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Bringing health care to the patient: An overview of the use of telemedicine in OECD countries

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BRINGING HEALTH CARE TO THE PATIENT: AN OVERVIEW OF THE USE OF TELEMEDICINE IN OECD COUNTRIES

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Abstract

Telemedicine is being used across OECD countries to deliver health care in a wide range of specialties, for numerous conditions and through varied means. A growing body of evidence suggests that care delivered via telemedicine can be both safe and effective, in some cases with better outcomes than conventional face-to-face care. Telemedicine services can also be cost-effective in different settings and contexts. However, despite these benefits, these services still represent a small fraction of all health care activity and spending. Important barriers to wider use remain, with providers and patients facing regulatory uncertainty, patchy financing and reimbursement, and vague governance. Due to inequalities in health and digital literacy, patients that most stand to benefit are also often those that are least able to access and make use of telemedicine. Telemedicine has the potential to improve effectiveness, efficiency and equity in health care, but can also introduce new risks and amplify existing inequalities. Policy makers seeking to maximise the potential benefits and limit the possible risks of telemedicine services can: 1) ensure that only telemedicine services that improve health care quality and provide clear benefits to patients are pursued, and that patient experiences are measured, 2) facilitate the spread of local and emergent best practices, through a supportive policy environment and knowledge transfer and dissemination, and 3) promote a transition to learning health care systems and a culture of continuous learning and improvement.

Résumé

La télémédecine est utilisée dans l'ensemble des pays de l'OCDE pour dispenser des soins de santé dans un large éventail de spécialités, pour de nombreuses maladies, et de différentes manières. De plus en plus de preuves démontrent que les soins dispensés via la télémédecine peuvent être à la fois sûrs et efficaces, avec dans certains cas de meilleurs résultats que les soins classiques reçus sur place en personne. Les services de télémédecine peuvent également être rentables dans différents contextes et situations, mais ils ne représentent toujours qu'une petite fraction de toutes les activités et dépenses de soins de santé. Il subsiste d'importants obstacles à une utilisation plus large, les fournisseurs et les patients étant confrontés à une incertitude réglementaire, à un financement et à des remboursements incertains et à une gouvernance vague. En raison des inégalités en matière de santé et de connaissance numérique, les patients qui en bénéficieraient le plus seraient également ceux qui sont le moins en mesure d'accéder à la télémédecine et de l'utiliser. La télémédecine a le potentiel d'améliorer l'efficacité, l'efficience et l'équité des soins de santé, mais peut aussi introduire de nouveaux risques et amplifier les inégalités existantes. Les décideurs politiques qui cherchent à maximiser les avantages potentiels et à limiter les risques éventuels des services de télémédecine peuvent: 1) s'assurer que seuls les services de télémédecine qui améliorent la qualité des soins et qui procurent des avantages évidents aux patients sont pris en compte, et que l'expérience des patients est mesurée, 2) faciliter la diffusion des meilleures pratiques locales et émergentes, grâce à un environnement politique favorable, au transfert et à la diffusion des connaissances, et 3) promouvoir une transition vers des systèmes de soins axés sur l'apprentissage et développer une culture d'apprentissage et d'amélioration continus.

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1 What is driving telemedicine use and how are countries responding?

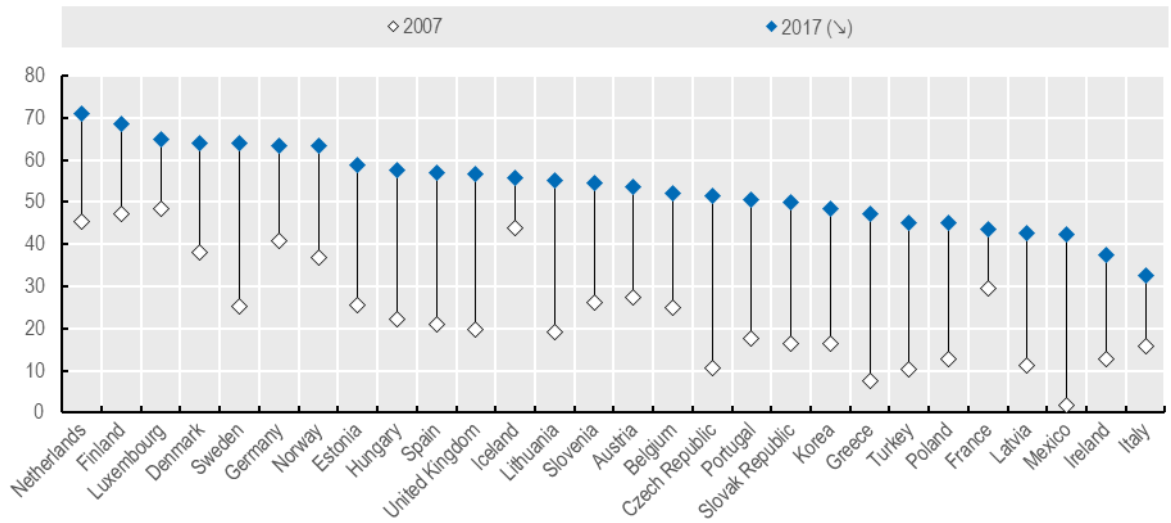
1.1. There is growing interest in digital health technologies like telemedicine

1.1.1. Societies are going digital and patients expect more from health care systems

1. Economies, governments and societies across the globe are going digital, as more people, things and activities go online (OECD, 2019[5]). Digital technologies and large-scale data flows are changing how people live, work and engage with others. In 2018, 64% of all internet users in OECD countries made a purchase online (up from 48% in 2010) and 56% used the internet to interact with public authorities, up from 45% in 2010 (OECD, 2019[6]). The proportion of digital natives among the entire population is increasing, with 17% of students in the OECD area having first accessed the Internet at the age of 6 or under (OECD, 2019[2]). By 2022, there will be three connected devices per person around the globe (OECD, 2019[5]). Also in health care, people are going digital. Between 2007 and 2017, the percentage of individuals across OECD countries seeking health information on the internet has doubled (see Figure 1.1).

Figure 1.1. The number of people using the internet to seek health information is growing

Percentage of individuals using the internet to seek health information in the last 3 months



Source: OECD database on information and communication technology (ICT) Access and Usage by Households and Individuals. ICTs include information technology equipment (computers and related hardware), communications equipment and software.

2. Patients are increasingly interested in digital health technologies and are broadly in favour of their health data being used to create new knowledge for better treatments and their management within health systems, so long as privacy is safeguarded (OECD, 2019[7]). Growing numbers of individuals in OECD countries are now comfortable using digital technologies in other industries and expect the same level of responsiveness and ease of use in health care. While the actual numbers will differ from country to country, it has been estimated that a typical visit to a doctor takes 121 minutes, 37 of which are spent travelling and 84 at the clinic, with just 20 minutes of face-to-face physician time (Ray et al., 2015[8]). The opportunity costs, for society and the economy, of all this idle time are substantial. Furthermore, many people do not even make it to the doctor's office due to barriers to access. Across 23 OECD countries for which data is available, between 11% and 65% of people reported unmet medical needs in 2015/16 due to barriers in access to care, among them waiting times, and distance and transportation (OECD, 2019[5]). Digital technologies promise greater access and responsiveness.

3. While wider uptake of digital technologies, including in health care, is hindered by digital divides along gender, age, geography, income and educational attainment (OECD, 2019[1]), there is evidence to suggest that these divides reflect barriers to access rather than preferences among different groups. For example, in a nationally representative sample of patients in the **United States**, the number of users of videoconsultations was almost 35 times higher among 25-44 year olds than among those aged 65 plus, yet the younger group was only 1.5 times more willing to use videoconsultations than the older cohort was (Park et al., 2018[9]). The poorest respondents were almost six times less likely to actually use videoconsultations but only 1.6 times less willing to do so. The same pattern was observed among rural patients compared to the overall population. In a study commissioned by the **Canadian** Medical Association on public opinion of digital health technologies, 7 in 10 surveyed said they would take advantage of virtual visits and 4 in 10 said they would do so for more than half of their physician visits (Ipsos and CMA, 2018[10]). Most respondents expected virtual visits to lead to more timely care, more convenience and better quality. Over half of those surveyed stated they would likely use a continuous monitoring device, especially if recommended by their physician. Three out of four would like to see more technology in the health system. A recent update to this survey found similar results, and importantly that the generation gap (i.e. differences in the interest of baby boomers compared to younger generations) was decreasing (Ipsos and CMA, 2019[8]).

1.1.2. Health care systems are turning to digital health to tackle important challenges

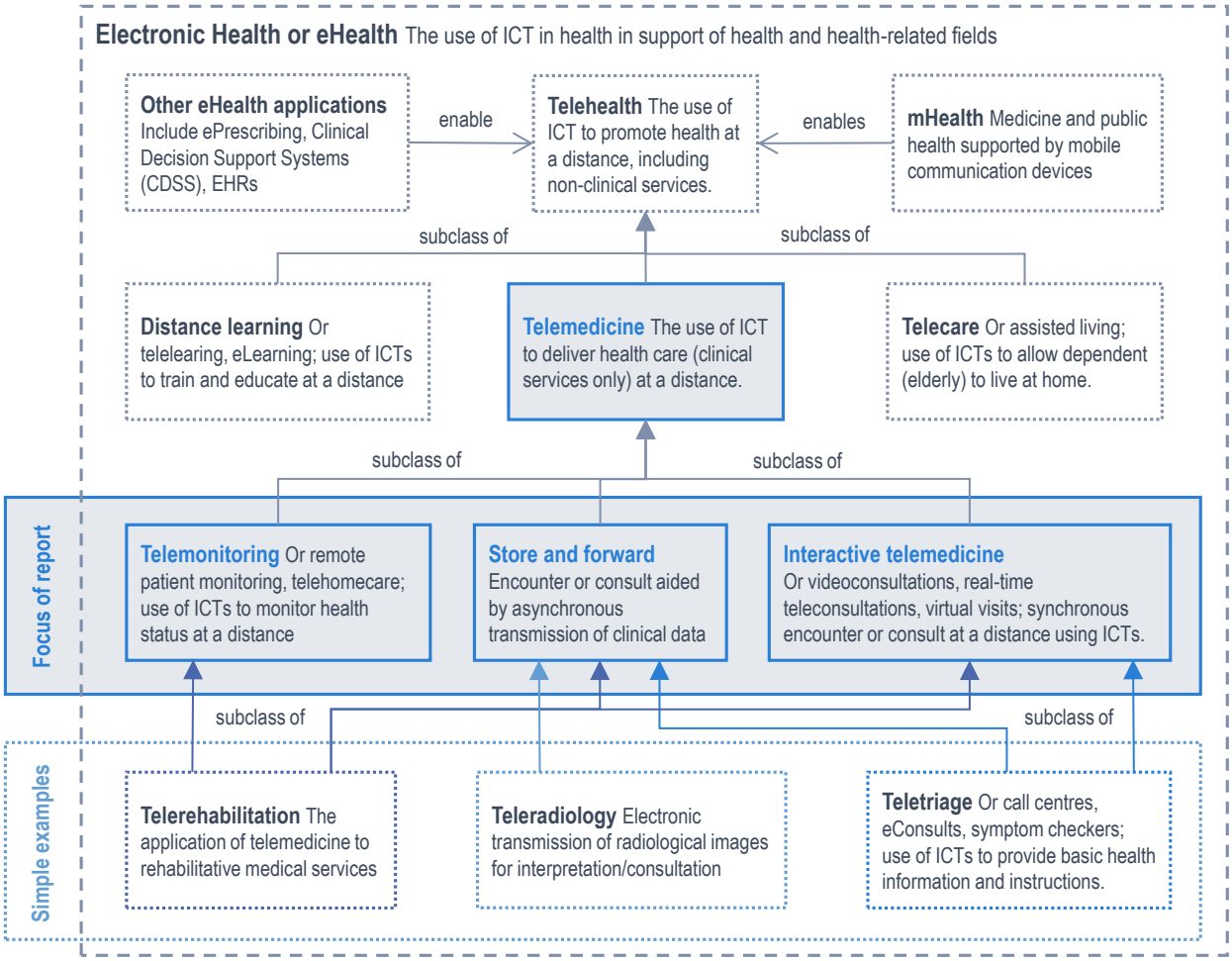
4. As demands for more responsive health care services are increasing, so are needs. Populations are ageing globally and the prevalence of multimorbidity – the presence of several chronic illnesses in the same person – is rising. Significant increases in life expectancy have not been met with comparable progress in healthy life expectancy and, as such, more people are living for longer with disability. Today, a person who is 65 years old can expect to live another 20 years, but less than half will be spent in good health and free of disability (OECD, 2017[7]). Nearly 65% of people aged 65 to 84 years are estimated to have more than one chronic condition, a prevalence that reaches 89% for those aged 85 and over (OECD, 2017[11]). More than one in ten people over the age of 65 are currently receiving long-term care and over half of all users are over the age of 80, a population group that is expected to double from 5% today to 10% in 2050 (OECD, 2017[12]).

