** **Explanation:** serious concerns regarding relevance because 10 of the 12 studies are from LMICs and we are very uncertain about the relevance of this finding across all settings. Healthcare workers in high-income settings may encounter this issue less because they may have better access to functional formal systems to perform these tasks as well as stricter regulations regarding communication with patients. The studies are from a range of healthcare settings and healthcare cadres and were carried out in different time periods, including during the last 5 years.	**Low confidence** **Explanation:** no/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; minor concerns regarding adequacy; and serious concerns regarding relevance	Bautista 2016; Bhat 2021; Brandt 2016; Chiang 2016; Chib 2013; Hampshire 2017; Hampshire 2021; Ismail 2019; Mariwah 2022; Moyer 2014; Venkataraghavan 2022; Watkins 2018
14	**Finding 3.3** Healthcare workers describe how their personal phone use can help them manage their relationships with other healthcare workers, for instance by providing additional information to justify a patient referral and protect themselves against criticism about their decisions, but also to support colleagues	**No/very minor concerns** **Explanation:** 1 of the 2 studies had no evidence of reflexivity. However, it is difficult to assess how the study authors' positions may have influenced this finding.	**No/very minor concerns**	**Serious concerns** **Explanation:** serious concerns regarding adequacy because the finding is only supported by 2 studies and 1 of the studies has thin data.	**No/very minor concerns** **Explanation:** 1 of the studies is from an LMIC and 1 is from a HIC. The studies are from hospital and community settings and include lay health workers and pharmacists. The studies appear to have been carried out during the last 5 years.	**Low confidence** **Explanation:** no/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; serious concerns regarding adequacy; and no/very minor concerns regarding relevance	Ling 2020; Rathbone 2020

					who need their assistance out of hours.		
15	**Finding 3.4** Healthcare workers complain that the use of their personal phones for work blurs the boundaries between personal and professional life as they are sometimes contacted by patients and colleagues at home, outside working hours, and this could be a significant disruption to their personal lives.	**No/very minor concerns** **Explanation:** 4 of the studies had used participant sampling techniques that may have limited the sample variation, but the other 7 studies had used appropriate sampling strategies. Several of the studies had no evidence of reflexivity. However, it is difficult to assess how the study authors' positions may have influenced this finding.	**No/very minor concerns**	**No/very minor concerns** **Explanation:** the finding is supported by 11 studies with sufficiently rich data.	**No/very minor concerns** **Explanation:** the studies are from high- and low- and middle-income countries, different types of healthcare settings and different healthcare worker cadres. The studies were carried out in different time periods, including during the last 5 years.	**High confidence** **Explanation:** no/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance	Bhat 2021; Chiang 2016; Hampshire 2017; Hampshire 2021; Karusala 2020; Mariwah 2022; Moyer 2014; Nerminathan 2017; Rathbone 2020; Shenouda 2018; Watkins 2018
16	**Finding 3.5** Healthcare workers describe how the use of their personal phones at work can lead to distraction at work, both because of other work calls to their personal phones and because of personal calls. However, some healthcare workers also appreciate the ability to stay connected to their home lives during working hours. Some managers complain that healthcare workers are distracted by their use of social	**No/very minor concerns** **Explanation:** 6 of the studies had used participant sampling strategies that may have limited the sample variation, but the other 4 studies had used appropriate sampling strategies. Several of the studies had no evidence of reflexivity. However, it is difficult to assess how the study authors' positions may have influenced this finding.	**No/very minor concerns**	**Moderate concerns** **Explanation:** moderate concerns regarding adequacy. Overall, the finding was supported by 10 studies, but each element of the finding was supported by a smaller number of studies.	**No/very minor concerns**	**Moderate confidence** **Explanation:** no/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; moderate concerns regarding adequacy; and no/very minor concerns regarding relevance	Bautista 2016; Bautista 2020; Brandt 2016; Hampshire 2021; Karusala 2020; Mariwah 2022; Nerminathan 2017; Pimmer 2018; Tran 2014; Venkataraghavan 2022