5. As health care systems are struggling to address these continued complex needs, across many OECD countries, there are also growing gaps between health care workers needed and those available (The King's Fund, The Health Foundation and Nuffield Trust, 2018[15]), a situation that is likely to be exacerbated in the future as older workers retire. Moreover, health expenditure is growing at its fastest rate in seven years and further growth is expected (OECD, 2018[16]). On average across the OECD, health spending is estimated to reach 10% of gross domestic product by 2030, up from 8.8% in 2015 (OECD, 2018[18]). At the same time, much effort and money are spent on wasteful care: care that does not have benefits for patients and that could be replaced by cheaper or better alternatives. Across the OECD, more

than 10% of hospital expenditure goes to correcting preventable medical mistakes or treating infections that people catch in hospitals (OECD, 2017[19]). Uncoordinated and fragmented care eventually leads to poor patient outcomes and a potential lack of trust in the ability of health care systems to provide the care patients need and prefer. Health care systems must be proactive in facing these challenges, or risk significant turmoil.

6. In response, health care providers and policy makers are increasingly exploring new digitally enabled models of care to meet growing demands and needs at sustainable cost, turning in particular to electronic or digital health, or eHealth: the use of information and communications technologies (ICTs) in support of health and health-related fields, from care services to surveillance and education (WHO, 2019[14]). Among eHealth interventions (see Figure 1.2), there is growing interest in telemedicine – the use of ICTs to deliver clinical services at a distance (see Box 1.1) – as a way to deliver quality health services: care that is effective, safe, timely, aligned with the preferences and needs of patients and communities, equitable and efficient (OECD/WHO/World Bank Group, 2018[18]). Figure 1.2 shows a varied and rich ecosystem of digital health technologies. The various terms tend to focus on a specific element: the technology or medium used (e.g. mobile health or mHealth), the specialty (e.g. teleradiology), the disease or condition (e.g. telestroke and telediabetes), the type of care (e.g. telerehabilitation and telecare), and the activity or task (e.g. clinical decision support systems and ePrescribing). Enabling factors and technologies (e.g. electronic health records) are also shown.

Figure 1.2. Telemedicine and the broader eHealth ecosystem



Source: OECD compilation building on glossaries from the American and German telemedicine associations, and from ISO/TS 13131:2014.

Box 1.1. Definition of telemedicine used in this report

There is no single widely used definition of telemedicine. One study found 104 peer-reviewed definitions (Sood et al., 2007[1]), a diversity that hinders comparisons across different studies. For the purposes of this report, telemedicine is the use of ICTs to deliver health care at a distance. Key elements of this definition are the use of *ICTs*, the delivery of *clinical services*, and the delivery at a *distance*.

Three categories are considered, which can be combined as appropriate (Flodgren et al., 2015[2]): telemonitoring, store and forward, and interactive telemedicine. Telemonitoring is the use of mobile devices and platforms to conduct routine medical tests, communicate the results to health care workers in real-time, and potentially launch pre-programmed automated responses. Store and forward is similar but is used for clinical data that are less time-sensitive and for which a delay between transmission and response is acceptable (e.g. store and forward is widely used in dermatology). Finally, interactive or real-time telemedicine involves direct and synchronous communication between providers and patients (e.g. direct-to-patient or in health care facilities).

Interventions that facilitate medical education of health care workers (e.g. physicians, nurses, etc.) at a distance via ICTs (e.g. tele-education or e-learning) are not included in the definition of telemedicine used in this report. Mobile applications that do not involve any transfer of data or any patient-to-provider communication, such as self-care and wellness mobile applications, are also not included. Any intervention that does not involve clinical services, such as public health awareness campaigns, is not included. All applications matching the definition of telemedicine in this report are included, whether they involve public or private providers, and regardless of the specific technology used (e-mail, video, fixed or mobile phone).

Note: see also OECD (2015[19]) for more on measuring ICTs in the health sector.

1.2. Countries differ widely in how telemedicine is regulated, financed and used

7. A majority of OECD countries allow at least some form of telemedicine, although policies vary widely in terms of the types of telemedicine allowed, the funding and payment schemes used, requirements in terms of distance between participants, eligibility of health workers and patients to participate, patient consent, and integration with traditional face-to-face health care services. How telemedicine services are regulated, financed and provided ultimately affect the level of use and development of telemedicine.

1.2.1. From stringent rules and regulations to "telemedicine is medicine"

8. Telemedicine is used in a large majority of OECD countries, although not all countries have national legislation, a strategy or policy specifically related to the use of telemedicine (see Table 1.1). In some countries, there is no national legislation, strategy or policy on the use of telemedicine as this is considered a regional purview, as is the case in **Spain** where autonomous communities are responsible for telemedicine services. **Australia**, **Canada**, **Germany** and the **United States** also devolve some regulatory authority to regions (provinces and states) but nonetheless have national regulations and strategies as well. Other countries, such as **Austria**, **Slovenia** and **Sweden**, do not have any national legislation, strategies or policies specifically on telemedicine but do allow telemedicine services under broader health care laws. Similarly, the **Netherlands**, **Finland**, **Iceland** and **Norway** have national strategies and policies on the use of telemedicine, but legally consider telemedicine simply another way of

delivering health care (a "telemedicine is medicine" approach), thus regulated by general health care legislation.

Table 1.1. The policy, regulatory and financial environment surrounding the use of telemedicine

Country	Has national legislation, strategy or policy on the use of telemedicine?	What is the main source of funding for eHealth?	Defines jurisdiction, liability or reimbursement of eHealth services (e.g. telehealth)?
Argentina	Yes	Public	No
Australia	Yes	Public	Yes
Austria	No[1]	Public	No
Belgium	Yes	Public	No
Canada	Yes	Public	Yes
Chile	No	Public	Yes
Costa Rica	Yes	Public	Yes
Czech Republic	No	Public & private	No
Denmark	Yes	Public	Yes
Estonia	No	Public	No
Finland	Yes[1]	Public	Yes
France	Yes	-	-
Germany	Yes	-	-
Greece	Yes	Public	Yes
Hungary	Yes[2]	Public	No
Iceland	Yes[1]	Public	Yes
Ireland	Yes	Public	Yes
Israel	Yes	Public	Yes
Italy	Yes	Public	Yes
Japan	Yes[2]	-	Yes
Latvia	Yes[1]	Donor/non-public	Yes
Lithuania	Yes[2]	Public	-
Luxembourg	Yes[1]	Public	Yes
Mexico	Yes[1]	Public	No
Netherlands	Yes[1]	Public	Yes
New Zealand	Yes	Public & private	Yes
Norway	Yes[1]	Public	Yes
Poland	Yes	Public	Yes
Portugal	Yes	Public	Yes
Slovak Republic	Yes[2]	-	-
Slovenia	No[1]	Public	Yes
Spain	No[1]	Public	No
Sweden	No[1]	Public	Yes
Switzerland	No	Public & private	Yes
Turkey	No	Public	Yes
United Kingdom	Yes	Public	No
United States	Yes[1]	-	Yes

Note: [1]no specific legislation on telemedicine but use is allowed; [2]use of telemedicine is allowed but with restrictions; private funding includes private or commercial funding and public-private partnerships; countries are sorted alphabetically from top to bottom.
Source: OECD Snapshot Survey on Telemedicine (2018), OECD interviews with country experts, WHO Third Global Survey on eHealth (2015).

9. While the use of telemedicine is generally allowed in most countries, there can be important legal restrictions to its use. **Hungary** sets limits on the types of services that can be delivered remotely, so that physicians making a final diagnosis or a significant therapeutic change are required to do so in the

presence of the patient. Similarly, ePrescribing is allowed in Hungary, yet the prescription must be written when the patient and physician are physically in the same location. In **Japan**, provider-to-patient telemedicine services are allowed since 2018 but only after an initial face-to-face meeting between the physician and the patient, and it is the sole responsibility of the physician to determine whether remote health care is appropriate and safe. **Lithuania** allows the use of telemedicine but only for provider-to-provider interactions. However, the Lithuanian eHealth Development Framework Programme, adopted in 2018, includes plans to develop provider-to-patient services starting in 2020. While the **Slovak Republic** does not have any legislation specifically on the use of telemedicine, the country does have a national strategy and telemedicine is allowed. However, the medical responsibility lies completely with the physician that is physically with the patient, and so only provider-to-provider communications are currently in use. The states of Georgia and Texas, in the **United States**, require that patients have a face-to-face follow-up appointment after a telemedicine encounter (Thomas and Capistrant, 2017[21]). In **Japan**, **Greece**, and 38 jurisdictions of the **United States** (CCHP, 2018[22]), patients must give their consent – either in writing or verbally – before a telemedicine encounter can take place. Medical licensure can also impose constraints in certain countries, as discussed in more detail below.

Funding and coverage impose conditions on the use of telemedicine

10. A number of countries that do not impose any legal restrictions on the use of telemedicine establish conditions for provider payment or patient reimbursement that may restrict the use of telemedicine. In the **United States**, Medicaid provides coverage for some form of real-time videoconsultations in 49 states and the District of Columbia, however only 20 states cover telemonitoring services and only 11 states cover store and forward services (CCHP, 2018[22]). Medicare focuses mostly on rural health care provision and reimburses only certain services delivered via live video, with store and forward only allowed in demonstration programs in Alaska and Hawaii. Recently, Medicare has decided to reimburse other telemedicine services like virtual check-ins and remote evaluation of pre-recorded patient information. Furthermore, 31 states have telemedicine parity laws for private insurance, guaranteeing that telemedicine services are reimbursed as face-to-face care, and 26 states have some type of telemedicine coverage for state employee plans (Thomas and Capistrant, 2017[21]). There are also large differences in coverage across states in terms of where the provider is physically located (e.g. in a health professional shortage area, in a metropolitan area, in a school, etc.), where the patient is physically located (e.g. at a health care facility or at home), which health care worker provides the service (e.g. physician, nurse, etc.), and the medical specialty in which care is being provided (CCHP, 2018[22]; Thomas and Capistrant, 2017[21]; Flannery and Jarrin, 2018[23]).

11. In **Australia**, public hospital services are partly funded by states, partly by the federal government and partly by non-government sources, while the federal government Medicare programme funds primary care and subsidises outpatient specialist care through the Medicare Benefits Scheme (MBS). Only real-time telemedicine services are currently funded via MBS through fee-for-service payments, although states can supplement MBS funding. Other telemedicine services (for example, a store and forward teledermatology project called Tele-Derm) are financed through specific state and national block funds. While telemonitoring and store and forward services are not currently funded through the MBS, the health departments of all Australian states and territories fund telemedicine in some form, including store and forward telehealth, and remote monitoring in the home. More recently, Australia is introducing and trialling at the national level new enrolment based service delivery and payment models that formalise the patient-doctor relationship, moving away from fee-for-service model and instead encouraging general practices to be innovative and flexible in how services are delivered to their enrolled patients, including through broadening the use of technology and telemedicine. In **Norway**, municipalities fund primary care and public health services while hospitals are funded through government budgets. Telemonitoring services are available in certain municipalities (e.g. in Oslo) at no cost to the patients and funded through municipal budgets.

12. In **Slovenia**, negotiations take place every year to determine which services the compulsory health insurance covers through fee-for-service payments. Currently, only telestroke is covered. In **France**, as of September 2018, patients seeking reimbursement of real-time videoconsultations from their health insurers must have consulted the physician face-to-face in the previous 12 months (with exceptions for urgent care or when the patient's usual physician is not available). In **Poland**, the National Health Fund reimburses a limited number of telemedicine services (e.g. cardiac rehabilitation) but is considering extending funds to more services in the near future. In the **Czech Republic**, health insurance only reimburses services when there is a face-to-face interaction between physicians and patients, thus telemedicine services must be paid fully out-of-pocket or through specific block grants typically associated with small-scale projects. Also in **Ireland**, there are some publicly funded pilot projects, but the majority of telemedicine services (real-time videoconsultations) is privately provided and financed. In **Argentina**, telemedicine consultations (synchronous and asynchronous) at the Hospital Italiano of Buenos Aires are funded through a fee-for-service scheme in haematology, but through capitation in cardiology. In the south of **Iceland**, there is no difference in the payment and reimbursement of a face-to-face consultation or a teleconsultation. In **Portugal**, various payment schemes are in use with special financial incentives to promote the wider use of telemedicine services (including premiums on provider payments and lower co-payments for patients).

Jurisdiction is particularly important in the context of telemedicine

13. All OECD countries regulate entry in medical and other health professions through some form of licensing and registration, with this responsibility often delegated to medical councils or other professional organisations (OECD, 2016[24]). While licensing and registration may promote quality and safety, they may also restrict the provision of remote health care services. Health care workers participating in telemedicine services may be based in a different jurisdiction than that of the patient. This is the case when workers provide remote clinical services across states in the United States or across countries in Europe. While Directive 2005/36/EC issued by the **European Union** allows medical workers to enjoy automatic recognition of professional qualifications, this only applies if health workers move to the country where they are practising, thus potentially limiting telemedicine (Raposo, 2016[25]). The question is then which jurisdiction – the patient's, the provider's or both – sets the legal and deontological requirements.

14. In the **United States** and most of **Canada**, the relevant jurisdiction is the patient's jurisdiction. Health workers wanting to provide telemedicine services must comply with the regulations of the patient's jurisdiction, including potentially being licensed in the state in which the patient is physically located. Conversely, in the **European Union** the health professional must comply with the requirements of their own jurisdiction, not the patient's (Europe Economics, 2019[26]). In **New Zealand**, the Medical Council considers that health workers who provide telemedicine services to New Zealanders should be registered with the Medical Council although it has no authority to enforce this (Europe Economics, 2019[26]). Within the **United States**, some states have joined the Federation of State Medical Board's Interstate Medical Licensure Compact, which promotes greater flexibility in medical practice across states (Thomas and Capistrant, 2017[21]).

15. Establishing the relevant jurisdiction is also important in the context of other rules and regulations, such as treatment of health data and liability. In the **European Union**, health data is regulated under the General Data Protection Regulation (GDPR), which sets out clear requirements for the sharing of data between members of the European Economic Area (EEA) and non-EEA countries and international organisations. As for liability, there is an important void. There are no European norms dealing with the regime of medical liability (Raposo, 2016[25]). This is also unclear in the United States. Differences in malpractice systems across countries – or even jurisdictions within the same country – can lead to complex situations. The **United States** has a tort litigation system that determines compensation based on negligence, while **Sweden**, **Finland** and **New Zealand** have a "no-fault system" in which compensation is based on proof of cause and effect between treatment and injury, without establishing provider fault or negligence (World Bank, 2003[27]). The question of which jurisdiction takes precedence when providers

and patients are based in different countries or states is important, especially when rules and regulations may be in conflict. This applies not only to the liability of medical workers but also of telemedicine equipment providers.

Stakeholders often produce additional guidance to complement rules and regulations

16. Telemedicine services are so diverse and potentially disruptive that it is not necessarily clear which stakeholder (e.g. medical councils) should regulate or control their use (Raposo, 2016[25]). There are nonetheless ways for the many stakeholders involved and affected by telemedicine to contribute to filling gaps, balancing access to these innovative services with safety and quality. A number of countries have published guidelines on specific aspects of telemedicine use or specific services. **Australia** has published guidelines on telemedicine, including the Medical Board of Australia Guidelines for Technology-Based Patient Consultations, the Australian College of Rural & Remote Medicine Telehealth Guidelines, and Telehealth Guidelines under the MBS. Medical colleges in most **Canadian** provinces have published telemedicine bylaws or policies. **Austria** has drafted a framework directive on the technological architecture needed to support the use of telemonitoring. **Israel** published its first circular on "Standards for Operating Telemedicine Services" in 2012, and has since then updated and refined its guidance on relevant procedures. For example, in 2015, the Ministry of Health issued a circular on the subject of telemedicine services in the field of dermatology and, in 2017, a circular on remote medical advice for patients with acute morbidity.

17. In **Mexico**, the *Centro Nacional de Excelencia Tecnológica en Salud* (CENETEC) has developed a Telehealth Service Catalogue, which aims to serve as a reference tool to unify criteria that allow decision makers in the field of telehealth to communicate in the same terms. The CENETEC also compiles and documents legal instruments related to telehealth, for dissemination to health workers. **Norway** established a national centre for telemedicine in 1994, today called the Norwegian Centre for E-health Research, whose role is to collect, produce and communicate knowledge required by the authorities to develop a knowledge-based policy on eHealth. In **Portugal**, the *Centro Nacional de Telessaúde* provides several resources to help health workers in the implementation and management of telehealth services, including a “tool kit” with tips for the implementation of teleconsultations and Telehealth Service Factsheets to disseminate good practices of existing telehealth services in the country. In the **United Kingdom**, the “Empower the Person” roadmap for digital health and care services includes information on several telemedicine services, from online consultations to remote monitoring, and provides links to documentation on technical standards and adoption guides.

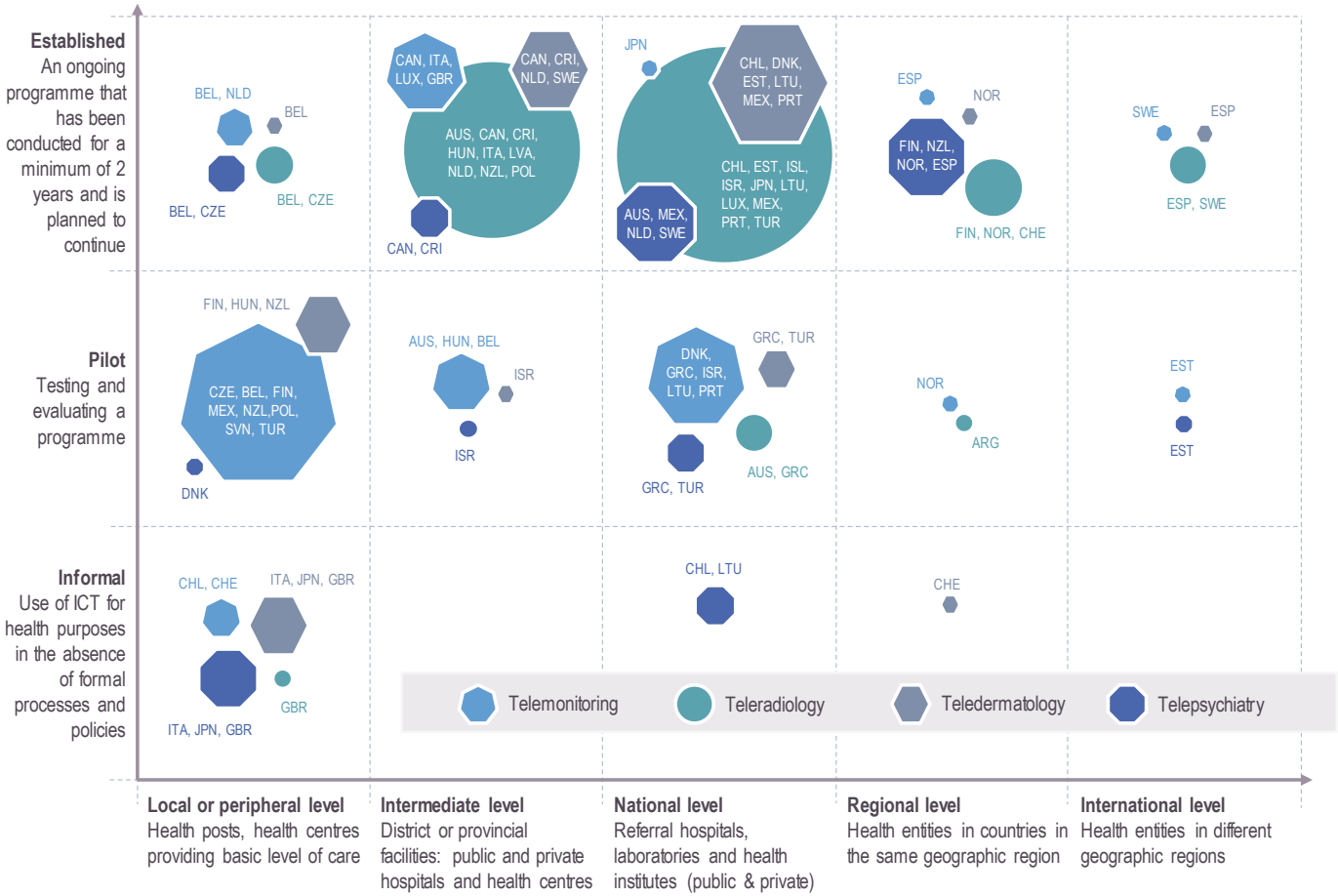
1.2.2. Despite growing interest the use of telemedicine remains very limited

18. Only a very few countries collect and report data on the number and volume of telemedicine services provided nationally. Those countries show a steady increase in the number of health care institutions and patients using telemedicine, as well as the volume of services provided. In **Canada**, between 2012 and 2014, the number of institutions using telemedicine grew by 42% (from 7 297 to 10 351), the number of patients being telemonitored increased by 54% (from 2 465 to 3 802) and the number of interactive real-time clinical sessions grew by 46% (from 282 529 to 411 778). There were 107 978 teleconsultations in **Mexico** in 2017, a 152% increase from the 42 874 teleconsultations provided in 2016. In **Greece**, the volume of telemedicine sessions increased more than threefold from 370 in 2017 to 1 205 in 2018. The volume of telemedicine services funded by the **Australian** MBS has been steadily growing from 101 741 in 2013 to 188 369 in 2017. As of June 2016, 13 815 providers have provided telemedicine services. In **Portugal**, the number of real-time and store and forward teleconsultations has increased from 12 127 in 2013 to 28 448 in 2017. The telephone and online service SNS 24 conducted one million teletriages in 2018. In the **United States**, a nationally representative survey of consumers found that the use of live video communication between patients and health care providers rose from 6.6% in June 2013 to 21.6% in December 2016 (Park et al., 2018[6]). In the state of Minnesota, the number of telemedicine

visits increased from 11 113 in 2010 to 86 238 visits in 2015 (Yu et al., 2018[28]). Among privately insured and Medicare Advantage enrolees, between 2005 and 2017, there were 383 565 telemedicine visits by 217 851 patients (Barnett et al., 2018[29]).

19. While these are significant numbers and growth rates, telemedicine services still represent a very small proportion of the overall volume of services provided by health care systems in OECD countries, even in countries where telemedicine is most used. Depending on the year, in Canada, Australia and Portugal, there are between seven and 25 teleconsultations per 1 000 people, compared to between four and eight traditional face-to-face doctor consultations for every person. Teleconsultations represent between 0.1% and 0.2% of face-to-face consultations in these countries, a figure that is in line with estimates from experts in Argentina, as well as Medicaid payments in the United States based on 45 million enrolees (Douglas et al., 2017[30]). In 2016, Medicare paid out USD 28.7 million for telehealth services out of a total budget of USD 588 billion (Flannery and Jarrin, 2018[23]). These figures show that, despite growing interest, telemedicine is still a nascent, and very mixed, field, with the level of reach and sophistication of telemedicine services depending on the medical specialty (see Figure 1.3). Teleradiology is established in most OECD countries, at least at district and provincial level, and more often at national level. The use of teledermatology and telepsychiatry is patchier, and telemonitoring is the least developed. With the exception of teleradiology, most telemedicine programmes are small-scale pilot projects, focussing on a specific specialty, health problem and target patient group.

Figure 1.3. Countries reporting use of telehealth, by level of health system and type of programme



Note: For countries that report more than one level and type of programme per specialty, the most advanced level and type are shown. Size of bubbles is proportional to the number of countries.
Sources: OECD Snapshot Survey on Telemedicine (2018), OECD interviews with country experts, WHO Third Global Survey on eHealth (2015).

Many countries have telemonitoring services, but these are typically small-scale pilots

20. The use of telemonitoring has increased in recent years in OECD countries, but few programmes are established at national or higher levels (only in Sweden, Spain and Japan as seen in Figure 1.3), with the majority of services being provided through small-scale pilot projects involving at most a few thousand patients. In Austria, the VAEB (social insurance institutions for railways and mining) provides telemonitoring as part of its "Health Dialogue Diabetes Mellitus", a comprehensive programme involving medical check-ups, advice on nutrition and exercise, and training in the electronic diabetic diary "DiabMemory". Clinical readings are electronically monitored by the doctor with feedback of the measured values by SMS or telephone. The programme had 700 participants in 2016 (Weik and Sauermann, 2016[31]). Also in Austria, the HerzMobil Tirol programme for heart failure has followed close to 200 patients since its inception (Ammenwerth et al., 2018[32]). In Belgium, the eRoadmap is funding a number of mobile telemonitoring applications, a number of which are being considered for reimbursement. The eRoadmap is establishing some building blocks including work on validation of mobile apps, regulatory frameworks and standards for interoperability. The Czech Republic has programmes on chronic heart failure and diabetes. The University Hospital Olomouc has a pilot study on telemonitoring for chronic heart failure involving a dozen patients, while the OZP (an occupational health insurance provider) has a telemonitoring service for gestational diabetes that has involved fewer than 20 women since May 2017.

21. **Denmark** is one of the most active countries in telemonitoring, with a range of services and solutions delivered through different programmes, for example TeleCare North, the Virtual Hospital and home-based wound treatment. TeleCare North is a telemonitoring programme involving the North Denmark regional authority, its hospitals, general practitioners (GPs) and 11 municipalities. Since 2013, 1 400 patients have been monitored in the context of chronic obstructive pulmonary disease (COPD) and a randomised controlled trial (RCT) ran until recently for patients being monitored for heart failure (Cichosz, Udsen and Hejlesen, 2019[30]). Based on early promising findings from TeleCare North, Denmark is mainstreaming home monitoring to all relevant COPD patients. As for the Virtual Hospital, Aarhus University Hospital uses this concept to monitor women with pregnancy complications in their own homes, a project that is to be scaled nationally in 2020. Since 2015, the Odense University Hospital has allowed more than 200 families with preterm babies to be followed at home using a tablet, a customised scale for weighing the infant and a measuring tape to monitor the growth of the baby's head, plus families can also request videoconsultations. Holstebro, in Central Denmark, is also using telemonitoring to detect hypertension, reducing the risk of "white coat" effect (a false positive from anxiety related to measurement in a clinic). In 2019, 32 000 patients benefited from home-based wound treatment, delivered by specialised nurses in the patient's home and coordinated by a hospital wound healing centre.

22. **Hungary** is starting a pilot project on various telemedicine services, including telemonitoring, in 2019, seeking to enrol 15 000 patients and 300 physicians. In **Ireland**, the Epilepsy Lighthouse Project is developing a new model of care working with 100 children and adults with intellectual disabilities who also have epilepsy. The project includes a Patient Mobile Application developed in order for patients to record seizure information, medicinal compliance and quality of life, with physicians able to review the data. In **Lithuania**, a regional project is combining telemonitoring and interactive telemedicine to provide palliative care at home. As only face-to-face provider-to-patient communications are currently allowed, nurses travel to the patient's home where they can take blood tests, and measure blood pressure and saturation levels, among other things. All data is digitally recorded and transferred to physicians, who can then provide feedback.