			No/very minor concerns		No/very minor concerns		
	media, games and videos.						
17	**Finding 3.6** Healthcare workers are concerned about privacy and confidentiality issues when storing and sharing patient information on their personal mobile phones. However, in some cases, healthcare workers also use their personal phones to keep patient-sensitive information out of the formal system.	**Minor concerns** **Explanation:** minor concerns regarding methodological limitations because the data collection methods used were primarily focus groups and interviews, and it is possible that social desirability bias may have led participants to justify their informal, unregulated behaviour with reference to the needs of the patient. In addition, 9 of the studies had used participant sampling strategies that may have limited the sample variation. However, the other 6 studies had used appropriate sampling strategies. Several of the studies had no evidence of reflexivity. However, it is difficult to assess how the study authors' positions may have influenced this finding.	**No/very minor concerns**	**Minor concerns** **Explanation:** minor concerns regarding adequacy. While the first part of the finding is supported by 13 studies with sufficiently rich data, the second part was only supported by 2 studies.	**No/very minor concerns** **Explanation:** the studies are from high- and low- and middle-income countries, different types of healthcare settings and different healthcare worker cadres. The studies were carried out in different time periods, including during the last 5 years.	**Moderate confidence** **Explanation:** minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; minor concerns regarding adequacy; and no/very minor concerns regarding relevance	Bautista 2016; Bhat 2021; Brandt 2016; Burns 2013; Chiang 2016; Hampshire 2021; Hussain 2022; Karusala 2020; Ling 2020; Mariwah 2022; Nerminathan 2017; Rathbone 2020; Shenouda 2018; Spink 2020; Tran 2014
18	**Finding 3.7** Healthcare workers are concerned about the legal implications of offering advice to patients and colleagues through informal channels.	**No/very minor concerns** **Explanation:** 1 of the studies had used participant sampling strategies that may have limited the sample variation, but the other 2 studies had used appropriate sampling strategies.	**No/very minor concerns**	**Moderate concerns** **Explanation:** moderate concerns regarding adequacy because only 3 studies supported this finding and these studies had relatively thin data.	**No/very minor concerns** **Explanation:** the studies are from high- and low- and middle-income countries, different types of healthcare settings and different healthcare worker cadres. The studies were carried out in different time periods, including during the last 5 years.	**Moderate confidence** **Explanation:** no/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; moderate concerns regarding adequacy; and no/very minor con-	Bhat 2021; Chiang 2016; Rathbone 2020

						cerns regarding relevance	
19	**Finding 3.8** Healthcare workers describe how sharing and storing information through informal digital channels and groups can lead to a loss of information in formal records, which can cause problems when managing patient care.	**Minor concerns** **Explanation:** participant sampling was unclear or may have limited the sample variation. The studies had no evidence of reflexivity. However, it is difficult to assess how the study authors' perspectives might have influenced this finding.	**No/very minor concerns**	**Serious concerns** **Explanation:** this finding is only supported by 2 studies (several other studies imply that when data are stored on private phones this information is not replicated in formal systems. However, few studies stated this specifically).	**Minor concerns** **Explanation:** minor concerns regarding relevance because the finding is based on only 2 settings (1 LMIC and 1 HIC setting) and we are uncertain about the relevance of the finding for other settings.	**Low confidence** **Explanation:** minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; serious concerns regarding adequacy; and minor concerns regarding relevance	Ling 2020; Ologeanu-Taddei 2019
20	**Finding 3.9** Healthcare workers who use their mobile phones to search for health information online are concerned about the quality and legitimacy of unendorsed online information and ask for more training and guidance in how to search for and assess this information.	**No/very minor concerns** **Explanation:** 1 of the studies had used participant sampling strategies that may have limited the sample variation, but the other 4 studies had used appropriate sampling strategies. Several of the studies had no evidence of reflexivity. However, it is difficult to assess how the study authors' positions may have influenced this finding.	**No/very minor concerns**	**Minor concerns** **Explanation:** minor concerns regarding adequacy because the finding was based on 5 studies, with relatively thin data.	**Minor concerns** **Explanation:** minor concerns because 4 of the 5 studies are from LMICs. Healthcare workers in high-income settings may encounter this problem less where they have easier access to online, endorsed clinical guidance. The studies are from a range of settings and include a range of cadres. The studies supporting this finding were all older than 5 years. We have no reason to believe that the quality and legitimacy of unendorsed	**Moderate confidence** **Explanation:** no/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; minor concerns regarding adequacy; and minor concerns regarding relevance	Anstey 2018; Barnor-Ahiaku 2016; Chib 2013; Nerminathan 2017; Watkins 2018