23. In **Norway**, a pilot study of a two-year telerehabilitation intervention for 10 patients with COPD consisted of three components: exercise training at home, telemonitoring and self-management. Participants trained on a treadmill at home, registered symptoms and oxygen saturation in a website available on a tablet, and received weekly follow-up by a physiotherapist via videoconferencing. Norway also has a national programme for telecare and telehealth running from 2013 to 2020, involving more than

80% of municipalities. The country is piloting a number of telemonitoring programmes (results are due at the end of 2021). In **Portugal**, public hospitals have the possibility to contract telemonitoring services. There are three programmes available, for COPD, chronic heart failure, and for acute myocardial infarction. Each programme involves the installation, in the patient's home, of simple devices (usually portable and Bluetooth connected devices) for measuring vital signs. These monitoring devices automatically transmit the data collected to specialised services. A pilot project on COPD in Minho, in the north of Portugal, enrolled 80 patients between 2014 and 2018. In **Poland**, telemedicine has been used to screen women for breast cancer (drastically increasing the number of women screened) and for telerehabilitation following acute myocardial infarction (improving patients' quality of life but also increasing efficiency in the use of hospital beds). The **United Kingdom** has run one of the most complex pilot projects in the field of telemonitoring. Launched in 2008, the Whole Systems Demonstrator programme involved 3 031 patients with COPD, heart failure or diabetes, and 238 primary care practices.

Remote consultations are used for a wide array of specialties

24. Many OECD countries have some form of real-time or asynchronous telemedicine services - in either the public or private sectors - and usually spanning a wide range of medical specialties and diseases. In **Australia**, Healthdirect Video Call provides two models of care: scheduled services where health care organisations provide online clinics attended by patients at pre-arranged times, and on-demand services for helpline contact centres where users initiate contact on an ad-hoc basis. Support is given in the areas of mental health, drug and alcohol, child and maternal health, pain management, cancer services and paediatric care. In **Argentina**, the *Programa Nacional de Telesalud Pediátrica* allows the provision of paediatric and adolescent care anywhere in the country where the platform is available. In **Denmark**, real-time videoconsultations between clinicians and patients has been widely used, particularly in the field of mental health have been in use since 2013. Videoconsultations are used for both scheduled and urgent outpatient visits, medication management, and psychotherapy among other things. Patients can use whatever device they wish. In 2017, there were 1 816 such teleconsultations in telepsychiatry.

25. In **Finland**, patients in remote archipelagos where health care provision is limited can use so called "health huts" to access synchronous and asynchronous remote care services. In **Iceland**, youth psychiatrists in the capital Reykjavik can use an encrypted and sanctioned solution to connect with rural patients in the north of the country, where psychiatrists are in short supply. In the south of the country, nurses in rural areas use a mini health care station to perform a number of tests (e.g. blood pressure, take pictures, etc.) and discuss diagnoses and treatments with remote specialists, a model that is being adopted in eastern Iceland. In **Japan**, teleradiology and telepathology are widely used. In **Luxembourg**, all hospitals are equipped with telepathology rooms in operating theatres connected to the national pathology laboratory, and the national Cancer Plan mandates that 95% of histopathology requests must be met within 30 minutes of the removal of the surgical sample. In **Lithuania**, the Dermtest application allows physicians to send dermatological images to specialists who typically respond within days. This type of store and forward teledermatology is also used in **Portugal**, where by law since 2018, primary care physicians must attach pictures of any skin lesion when referring a patient to a first dermatology consultation at the hospital. Also in Portugal, real-time teleconsultations have been in use since the inception of a teleconsultation programme in paediatric cardiology in Coimbra in 1998 (a programme that is still ongoing today), although in the public sector teleconsultations at home are currently not allowed but planned for the end of 2019. In **Norway**, real-time video consultations between clinicians and patients in the field of mental health have been in use since 2017, especially in the northern part of the country.

26. **Australia, Finland**, **Hungary**, **Ireland**, **Slovak Republic**, **Scotland** and **Slovenia** all have telestroke programmes that allow stroke experts to give remote advice to other health workers in distant locations. In remote locations where stroke expertise may be unavailable, telestroke can reduce time to treatment, thus saving lives and preventing complications. In the **Slovak Republic**, a mobile application allows ambulances and emergency care units to send electrocardiogram results and consult with stroke

experts. In **Slovenia**, the telestroke programme run by the University Medical Centre in Ljubljana connects general hospitals spread across the country, providing timely care to stroke patients from remote areas. Interactive and asynchronous telemedicine can also help triage patients. More generally, beyond telestroke, **Austria**, **Sweden** and **Portugal** have teletriage services accessible online or through the phone. The Austrian *Telefonische Gesundheitsberatung 1450* programme started as a pilot and has now been rolled out nationally. The already mentioned Portuguese SNS 24 offers support to patients who need advice with acute, non-emergent health complaints. It also offers a set of services that allow patients to solve health-related issues without having to go to a primary care unit or hospital. Sweden's 1177 hotline (and website) provides medical information to the public, and is linked to electronic health records.

Private providers are increasingly offering easy access to remote consultations

27. Private providers (including health insurers in **Israel**, **Portugal**, **Ireland** and the **United States**) are increasingly offering easy and quick access to remote consultations. In Ireland, videoDoc allows any registered member to see a doctor via their mobile phone under a pay-as-you-go scheme or with an annual subscription. In the **United States**, there are numerous private teleconsultation providers, including Teladoc (Nakagawa, Kvedar and Yellowlees, 2018[33]), which expects the volume of services provided in 2019 to reach as high as 3.9 million. In the **England**, according to the Care Quality Commission there are 37 private providers registered to carry out online consultations. Besides operating in the United Kingdom, the Swedish Livi is present also in **Sweden**, **Norway**, **Spain**, and **France**, and has provided more than 500 000 videoconsultations, working with over 300 physicians. Also in France, Doctolib allows health care providers to sign up to its teleconsultation platform. In **Belgium**, Vividoctor – a teleconsultation provider with pilots in endocrinology and fertility – has received innovation funds from the region of Wallonia. In the **Czech Republic**, the private *International Center for Telemedicine* offers videoconferencing services in cardiology and diabetes.

Telemedicine services help provide care to difficult-to-reach patient groups

28. Telemedicine can reach groups of patients that would be otherwise difficult to reach, be it for reasons of cost, physical access or even privacy. In Northern **Iceland**, "The Life-line" project aims to provide health care services to ships on sea using telemedicine. Other countries (e.g. **Australia**, **Denmark**, **France**, **Germany**, **Italy**, **Norway**, **Sweden**, the **Netherlands** and **Spain**) also provide telemedicine services to seafarers on board ships (Henny et al., 2013[34]). In **Australia**, the Centre for Antarctic, Remote and Maritime Medicine and the Australian Antarctic Program provide telemedicine services to patients up to 5 500 km away, including monitoring vital signs. In 2018, **Greece** implemented a programme of health services in detention centres. Specialists support physicians in prisons and health services are provided remotely without the need for potentially costly and risky transfers. In the **United States**, prisons in around 30 states use telemedicine for at least one specialty health or diagnostic service (Chari, Simon and Defrances, 2016[35]). Ontario, in **Canada**, also provides virtual care services to correctional facilities.

29. In **Australia** and **Canada**, telemedicine services are used to promote better health care among indigenous people. Due to a number of factors, including inadequate clinical care and health promotion, and poor disease prevention services, indigenous people tend to have poor health (Gracey and King, 2009[36]). Telemedicine services have been identified as a means to improve health outcomes among indigenous communities by increasing access to what are often rural and remote patients, suffering from multiple chronic conditions and limited resources (Caffery et al., 2017[37]). Canada's eHealth Infostructure Program seeks to modernise and improve health care services in First Nations communities, using in part telehealth. In 2017, the Ontario Telemedicine Network included 120 indigenous telemedicine sites and counted 9 628 indigenous patient events (OTN, 2018[38]). The convenience of accessing health care services in one's own home can also make a difference for more sensitive types of care. Telemedicine is used in the **United States** to provide abortion care (Endler et al., 2019[39]) and to support victims of sexual

and domestic abuse (Stavas et al., 2018[40]; Thomas et al., 2005[41]), providing an environment in which patients can feel more at ease, thus promoting access to needed health care services.

1.3. Telemedicine provokes both considerable optimism and scepticism

30. A quick search of PubMed, an archive of biomedical and life sciences journal literature, using the term "telemedicine" returns over 8 500 studies, just in the last five years: an average of just under five publications every day for the last five years. The number of telemedicine pilots, projects and applications across the OECD – and more widely – is more difficult to determine but is likely in the thousands. Yet, despite this astounding growth in research and experimentation, rates of telemedicine use remain low, and telemedicine programmes (beyond teleradiology) struggle to make it past pilot stages at the local level.

31. As shown in the previous section, telemedicine services can be used to deliver health care in a wide range of specialties for numerous conditions and through varied means. This broad heterogeneity in contexts, applications and actors, makes it challenging to establish whether telemedicine – as a whole – is safe, effective and cost-effective. This is akin to asking whether primary care or hospitals – as a whole – are safe, effective and cost-effective. Proponents and champions of telemedicine point to the cases around the world in which remote care services have led to improvements in quality, efficiency and equity. Sceptics and critics draw attention to the considerable uncertainty and hype around telemedicine services, and the potential for disruption and harm to patients and health care systems. The following chapter reviews the impact that telemedicine services are having across the OECD, and the barriers and enablers to wider use of telemedicine.

2 What has been the impact and what are barriers and enablers to use?

32. The majority of OECD countries (15 out of 22 countries) have not conducted comprehensive evaluations of telemedicine programmes or services. Seven countries – **Australia**, **Canada**, **Denmark**, **New Zealand**, **Norway**, **Spain** and the **United Kingdom** – have conducted national evaluations or assessments of their telemedicine policies, strategies and/or programmes. Typically, national assessments focus on implementation, user outcomes and value for money. The type of data used differs between applications, even within the same country, with some assessments being based on interviews, some on observational data, and some on RCTs. For example, the Spanish Ministry of Health has commissioned the Spanish Network of Health Technology Assessment and Benefits Agencies to study the potential impact of introducing certain telemedicine services more widely in the country. The United Kingdom has also conducted one of the largest RCTs of telehealth and telecare in the world with its Whole System Demonstrator programme. While not all countries have conducted national evaluations, many have assessed the impact of specific programmes, published either as institutional case studies or in the peer-reviewed literature. An umbrella review of systematic reviews and meta-analyses of telemedicine in OECD countries (see Box 2.1), conducted for this report, identified primary studies from 28 OECD countries.

Box 2.1. Sources of information on impact, barriers and enablers of telemedicine

Snapshot survey and semi-structured interviews with country experts

A snapshot survey on telemedicine was sent to OECD delegations and members of the Health Committee, focussing on legislation, policies and strategies on telemedicine use, as well as impacts, barriers and enablers. A total of 26 countries responded (one country declined to participate). Countries were also asked to nominate experts for semi-structured interviews to provide more in-depth information. Interviews were conducted with experts from 13 countries.

Umbrella review of systematic reviews and meta-analyses of telemedicine

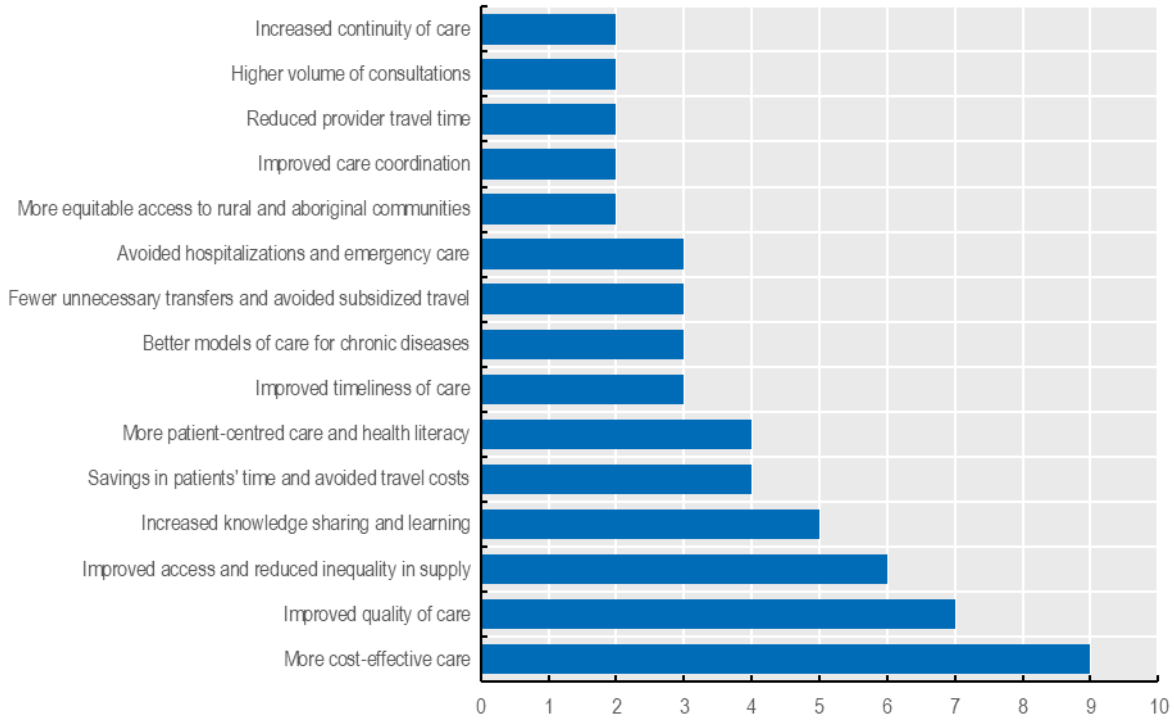
An umbrella review of systematic reviews and meta-analyses published between 2014 and 2019 was conducted focussing on effectiveness, cost-effectiveness, patient experience, and implementation of telemedicine (telemonitoring, real-time or store-and-forward). Telemedicine interventions not conforming to the definition in Box 1.1 were excluded. Searches conducted on Pubmed/Medline and the Cochrane library yielded 320 unique citations, of which 103 were eventually included in the review. Included reviews focused on at least 16 medical specialties or fields, and covered 54 countries (including 28 OECD countries). More detail is provided in Annex B.

2.1. The impact of telemedicine has been mostly positive but there are also risks

33. In interviews with specialists from 13 countries, experts considered overwhelmingly that telemedicine services have a positive impact (as illustrated in Figure 2.1 by the absence of any negative effects). However, experts from different countries stressed that telemedicine is simply a tool that can be well used or misused; it can have benefits but has the potential to also cause harm. The information collected for this report suggests that telemedicine is not beneficial or harmful in itself, and that under a best use scenario, it can lead to gains in effectiveness, efficiency and equity.

Figure 2.1. Delivering care through telemedicine has benefits

Impacts of telemedicine highlighted by experts, by number of reporting countries



Source: OECD analyses of interviews with experts from 13 countries.

2.1.1. Evidence is building that telemedicine can be effective and cost-effective

34. In nine out of 13 expert interviews, it was reported that telemedicine services can help deliver more cost-effective health care, a consequence of positive effects on both patient outcomes and costs of care (see Figure 2.1). Respondents consider that telemedicine services may improve access, quality, timeliness, coordination and continuity of care. Furthermore, they may increase knowledge sharing and promote learning among health workers and patients, allow better models of care for multimorbid chronic patients, and prevent avoidable costly hospital use. Consequently, they improve patient outcomes and save resources that would be spent on unnecessary services. They may further increase efficiency and productivity by reducing provider travel time and allowing a higher volume of consultations.

35. These views are aligned with existing reports from surveys and the peer-reviewed literature. A survey of 9 126 general practitioners from 31 European countries found that 79% of respondents agreed that ICTs improved the quality of care (Codagnone and Lupiañez-Villanueva, 2013[43]). Another survey found that all 18 European countries responding to the questionnaire agreed that the adoption of

telemedicine services would improve the quality and continuity of care, and a large majority of countries agreed telemedicine would help reduce avoidable health costs and increase access to care for remote patients (Carrasqueiro et al., 2017[44]). Out of 57 systematic reviews and/or meta-analyses focussing on effectiveness, included in this report's umbrella review, 50 reported that telemedicine interventions were at least as effective as conventional face-to-face care. Of another 19 systematic reviews and/or meta-analyses on cost-effectiveness, 13 concluded that telemedicine interventions were either cost-effective or had the potential to be cost-effective.

Health care can be delivered through telemedicine in a safe and effective way

36. While there is broad heterogeneity in how telemedicine is being used across OECD countries, there is a growing body of evidence that health care can be safely delivered via telemedicine, and may even lead to better patient outcomes than conventional face-to-face care. The umbrella review conducted for this report found 57 systematic reviews and/or meta-analyses focussing on effectiveness of telemedicine in 13 medical specialties (see Annex B for a more detailed overview of included studies).

37. **Telemedicine interventions can improve glycaemic control in diabetic patients** and can be more effective than conventional face-to-face care (Flodgren et al., 2015[2]; Huang et al., 2015[45]; Toma et al., 2014[46]; Zhai et al., 2014[47]; Su et al., 2016[48]; Jeon and Park, 2015[49]; Liu et al., 2017[50]). Telemedicine interventions for gestational diabetes have similar clinical outcomes, including glycaemic control and caesarean delivery rates, compared to face-to-face care (Raman et al., 2017[51]; Ming et al., 2016[52]; Rasekaba et al., 2015[53]). Furthermore, telemedicine is more convenient and can potentially reduce the use of face-to-face and unscheduled consultations (Rasekaba et al., 2015[53]). The benefits extend beyond glycaemic control. Real-time videoconferencing leads to comparable results, in terms of healing time for diabetic foot ulcers, as usual face-to-face care (Tchero et al., 2017[54]), and telemedicine interventions are effective for weight loss in diabetic patients (Joiner, Nam and Whittemore, 2017[50]).

38. **Telemonitoring can reduce mortality and hospitalisation due to chronic heart failure**. Structured telephone support and telemonitoring reduces the odds of mortality and hospitalizations related to heart failure compared to usual post-discharge care (Kotb et al., 2015[51]). Based on high quality evidence, telemedicine interventions improve survival rates and reduce the risk of heart failure related hospitalizations, when compared to usual face-to-face care (Kitsiou, Paré and Jaana, 2015[52]). Telemonitoring is also associated with a reduction in planned hospital visits, and does not compromise survival (Klersy et al., 2016[53]). Telemedicine can be used to manage heart failure with similar health outcomes as face-to-face care (Flodgren et al., 2015[16]). Compared to face-to-face home visiting programs and multi-disciplinary heart failure clinics, transitional care telemedicine interventions delivered through structured telephone support reduce heart failure related readmissions (Feltner et al., 2014[54]). Compared to nurse home visits, telemonitoring has no statistically significant improvement on readmission or mortality in heart failure patients, but reduces overall health care costs (Van Spall et al., 2017[55]).

39. **Telerehabilitation can be effective in managing pain and increasing physical activity**. For musculoskeletal conditions, telerehabilitation is effective in improving physical function compared to usual care (Cottrell et al., 2017[61]). For post-surgical patients, telerehabilitation is at least as effective as usual care and improves quality of life compared to usual care (van Egmond et al., 2018[57]). Telemedicine interventions may lead to improvements in physical activity in patients with COPD, although there is high heterogeneity (Lundell et al., 2015[58]). When combined with usual care, telemedicine interventions can be an effective way to manage pain (Dario et al., 2017[59]). With respect to motor function, telemedicine is effective for cardiac and orthopaedic patients, but the evidence was inconclusive for neurological patients (Agostini et al., 2015[65]). For patients suffering from chronic pain, exercise-based telemedicine is effective in reducing pain, when compared to no intervention, and there is no difference in effect between telemedicine and usual care for increased physical activity, or activities of daily living (Adamse et al., 2018[66]). For cardiac rehabilitations, telemedicine can be as effective as face-to-face care in improving

cardiovascular risk factors and functional capacity, with the benefit of increased access for patients who cannot attend centre based cardiac rehabilitation (Huang et al., 2015[45]; Rawstorn et al., 2016[67]). Finally, telemedicine can be used effectively to manage cancer related fatigue (Seiler et al., 2017[63]).

40. **Telemedicine is an effective way to improve mental health, especially through cognitive behavioural therapy**. Telemedicine is at least as effective as face-to-face interventions in tackling depression and/or anxiety, symptoms of obsessive-compulsive disorder (OCD), insomnia, and excessive alcohol consumption. Occupational telemedicine interventions have a small positive effect on stress and anxiety in employees and are especially effective when targeted to individual employees (Stratton et al., 2017[64]). Telemedicine interventions are effective in improving maternal depression symptoms (Nair et al., 2018[65]). Internet delivered cognitive behavioural therapy (iCBT) is an effective way to treat psychiatric and somatic conditions in children and adolescents (Vigerland et al., 2016[66]) and improve sleep in adults with insomnia (Seyffert et al., 2016[70]). Furthermore, it is as effective as usual care in reducing symptoms of depression (Deady et al., 2017[73]; van Beugen et al., 2014[74]; Linde et al., 2015[75]). mHealth can reduce symptoms of anxiety, stress and depression while improving patient adherence and reducing face-to-face visits (Rathbone and Prescott, 2017[71]). Remote treatment for OCD is as effective as face-to-face treatment (Wootton, 2016[72]). Finally, behavioural interventions delivered through telemedicine to reduce alcohol abuse are as effective as face-to-face interventions in young adults (Oosterveen et al., 2017[73]).

41. **Telemedicine is at least as effective as usual approaches to nutrition and physical activity**. Telemedicine interventions are comparable to face-to-face interventions in improving physical activity and reducing sedentary behaviour (Direito et al., 2017[74]), while targeted interventions are more effective than usual care in increasing physical activity (Hakala et al., 2017[75]). Telemedicine interventions can improve diet quality, including the intake of fruits, vegetables, and dietary sodium for people with chronic conditions (Kelly et al., 2016[76]) and for malnourished community dwelling older adults (Marx et al., 2018[83]). Telemedicine interventions may achieve modest weight loss compared to no intervention, while telemedicine combined with behavioural features can achieve significantly greater weight loss (Hutchesson et al., 2015[78]). Telemedicine interventions for weight control may have no significant benefits for elementary school children (Lee et al., 2016[79]), but may be effective for postpartum women (Sherifali et al., 2017[80]). Finally, telemedicine interventions can reduce cardiovascular disease risk factors such as weight, body mass index and blood pressure, when compared to usual care (Widmer et al., 2015[87]).

42. **Telemedicine services may improve care for respiratory diseases like asthma and COPD**. Telemedicine interventions, such as remote patient monitoring, improve asthma control and reduce exacerbation rates (Hui et al., 2017[82]; McLean et al., 2016[83]), and lead to statistically similar asthma symptom scores as face-to-face care (Zhao et al., 2015[83]). Telemonitoring appears to reduce respiratory exacerbations and hospitalisations, and may improve health-related quality of life, but there is limited evidence that it reduces health care utilisation and associated costs (Cruz, Brooks and Marques, 2014[85]).

Telemedicine can help patients find the right type of care at the right time in the right place

43. There is a growing evidence base suggesting that telemedicine services can be used to design more appropriate patient pathways. According to preliminary assessments, of the one million patients triaged in 2018 by the **Portuguese** SNS 24 programme, 30% were prescribed self-care, another 30% were directed to primary care, and the remaining 40% were referred to urgent care. Of the 30% who were prescribed self-care, 70% adhered to the recommendation thus avoiding any further health care utilisation. Also in Portugal, it has been estimated that teledermatology may lead to a reduction in referrals to face-to-face specialised hospital care of between 20% and 50%. In Ontario, **Canada**, a 78% reduction in referrals was achieved using teledermatology and teleophtalmology services (OTN, 2018[38]). In the **United States**, a store and forward patient-to-provider service was able to resolve patient complaints in 92% of cases with the majority of the remaining 8% going to primary care instead of emergency services (Player et al., 2018[92]). These figures are in line with evidence suggesting that 16% to 92% of patients participating in

store and forward teleconsultations avoid a referral to specialised hospital care (Eminović et al., 2009[93]; Caffery, Farjian and Smith, 2016[94]). Furthermore, these types of solutions that allow a quick turnaround may also result in fewer, and unnecessary, procedures and tests (Reines et al., 2018[95]). In addition, when the patient needs to see a physician face-to-face following teletriage or store and forward, two country experts believed the first telemedicine encounter resulted in interactions that were more useful.

44. Telemonitoring has also been shown to reduce unplanned and avoidable admissions to hospital by following patients more closely in their own homes. In **Canada**, telehomecare has reduced hospital admissions by 60% to 80% (OTN, 2018[34]). In **Denmark**, telemonitoring for COPD reduced the number and length of hospitalisations by 11% and 20% respectively. These findings are in line with a systematic review and meta-analysis of the impact of telemonitoring for COPD patients on emergency room visits and hospitalisations (Hong and Lee, 2019[96]). Also in Denmark, the "Chemo at Home" programme, which offers certain patients with acute leukaemia the opportunity to receive most of their treatment at home, has reduced the average number of inpatient days from 30 to 10, and freed up beds for elderly cancer patients. In the **United States**, a telemedicine service to assist physicians in smaller hospitals provide neonatal resuscitation led to a 29% reduction in a newborn's odds of being transferred (Albritton et al., 2018[97]).

45. Telemedicine services may further promote care in the right place at the right time by promoting continuous learning among medical workers (Albritton et al., 2018[97]). Teleconsultations have been associated with knowledge transfer from specialists to GPs (Whited, 2006[98]; Moreno-Ramirez et al., 2005[99]). Real-time videoconsultations, specifically, may lead to GPs feeling less isolated from their peers and being better able to triage patients, often avoiding unnecessary referrals to secondary care (Shapiro et al., 2004[100]; Nordal et al., 2001[101]). Reductions in referrals of between 10% and 25% have been reported (Taylor, 2005[102]; Loane et al., 2001[103]; Wootton, 2002[104]). Telemedicine may also lead to more utilisation, though it is not clear if this is frivolous or justified (Pekmezaris et al., 2018[105]). Some services might not be provided if telemedicine is not available, as 26% to 30% of patients would not attend a face-to-face consult if teleconsultations were not available (Stensland et al., 1999[106]; Hicks et al., 2003[107]), foregoing potentially important care (one area of particular concern is real-time videoconsultations in primary care, as discussed in section 2.1.3). For those living in very remote locations, telemedicine might be the only option (see section 1.2.2). Providing patients with the right type of care at the right time in the right place has clear benefits for patients and can avoid higher downstream costs for health systems.