(Continued)

					online information has improved. However, it is possible that healthcare workers' ability to search for and assess this information may have improved.		
21	**Finding 3.10** Healthcare workers' use of their personal mobile phones for work has cost implications, including the costs of the phone, data, airtime and electricity. Healthcare workers in low- and middle-income settings, particularly healthcare workers on lower salaries and volunteer lay health workers, describe these costs as a significant financial burden, and call for some form of compensation.	**No/very minor concerns** **Explanation:** 6 of the studies had used participant sampling strategies that may have limited the sample variation, but the other 7 studies had used appropriate sampling strategies. Several of the studies had no evidence of reflexivity. However, it is difficult to assess how the study authors' positions may have influenced this finding.	**No/very minor concerns**	**No/very minor concerns** **Explanation:** the finding is supported by 13 studies with sufficiently rich data.	**No/very minor concerns** **Explanation:** the studies were carried out in different time periods, including during the last 5 years.	**High confidence** **Explanation:** no/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance	Abane 2021; Anstey 2018; Barnor-Ahiaku 2016; Bautista 2016; Bautista 2020; Chib 2013; Hampshire 2017; Hampshire 2021; Ismail 2019; Mariwah 2022; Moyer 2014; Spink 2020; Venkataraghavan 2022
22	**Finding 3.11** Healthcare workers describe how the use of their mobile phones to access informal digital communication channels can help them extend their networks and cross geographical and professional boundaries. But they also explain how these channels	**Minor concerns** **Explanation:** minor concerns regarding methodological limitations because several of the studies had used participant sampling strategies that may have limited the sample variation.	**No/very minor concerns**	**Serious concerns** **Explanation:** serious concerns regarding adequacy. This finding was supported by 6 studies overall, but the data in these studies were relatively thin.	**No/very minor concerns** **Explanation:** no or very minor concerns. 6 of the 7 studies are from LMICs. However, we do not have any reason to believe that this finding would not apply to HICs also. The studies are from a range of settings and include a range of healthcare worker cadres. The studies were	**Low confidence** **Explanation:** minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; serious concerns regarding adequacy; and no/very minor concerns	Bautista 2017; Chib 2013; Ismail 2019; Karusala 2020; Pimmer 2018; Rathbone 2020

	can replicate existing social and professional structures and hierarchies, thereby limiting healthcare workers' access or participation.				carried out in different time periods, including in the last 5 years.	regarding relevance	
23	**Finding 3.12** Healthcare workers in low- and middle-income settings who use their personal mobile phones for work purposes describe many of the same practical and infrastructural challenges encountered in formal systems, including lack of electricity and internet.	**No/very minor concerns** **Explanation:** 4 of the studies had used participant sampling strategies that may have limited the sample variation, but the other 5 studies had used appropriate sampling strategies. Several of the studies had no evidence of reflexivity. However, it is difficult to assess how the study authors' positions may have influenced this finding.	**No/very minor concerns**	**No/very minor concerns** **Explanation:** the finding is supported by 9 studies with sufficiently rich data.	**No/very minor concerns** **Explanation:** the studies include different types of healthcare settings and different healthcare worker cadres, all from LMICs. The studies were carried out in different time periods, including during the last 5 years.	**High confidence** **Explanation:** no/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance	Anstey 2018; Barnor-Ahiaku 2016; Chib 2013; Hampshire 2017; Hampshire 2021; Mariwah 2022; Pimmer 2018; Spink 2020; Venkataraghavan 2022

THEME 4: HOW IS PERSONAL MOBILE PHONE USE CURRENTLY REGULATED?