Care delivered through telemedicine can be cost-effective but generalisability is challenging

46. As care can be delivered through telemedicine in a wide variety of contexts and ways, it is challenging to make broad statements regarding the cost-effectiveness of telemedicine services in general. Out of the 19 systematic reviews and/or meta-analyses focussing on cost-effectiveness of telemedicine interventions included in the umbrella review, eight found that telemedicine was or could potentially be cost-effective (McDougall et al., 2017[102]; Musiat and Tarrier, 2014[103]; Thomas et al., 2014[104]; Akiyama and Yoo, 2016[105]; Iribarren et al., 2017[106]; López-Villegas et al., 2016[107]; Elbert et al., 2014[108]; Snoswell et al., 2016[109]). Cost-effective telemedicine interventions included the management of rheumatoid arthritis, computerised cognitive behavioural therapy (cCBT), teleglaucoma, telemedicine interventions delivered through mobile devices to provide support, information and collect data, pacemaker telemonitoring, eHealth interventions in somatic diseases, and teledermatology for triage. Besides being clinically effective, these interventions delivered value for money by reducing the workload of health care workers, reducing waiting and travelling times, reducing unnecessary face-to-face care, shortening the length of consultations, and having lower unit costs than face-to-face services.

47. Five reviews concluded that although telemedicine interventions could be cost-effective, or cost saving, poor quality and paucity of cost data limited the ability to arrive at a definitive conclusion (de la Torre-Díez et al., 2015[110]; Michaud et al., 2018[111]; Estai et al., 2018[112]; Grustam et al., 2014[113]; Udsen, Hejlesen and Ehlers, 2014[114]). Three reviews were unable to arrive at a conclusion due to variation in

outcomes within included studies (Liddy, Drosinis and Keely, 2016[121]; Zhai et al., 2014[47]; Sanyal et al., 2018[122]). In one of these reviews, the incremental cost-effectiveness ratios ranged from USD 491 to USD 29 869. Another three reviews concluded, based on the available evidence, that telemedicine interventions were not a cost-effective way to deliver care for inflammatory bowel disease, provide dermatological care, or increase patient adherence to pharmacological and non-pharmacological recommendations among patients with heart failure (Jackson et al., 2016[123]; Fuertes-Guiró and Girabent-Farrés, 2017[124]; Hameed, Sauermann and Schreier, 2014[125]).

48. Cost-effectiveness is contextual. Similar telemedicine services can be cost-effective in one setting and not cost-effective in another, as a review of the use of telehomecare in Japan illustrates (Akiyama and Yoo, 2016[105]). Two primary studies reported cost savings and three studies reported cost increases due to regional budgeting rules. In the same country, the same intervention was both cost-effective and not cost-effective due to contextual idiosyncrasies. The generalisability of cost-effectiveness studies is, naturally, limited, given differences in scale at which the intervention is being assessed, the perspective used in the evaluation, the choice of time frame, and the choice of comparator. Even if methodological choices remain constant, other factors can affect results. Generalisability across settings (within and across countries) is affected by many factors including the epidemiology of disease and demographics; funding, infrastructure and basket of services; remuneration of health care workers and institutions; relative prices and costs; target populations and subgroups; interactions between interventions and economies of scope; and finally, baseline or initial conditions (Hauck, Smith and Goddard, 2004[126]). In the case of telemedicine and other digital technologies, there is also a degree of flexibility and tailoring that further limits generalisability. Unfortunately, the quality of reporting of economic evaluations of telemedicine services remains low, limiting generalisability and understanding of factors driving cost-effectiveness.

Important cost savings are missing from most economic assessments of telemedicine

49. Because analyses of the cost-effectiveness of telemedicine interventions usually take a health system perspective, they tend to miss important cost categories that would make the economic case for telemedicine more favourable. Teleconsultations – whether interactive or asynchronous – are associated with reduced waiting times (Caffery, Farjian and Smith, 2016[94]) and reduced travel (Masino et al., 2010[127]). Patients in the **Canadian** Ontario Telemedicine Network avoided travelling 270 million km in 2017 and the network saved CAD 71.9 million in travel grants (OTN, 2018[38]). While provider savings associated with travel subsidies would be included in a cost-effectiveness analysis with a health system perspective, the significant costs of unsubsidised patient travelling would not. These costs would include not only direct costs (e.g. gas, bus fare, etc.), but also indirect costs in time away from work or leisure, as well as pollutant emissions (Oliveira et al., 2013[128]). Furthermore, as previously noted, teleconsultations and teletriage programmes often result in lower downstream utilisation since the health complaint can be resolved through self-care or in primary care. These avoided costs to patients are also typically not included in cost-effectiveness studies. While the costs of avoidable and unplanned admissions are frequently considered in cost-effectiveness analyses of telemonitoring interventions, again the potential costs to family members meeting their relatives at the hospital are not. These are all quantifiable and monetisable costs that are typically not considered in economic evaluations of telemedicine.

2.1.2. Telemedicine interventions have clear and significant benefits for patients

50. It is widely accepted that telemedicine services provide significant benefits to patients. Country experts interviewed for this report highlighted improvements in access and quality of care, patient empowerment, greater health literacy, reduced travelling costs and travelling and waiting times, fewer unnecessary and potentially dangerous transfers, and better equity for rural and indigenous patients (see Figure 2.1). These views are in wide agreement with the literature on the impact of telemedicine services on patient experience.

Patients tend to report very high satisfaction, empowerment and reassurance

51. In **Canada**, 96.8% of patients receiving telehomecare would recommend it (OTN, 2018[38]). In **Denmark**, 71.7% of COPD patients experienced an improved sense of safety from telemonitoring. Half of the patients reported increased awareness of their COPD symptoms and responded proactively, and 96% found the system easy to use. In the **United States**, 95% of patients using a store and forward patient-to-provider service would recommend it to others and 98% found it easy to use (Player et al., 2018[92]). Because telemedicine services typically have shorter waiting times, require less travelling and thus involve lower costs and effort, patients are generally receptive, especially after initial experiences. Even some patients who would prefer traditional face-to-face appointments report they would rather have a teleconsultation if the waiting time was lower (Collins, Walters and Bowns, 2004[129]). For patients with mental health conditions, telemedicine interventions improve treatment adherence, symptom surveillance and increase patient satisfaction with management and health care services (Berrouiguet et al., 2016[130]). Telemedicine patients receiving cCBT report high treatment satisfaction rates, with personal support improving treatment adherence and reducing attrition (Musiat and Tarrier, 2014[103]).

52. Patients with cancer have a positive experience with telemedicine and find it to be convenient and acceptable (Liptrott, Bee and Lovell, 2018[125]). For cancer survivors, telemedicine is convenient, provides independence and remote reassurance, reduced burden, and the safety net of connections with health workers (Cox et al., 2017[126]). Telemedicine also improves social and emotional wellbeing of indigenous people receiving care in the community, provides a choice for palliative patients to die at home and greater patient empowerment due to increased health literacy (Caffery et al., 2017[37]). COPD patients are also satisfied with home telemonitoring, and find it helps them manage their condition (Cruz, Brooks and Marques, 2014[133]). The use of mHealth applications promotes patient empowerment, supports patients in assuming more proactive management of their own health while improving relationships between patients and health workers (Qudah and Luetsch, 2019[128]). Patients being telemonitored for chronic conditions report enhanced understanding of their condition and better management, self-care and shared decision-making, as well as increased reassurance and security (Walker et al., 2019[135]). Care should be taken, however, to address the reservations of some patients in terms of trusting the technology and learning how to use it, as well as the potential to jeopardise interpersonal connections.

2.1.3. Questions remain, notably at the interface between telemedicine and usual care

53. Telemedicine services can lead to reductions in costly and avoidable hospital use, but they can also stimulate demand for health care. In the **United States**, a real-time videoconsultation service reduced face-to-face visits by 33% but increased all telemedicine and conventional visits by 80% over 18 months (Shah et al., 2018[136]). Furthermore, after the first year the substitution effect declined. In some cases, increased demand and utilisation reflect patient needs that would have gone unmet if it were not for telemedicine, but in other cases, the new demand and use could be frivolous. Differentiating between these two cases is not always straightforward. One area of particular concern is what happens at the interface between telemedicine services and more traditional brick-and-mortar health care provision.

54. Teleconsultation services in primary care may lead to problematic patient pathways when providers are poorly integrated, or have different objectives and incentives. In the **United States**, when a virtual visit identifies the need for a face-to-face appointment, the provider, CVS, will recommend a visit to one of their retail clinics. However, CVS does not have any retail clinics in two states where it is currently offering virtual visits. In the **United Kingdom**, GP at Hand - a GP practice that offers digital and face-to-face consultations to registered patients – has attracted a large number of patients from out of their area. Because GP practices are funded under a capitation system, and because GP at Hand attracts so many younger patients with fewer complex care needs, there are questions around the financial sustainability of not only GP at Hand's model but also that of other nearby practices. Nearby brick-and-mortar GP practices

without telemedicine services are losing younger patients and still need to provide face-to-face care to older more complex patients.

55. Seven country experts raised concerns over the use of teleconsultations, both synchronous and asynchronous, in primary care under fee-for-service payment schemes, especially in a publicly funded system. There is a risk that providers might "break the bank" by providing easy-to-access, quick and convenient teleconsultations to younger and healthier patients. This risk can be exacerbated when the primary care provider is not the patient's usual physician, and continuity of care is limited. This is why certain countries and jurisdictions require face-to-face visits before or after a telemedicine encounter and provide limited or no reimbursement for teleconsultations in primary care. Two country experts noted that the risk of telemedicine leading to increased frivolous demands for specialist care was less important, due to specialists' control over referrals and consultation time.

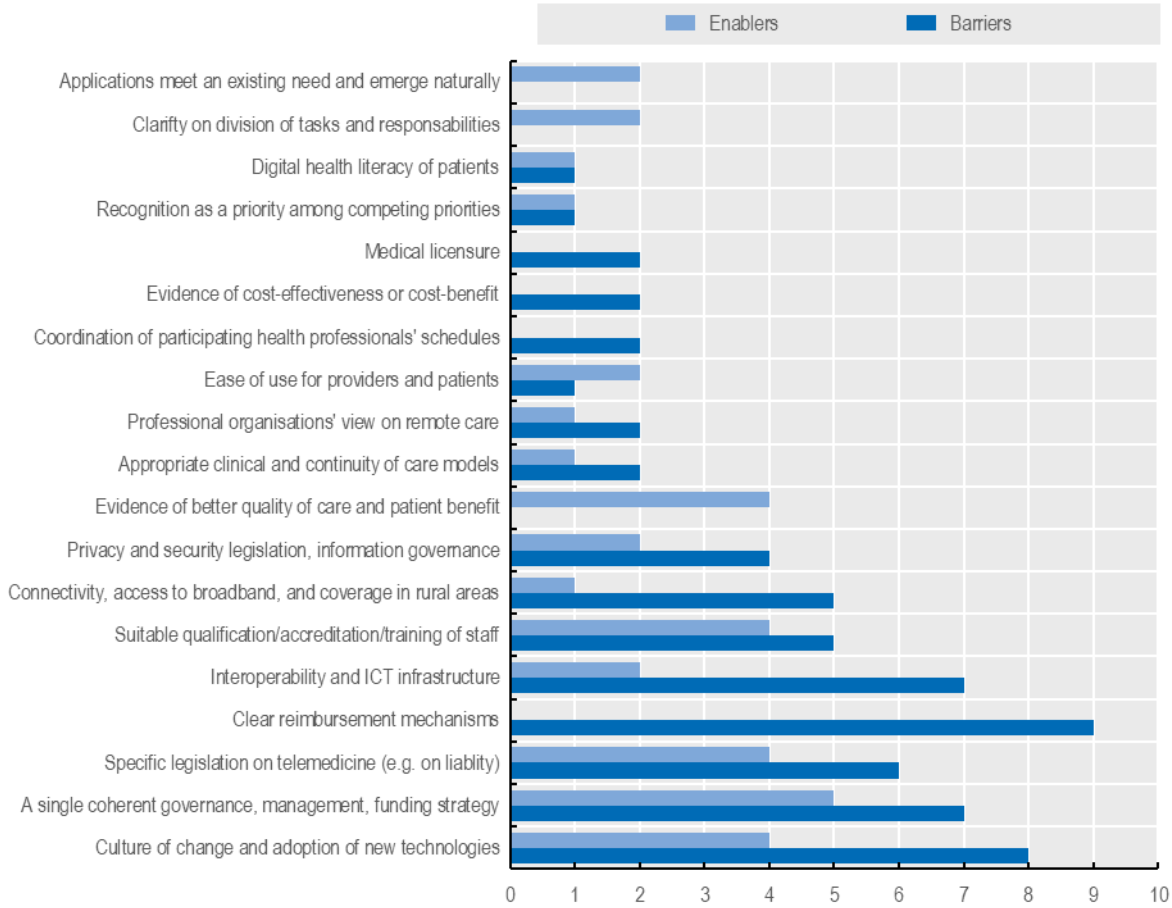
56. Another way in which telemedicine services can lead to increased use of conventional face-to-face care is through greater patient perceptions of medical needs, whether appropriate or not. In the **United States**, a systematic review of telemonitoring services for heart failure found that they significantly increased the probability of a visit to the emergency department, a finding that could be associated with early identification of significant exacerbation in symptoms (Pekmezaris et al., 2018[105]). In **Norway**, telemonitoring has led to fewer hospital visits but slightly more primary care encounters, in some municipalities. This is in line with a previous finding that telemonitoring does not seem to reduce primary care utilisation (Castle-Clarke and Imison, 2016[137]).

2.2. There are more barriers than enablers to the wider use of telemedicine

57. Barriers to the wider use of telemedicine in the OECD were reported 64 times by countries compared to 36 mentions of enablers, indicating there are more hurdles to the use of telemedicine in the OECD than there are facilitators (see Figure 2.2). The most frequent barrier, mentioned by nine countries, was the lack of clear reimbursement mechanisms for telemedicine services, while the most repeated enabler was the existence of a single coherent governance, management and funding strategy.

Figure 2.2. Barriers to the wider use of telemedicine outnumber enablers

Barriers and enablers of telemedicine use highlighted by respondents, by number of reporting countries



Note: Countries were grouped into categories based on responses to the question "What are barriers and enablers to the development of telemedicine in your country?" Barriers/enablers are sorted top to bottom by number of reporting countries.
Source: OECD Snapshot Survey on Telemedicine (2018), OECD analyses of interviews with experts from 13 countries.

2.2.1. Most barriers to wider use of telemedicine fall under the remit of governments

58. Seven of the eight most frequently reported barriers to wider use of telemedicine services are related to public policy. A lack of funding and clear reimbursement mechanisms is the single biggest hurdle to wider development, a finding that is in line with previous surveys of policy makers, health technology industry representatives and general practitioners in Europe (European Commission and ECHAlliance, 2018[134]; Carrasqueiro et al., 2017[41]; European Commission, 2018[135]). A shortage of sustained funding is likely behind, at least in part, the large number of small-scale telemedicine services that do not make it past pilot stages in many OECD countries (see Figure 1.3). Existing provider payment and patient reimbursement practices also make it hard for providers and patients to take greater advantage of telemedicine. When telemedicine encounters are not publicly financed, provision is limited.

59. It is not just the lack of coverage but also the use of payment schemes that effectively disincentivise new models of remote care. In **Norway**, municipalities are responsible for financing primary care and hospitals are paid through central budgets, while in **Australia**, Medicare funds primary care and a combination of states, federal government and non-government sources finance hospitals (these types of splits exist in other countries as well, e.g. **Germany**). In both countries, the use of telemedicine services

would require investments from different sources of funding while having differential impacts on the revenue side (e.g. through reductions in referrals and hospitalisations). In the **United States**, payment policies do not allow certain telehealth services to be reimbursed, so that a telemedicine service to assist physicians in smaller hospitals provide neonatal resuscitation, with important benefits to patients and providers, is effectively disincentivised (Albritton et al., 2018[139]).

60. Seven countries noted that a lack of a single coherent governance, management and funding strategy was an obstacle to wider use of telemedicine, with another six countries adding also the lack of legislation specific to telemedicine (e.g. on medical liability and malpractice). Twelve countries in the OECD have no national legislation, policy or strategy on telemedicine, and 11 do not define medical jurisdiction, liability or reimbursement of eHealth services such as telehealth (see Table 1.1). It is not just the lack of legislation but also the lack of leadership and ownership that contribute to uncertainty, and hinder wider use of telemedicine. The telemedicine ecosystem is complex, covering a wide range of specialties, numerous conditions, and varied means and technologies. The formation of a single coherent strategy and/or entity to provide clarity on the many aspects (e.g. clinical, legal, financial, ethical, etc.) related to telemedicine could be a driver for further use, as indicated by nine countries.

61. Insufficient interoperability and inadequate ICT infrastructure were reported as barriers by seven countries. Interoperability standards ensure that records can be shared or exchanged, a key requirement for telemedicine applications. While 21 OECD countries have a national organisation responsible for setting national standards for electronic messaging (interoperability), 18 countries do not have a legal requirement to adopt electronic health record systems that conform to clinical terminology and electronic messaging standards (Oderkirk, 2017[140]). Moreover, only 11 countries have certification procedures that require vendors to adopt standards and use structured data (Oderkirk, 2017[140]).

62. Five countries noted issues with connectivity, access to broadband, and coverage in rural areas as obstacles to telemedicine services. Telemedicine services vary significantly in terms of the amount and type of information exchanged. Remote surgery using robotics requires reliable high-speed connections (up to 100 Mbps) while asynchronous store-and-forward and telemonitoring services can be delivered in most networks in use today. The availability of reliable broadband is thus a limiting factor in the diffusion of telemedicine applications. Across the OECD, rural areas lag behind urban and other areas in broadband access at sufficient speeds (OECD, 2019[2]). In large countries with sparsely populated areas where health care services are more constrained, like the **United States**, **Canada**, **Norway**, **Sweden** and **Finland**, limited broadband access can hinder the use of telemedicine services where they are most needed. While the fifth generation of wireless networks, 5G, does hold many promises due to its significantly faster download and upload speeds, addressing geographical digital divides will still be a challenge as investment in sparsely populated rural areas will likely remain limited (OECD, 2019[1]).

63. Nine countries reported that health care staff training, qualifications and accreditation were important for telemedicine to develop (five countries considered these hurdles, while four countries mentioned them as enablers). Around one third of health workers in the OECD report not being accustomed to using digital solutions due to gaps in knowledge and skills in data analytics (OECD, 2019[7]). Some countries are working towards developing clinical informatics skills and improving digital literacy among health care workers. **Australia**, **Canada**, **Germany**, and the **United States** have policies or initiatives in place to adjust pre-service education curricula (and even ongoing professional development) to digital technology, and some have policies in service delivery, such as new tasks and professions. However, none of the policies and initiatives reported involve bottom-up and coordinated approaches across the education, health and ICT sectors (OECD, 2019[7]).

64. Six countries mentioned privacy, data and information security and governance as crucial to the use of telemedicine services (four countries mentioned these as barriers, while two countries reported them as enablers). Telemedicine services necessarily involve the exchange of personal health data across different institutions, accessible to different health care workers, and potentially on sensitive subjects (e.g.

mental health and domestic abuse). This naturally presents a number of important risks to the privacy of individuals. Trust in telemedicine services is conditional on adequate security and privacy protections, which may be lacking (Hall and Mcgraw, 2014[140]). Yet, equally, telemedicine services are not possible if health information and data are not developed, are unused, or are very difficult to use, thus depriving many patients and providers from the potential benefits. Adhering to a governance framework that contains technical, legal and political mechanisms would help realise the benefits and manage the risks of using telemedicine services in a transparent and explicit way (OECD, 2015[141]). As an example, the **United States'** HIPAA guidelines on telemedicine clarify what measures should be introduced to secure the integrity of electronic protected health information. The challenge, from a regulator's point of view, is to design a framework that minimizes clinical, privacy and security risks, encourages innovation, and prevents ineffective, unsafe and low-value products and services from flooding the market, crowding out more effective and beneficial products and services (OECD, 2017[142]).

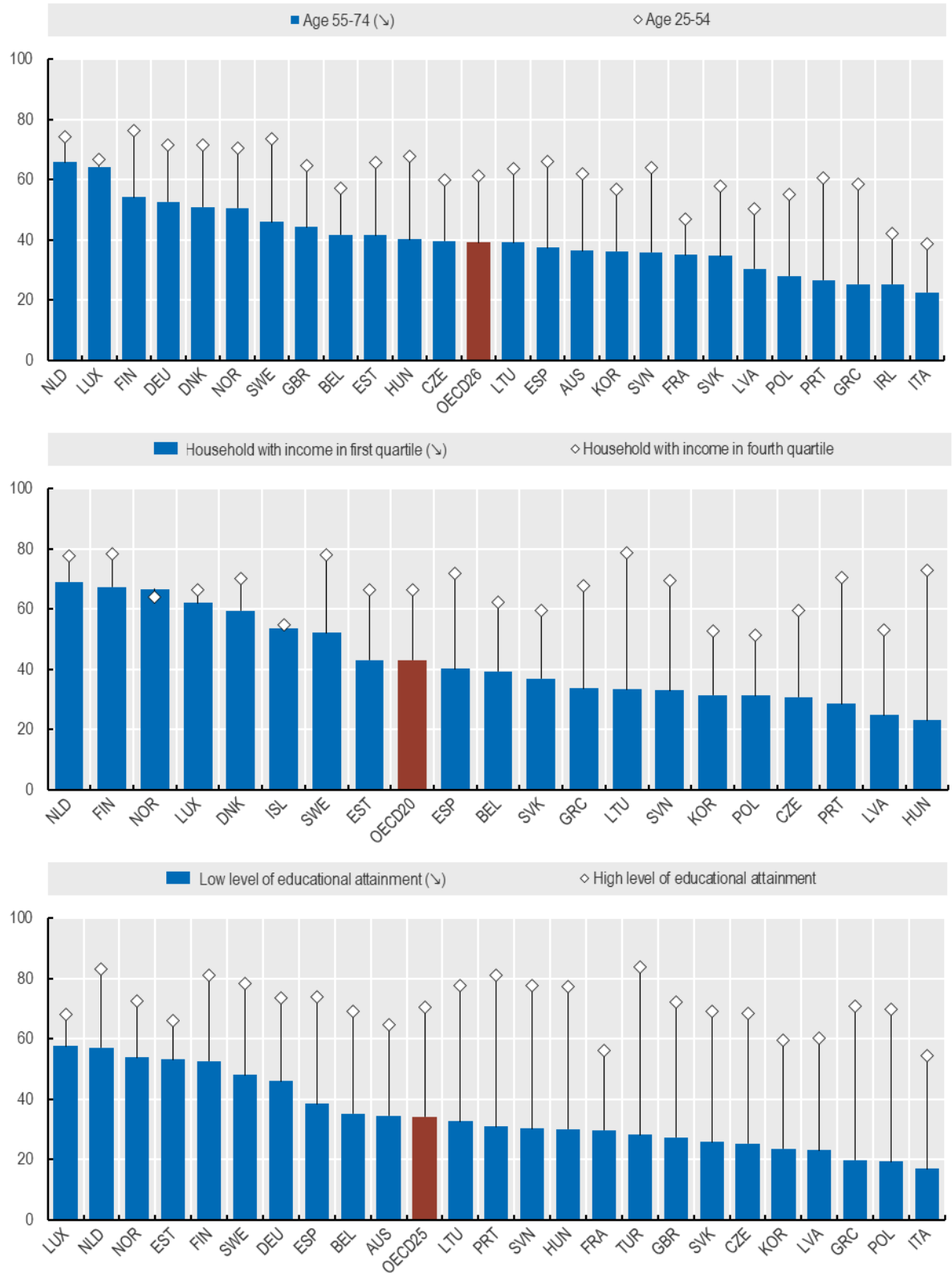
2.2.2. Patient related factors are key enablers of wider telemedicine use

65. Four countries considered that in order for telemedicine services to be used more widely, there must be evidence that these services increase quality and provide benefits to patients. As one country expert noted, patients must not feel that they are being offered a lower-quality alternative through telemedicine. This is especially true for rural patients who may see telemedicine as a deterrent to more face-to-face services. Three countries mentioned that telemedicine services must to be easy for patients (and providers) to use. This is in line with evidence from the umbrella review, although studies tend to focus more on barriers than enablers to wider use of telemedicine among patients. Barriers to patient uptake and sustained use mentioned in the literature include lack of training, transmission with delayed feedback, poorly designed interfaces requiring manual input, lack of collaboration between implementers and end users, inability to tailor and adapt the technology to meet specific patient needs, low patient motivation, lack of confidence, technological illiteracy, lack of support from medical staff, and patient preferences for face-to-face care (Gorst et al., 2014[138]; Slater et al., 2017[139]; Cruz, Brooks and Marques, 2014[140]; Greenhalgh, A'Court and Shaw, 2017[141]; Macdonald, Perrin and Kingsley, 2018[142]).

Inequalities in digital health literacy and access must be tackled for telemedicine to succeed

66. Two countries noted the importance of digital health literacy to achieve the full potential of telemedicine in reaching those patients that most need it. Telemedicine interventions can increase patients' awareness and understanding of their health problems and symptoms, help them self-manage their condition better, empower them to adopt a proactive role in their care, and improve relationships between patients and health workers, promoting shared decision-making (Caffery et al., 2017[35]; Cruz, Brooks and Marques, 2014[129]; Qudah and Luetsch, 2019[130]; Walker et al., 2019[131]). But, for this to happen, patients must have trust in the technology, be confident that they have the skills or can learn them, and be able to find support in care services (Walker et al., 2019[131]). The challenge is that the patients that most stand to benefit from digital technologies like telemedicine are also those who are most likely to face difficulties in accessing and using it. This is the case for rural patients, whose broadband access is not always appropriate, but barriers goes beyond internet coverage. There are significant demographic and socio-economic gradients in the use of the digital health among patients (see Figure 2.3).