24	**Finding 4.1** Healthcare workers do not always know if policies or guidelines regulating the use of personal mobile phones in the workplace exist. Where they are aware of them, healthcare workers explain that the aim is to protect patient confidentiality and data security and avoid healthcare worker distraction. However, some	**No/very minor concerns** **Explanation:** 5 of the 8 studies had used participant sampling strategies that may have limited the sample variation. However, we do not consider this to be a very important concern.	**No/very minor concerns**	**No/very minor concerns** **Explanation:** The finding is supported by 8 studies with sufficiently rich data.	**No/very minor concerns** **Explanation:** no or very minor concerns: 5 of the 8 studies were from high-income settings and most of the studies were set in hospitals, but we do not have any reason to believe that this finding would not apply to LMICs and primary healthcare settings also. The studies were carried out in different time periods, including during the last 5 years.	**High confidence** **Explanation:** no/very minor concerns regarding methodological limitations; no/very minor concerns regarding coherence; no/very minor concerns regarding adequacy; and no/very minor concerns regarding relevance	Bautista 2016; Bautista 2020; Brandt 2016; Karusala 2020; Mather 2018; Nerminathan 2017; Ologeanu-Taddei 2019; Spink 2020

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healthcare workers
and their managers
perceive these poli-
cies as unclear or as
unrealistic and diffi-
cult to enforce.

**Healthcare workers' informal uses of mobile phones and other mobile devices to support their work: a qualitative evidence synthesis
(Review)**

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Abbreviations

HIC: high-income country
LMIC: low- and middle-income country

HISTORY

Protocol first published: Issue 7, 2023

CONTRIBUTIONS OF AUTHORS

Conceptualisation: CG, EP, SA, UG, DK, SMB, JNAB, IN, JNAM, TN, AN, NMPW, AR, GR, NS, TT and SL participated in the conceptualisation of the review through discussions of the overarching research goals and aims, key definitions, and inclusion criteria.

Methodology: CG, EP, and SL developed the methodology with input from all other authors. MJ developed the search strategy.

Investigation: CG and EP screened potential studies for inclusion. CG, EP, SA, SL and RN extracted the data or checked the extracted study data. CG, EP, SA, SL and RN carried out the assessment of the methodological limitations of the included studies. CG carried out the TRANSFER process. CG, EP, SL, RN and SA coded the data and drafted the findings, and thereafter shared these with the remaining co-authors for review. CG, EP, SL and RN carried out the GRADE-CERQual assessments of the findings. CG developed the implications for research. CG developed the implications for practice, with support from TT, SA, JNAB, GR and NPW.

Writing (original draft): CG wrote the first draft and managed and co-ordinated the development of the protocol and review.

Writing (review and editing): CG, EP, SA, UG, MJ, DK, SMB, JNAB, IN, RN, JNAM, TN, AN, NMPW, AR, GR, NS, TT and SL critically reviewed and commented on all drafts of this review. CG, EP, SA, UG, MJ, DK, SMB, JNAB, IN, RN, JNAM, TN, AN, NMPW, AR, GR, NS, TT and SL approved the review. CG is the guarantor of the review.

DECLARATIONS OF INTEREST

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Arash Rashidian (AR) is a health professional by background, and now works as a director within the WHO, who have a stated policy to support countries by enhancing the use of digital health to support health systems and respond to people needs. He declares that he has published papers on digital health. AR is an EPOC Editor, but was not involved in the editorial process for this review. AR also declares that he holds a professorship position in health policy (however, he is on unpaid leave from this position while he works for the WHO).

Geoff Royston (GR) is a member of the Steering Group for HIFA (www.hifa.org), who have declared an opinion or position on the topic. GR reports that he is a co-author of two papers relevant to the review: (PAPER 1) Royston G, Pakenham-Walsh N, Zielinski C. Universal access to essential health information: accelerating progress towards universal health coverage and other SDG health targets. BMJ Global Health 2020;5:e002475. DOI:10.1136/ bmjgh-2020-002475; and (PAPER 2) Royston G, Hagar C, Long L-A, et al. Mobile health-care information for all: a global challenge. Lancet Glob Health 2015;3:e356–7.

Nelson Sewankambo (NS) declares that he has no conflicts of interest.

Tigest Tamrat (TT) declares that she has no conflicts of interest.

Simon Lewin (SL) declares a grant from the Research Council of Norway – he is Co-investigator on the mHEALTH-INNOVATE research project (prosjektbanken.forskningsradet.no/en/project/FORISS/325476), paid to institution but managed by SL (covered person-time related to this review, including writing the review). SL is the Fiduciary Officer and CoLead for Cochrane Person-Centred Care, Health Systems and Public Health Thematic Group; unpaid position. SL was employed as the Joint Co-ordinating Editor of Cochrane EPOC, paid to institution. He was not involved in the editorial process for this review. SL declares that he was on the Trial Steering Committee, which received no funding, for a trial that was linked to one of the included studies (Anstey 2018).

A number of non-financial issues, including personal, political, and academic factors, could have influenced the review authors' input when conducting this review. The review authors have discussed this further in the sections on reflexivity in the Methods section.

SOURCES OF SUPPORT

Internal sources

External sources

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

The title of the protocol for this review was "Healthcare workers' informal uses of mobile devices to support their work: a qualitative evidence synthesis". We added the term "mobile phones" to the title of the review because we received feedback that the term "mobile devices" by itself was not sufficiently informative.

We did not search the Epistemonikos database and the BASE database for individual studies, as searching the MEDLINE, Embase, Cinahl and Scopus databases identified a sufficient number of studies.

In the protocol, we stated that we would use priority screening and would stop screening titles and abstracts when a plateau of 200 titles and abstracts with no included records had been reached. There is currently no formal guidance regarding when to stop priority screening, and the decision is arbitrary. However, we decided to increase this number in the review, and only stopped screening when we had reached a plateau of 900 titles and abstracts.

In the protocol, we stated that we would consider selecting a sample of studies if we considered that the number of eligible studies could represent a problem for the analysis. If sampling had been carried out, we had planned to use a purposive sampling approach to achieve the broadest possible variation within the included studies (EPOC 2017). In that case, we would have identified three to five sampling criteria to help us capture data that would best answer our review objectives. These criteria would have been based on key areas of variation within the included studies and on discussions with stakeholders and could have included the type of health worker, the type of setting, or other contextual factors identified as important, and the richness of the data. However, we decided that the number of eligible studies was manageable and decided not to select a sample of studies, but instead to extract data from all included studies.

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We extracted the following types of information from the included studies that were not previously described in our protocol: the aim of the study; any conflicts of interest; and any suggestions and recommendations made by the study authors. This latter type of information was used to inform our 'Implications for practice' section.

In the protocol, we stated that we aimed to use a meta-ethnographic approach. However, most of the included studies were largely descriptive as opposed to highly theorised or conceptual. We therefore decided to analyse and synthesise the data from the studies using a thematic synthesis approach, including the development of a line of argument. We have rewritten the data analysis section to reflect this approach.

INDEX TERMS

Medical Subject Headings (MeSH)

Attitude of Health Personnel; Bias; *Cell Phone; *Health Personnel; Qualitative Research; Text Messaging; Workplace

MeSH check words

Humans

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