Figure 2.3. Percent using internet to seek health information, by age, income and education



Note: Data shown are for 2017 and refer to internet searches in the last 3 months.
Source: OECD database on ICT Access and Usage by Households and Individuals.

67. Around 61% of people aged 25 to 54 years old used the internet to search for health information, compared to 40% of individuals aged between 55 and 74 (see Figure 2.3). As previously mentioned, interactive telemedicine services, like those offered by GP at Hand, tend to attract many more younger patients than older patients (Iacobucci, 2018[144]). Age is a key dimension in digital health literacy, with important consequences for telemedicine adoption and use. The number of chronic conditions increases with age, with nearly 65% of those aged 65-84 estimated to have more than one chronic condition, a prevalence that reaches 89% for those aged 85 and over (OECD, 2017[9]). Rural areas have higher shares of older people (UNECE, 2017[145]). It is thus likely that even if telemedicine services are available to older people, they might struggle to make use of them. Younger patient groups might be more receptive. Grist et al. (2017[146]), for example, found that telemedicine interventions delivered through mobile apps were acceptable to children and adolescents with mental health conditions.

68. It is likely that as younger generations age, digital literacy will become less of a challenge. However, there are also socio-economic gradients that can act as barriers to wider telemedicine use. Across the OECD, poorest and least educated individuals were 65% and 50% less likely to use the internet to seek health information than respectively the richest and most educated citizens were. Exposure to poor working conditions, smoking, overweight and heavy drinking (among men) is less frequent among the most educated people in a vast majority of **European** countries (OECD, 2019[14]). When controlling for differences in health care needs, people with lower income are less likely to visit a doctor, especially a specialist, in most European countries (OECD, 2019[14]). As with age, it is those on lower incomes and with lower educational attainment that most stand to benefit from the increased access that telemedicine provides, yet they are also the most likely to lack the health and digital literacy to use telemedicine services.

2.2.3. Health care systems and workers are hesitant to adopt telemedicine more widely

69. A culture of change and adoption of new technologies was considered by twelve countries as a key factor in both hindering (eight countries) and enabling (four countries) the use of telemedicine more widely. There are good reasons for health care systems and workers to be cautious of adopting new – often unproven – ways of delivering care. As shown before, there is a large and growing body of evidence indicating that care can be safely delivered through telemedicine as effectively, if not more, as through face-to-face interactions, while increasing access to underserved populations. However, limited generalisability and low quality of reporting on economic evaluations impede wider understanding of how best to implement telemedicine services (what works well, where and when). Telemedicine services are contextual. As two countries noted, the most successful telemedicine interventions are those that emerge naturally as solutions to existing problems and with clear economic rationales (two countries mentioned the lack of economic evaluations was a barrier). Yet, as one country expert put it, often telemedicine services are pushed as solutions in search of problems, with little understanding of the local contexts.

70. More than half of US physicians experience substantial symptoms of burnout, with work process inefficiencies (often related to digitalisation of administrative and care processes) and excessive workloads being key determinants (Dyrbye et al., 2017[152]). Every year, health care workers are subjected to new initiatives and recommendations and each new initiative often requires the allocation of scarce work time to learning, adjusting and incorporating the new practice into their everyday routines (Ead, 2015[153]). Often, even after all the effort, new initiatives fail to deliver; almost one in every five software projects in health care between 2011 and 2015 failed (The Standish Group, 2015[154]). Digital technologies, like telemedicine, are both technology and service innovations, requiring a wide array of organisational, financial and clinical changes across multiple institutions and professions. With workers already stretched, there is a serious risk of change fatigue: workers getting tired of new initiatives and the way they are implemented (Garside, 2004[155]). Furthermore, it is likely that patients are only exposed to telemedicine interventions after they have been vetted and worked out by health workers, which would explain why telemedicine interventions are almost systematically more acceptable to patients than to health care providers (Bashshur et al., 2016[156]).

71. Three countries noted the importance of having appropriate clinical models in place to ensure quality and continuity of care. Two countries reported that it was essential for telemedicine adoption and use to be recognised as a priority, given other competing priorities. Two countries reported that providing clarity on the division of tasks and responsibilities would enable greater use of telemedicine services, and another two countries mentioned practical challenges in coordinating the schedules of multiple health care workers participating in telemedicine encounters. These views on barriers and enablers to wider telemedicine use at the level of health systems and workers are in line with evidence from the umbrella review. Staff factors that affect the sustainability of telemedicine include the absence of champions, dislike of new clinical routines or interactions, and perceptions of no value or compromised clinical expertise (Greenhalgh, A'Court and Shaw, 2017[139]). Technical factors include unreliable or difficult technology and inadequate technical support, while service factors include lack of clarity on who will interpret or act on remote monitoring data (Greenhalgh, A'Court and Shaw, 2017[139]). Barriers to the implementation of eHealth services across all health care settings include cost, complexity, adaptability, implementation climate, external policies, knowledge and beliefs, planning and engagement (Ross et al., 2016[157]). Costs include start-up costs, operating costs, and loss of revenue. Liability coverage and absent or inadequate legislation and policies, further hinder implementation at organisation and health worker levels. Furthermore, eHealth interventions may be incompatible with health systems, work practices or daily clinical work leading to disruptions in workflow and delivery of care. Finally, lack of strategic planning and engagement of key stakeholders in development, selection and adoption of eHealth systems are associated with failure.

72. Medical councils or other professional organisations also have a fundamental role in promoting, or otherwise, the use of telemedicine. Three countries noted that professional organisations' views and guidance on telemedicine were important determinants of use, and another two countries considered medical licensure a barrier to wider adoption of telemedicine services. As previously discussed, medical licensure and professional organisations can promote care quality and safety, but they may also restrict the provision of needed remote health care services, either explicitly by advising against or even prohibiting them, or implicitly by allowing a void in regulations and guidelines. As pointed out, there are no European norms dealing with the regime of medical liability (Raposo, 2016[25]). Both conscientious providers and careless, or even negligent, ones can fill such a regulatory void. There is a risk of malpractice and harm to patients that, if materialised, can diminish public trust in institutions, and hinder the use of safe and effective telemedicine services that provide real benefits to patients, providers and health care systems.

3 How can countries promote appropriate use of telemedicine?

73. Telemedicine services have the potential to improve effectiveness, efficiency and equity in health care, helping policy makers respond to increasing patient demands and needs. However, telemedicine interventions can also introduce new risks and amplify existing inequalities. In order for countries to maximise the benefits and limit the risks, telemedicine services need to improve the quality of care and provide clear benefits for patients. Telemedicine programmes that do not have benefits for patients are not worth pursuing and detract attention from other more effective interventions. Health care providers and patients more easily adopt telemedicine interventions that meet existing patient needs in a safe and secure way, using technologies that are easy to use and perhaps even co-designed.

74. As providers and patients explore how telemedicine can contribute to more effective, timely and safe health care services that are well aligned with the preference and needs of patients and communities, they often hit a wall of regulatory uncertainty, patchy financing and vague governance. As a result, potential bottom-up solutions never make it past pilot stages at local levels of provision. It is undoubtedly challenging for policy makers to provide clarity on the provision of care through telemedicine. However, throughout the OECD, some policy makers are becoming facilitators, helping local and emergent best practices spread across health care systems. Identifying these emerging best practices can be challenging nonetheless.

75. Telemedicine services are both technological and service innovations. They go much further than simply digitising traditionally analogue health care processes and services, they fundamentally reorganise processes, procedures and services (OECD, 2019[5]). The challenge is that processes and care models that are well aligned with the preferences and needs of certain communities may not be generalisable to other communities. RCTs – the "gold standard" of effectiveness research – have been widely used in the pharmaceutical sector to provide evidence of high internal validity under carefully controlled conditions (OECD, 2019[158]). While RCTs have strong internal validity, they are less useful when interventions are implemented in different settings and populations, or even when small process changes are made to interventions in the exact same setting and population. It is increasingly clear that evaluating digital health technologies like telemedicine requires a process of continuous learning, a mix of methods, and the use of both experimental and non-experimental "real world" data (OECD, 2019[158]). A transition to learning health care systems is needed to reap the benefits of telemedicine and other digital technologies.

3.1. Telemedicine services deliver when they meet patient needs and preferences

76. Telemedicine services need to improve health care quality and meet needs of patients, which are key dimensions of people-centredness. That is the standard for any other health intervention or technology and it is no different for digital health technologies such as telemedicine applications. Telemedicine interventions are successful when they are designed to address specific clinical and behavioural problems identified as priorities by patients, tailored to patient characteristics and preferences, financially accessible to patients, contribute to shared decision making, and are coupled with appropriate support and training (Macdonald, Perrin and Kingsley, 2018[146]; Radhakrishnan et al., 2016[159]; Meurk et al., 2016[160];

Greenwood, Young and Quinn, 2014[161]; Berry et al., 2016[162]; Kampmeijer et al., 2016[163]). A key question for any telemedicine programme is how does this programme benefit patients? Considering patient benefit early on can deter the adoption and use of wasteful, or even potentially harmful, telemedicine interventions.

77. People-centred telemedicine services that improve quality and add value for patients are more likely to be adopted and promoted by health care workers. Nurses and doctors are among the professions that the public most trusts (Ipsos MORI, 2017[164]) and patients value continuity of care (Turner et al., 2007[165]; Gerard et al., 2008[166]). Telemedicine services that are backed by health care workers are more likely to be accepted, culturally appropriate and understanding of local context (Wickramasinghe et al., 2016[148]; Castle-Clarke and Imison, 2016[137]). Frontline health workers are best positioned to understand patient needs, wants and satisfaction with care services, delivered via traditional face-to-face encounters or remotely through telemedicine. Consequently, they are also better able to judge the appropriateness of a specific telemedicine service for a specific patient or community. Appropriately defining the target patient group for a given telemedicine programme is essential as not every patient can benefit from remote care services. Furthermore, patients who may stand to benefit, may lack the health and digital literacy needed to realise those benefits, and thus may require more support and training. It is also important to ensure that the same standards of medical need and coverage are applied in both the conventional and the digital care pathways, to prevent cherry-picking and frivolous supply-induced demand.

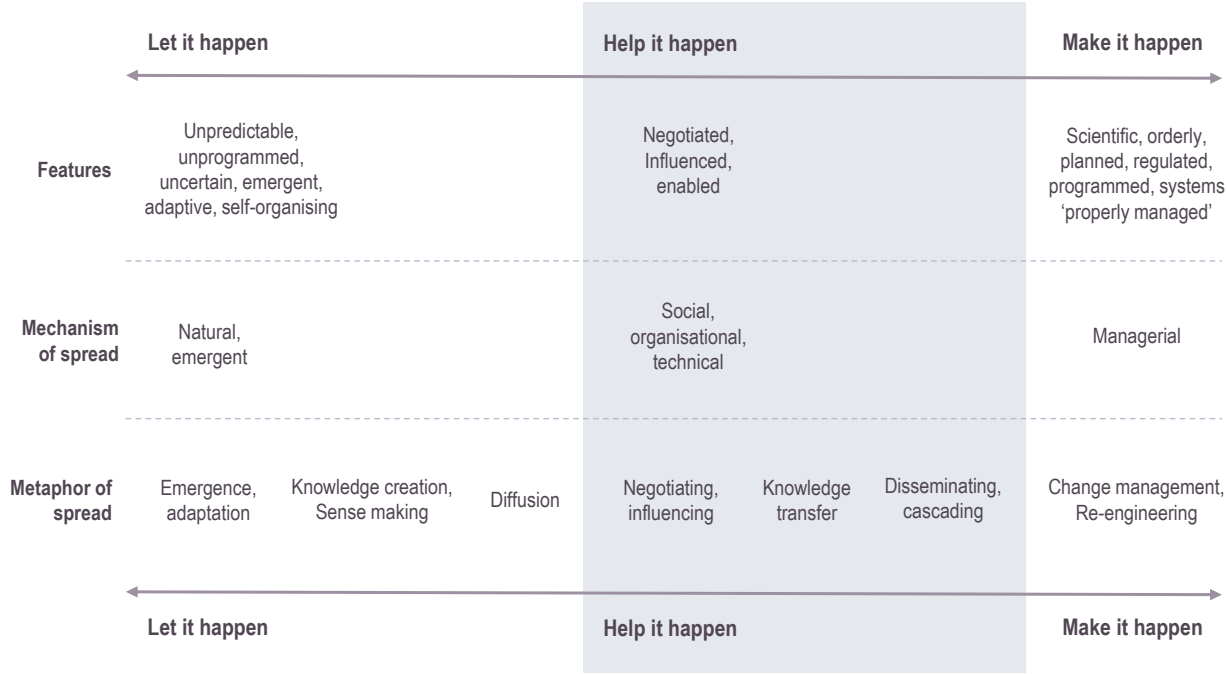
78. To understand if telemedicine services are meeting patient needs and preferences, countries must collect data on patient experiences. Most OECD countries collect nationally representative data on patient experience in a regular and systematic way (Fujisawa and Klazinga, 2018[167]). Yet, systematic collection of patient-reported experience and outcome measures from patients receiving care via telemedicine is virtually non-existent, even though the same digital technologies used to deliver care could, within certain conditions, be used to collect patient experiences (O'Connell et al., 2018[168]). In the **United Kingdom**, the Whole Systems Demonstrator trial included a study of patient reported outcomes (Cartwright et al., 2013[169]), and in **Canada** there is interest in wider and more sophisticated use of patient satisfaction surveys (COACH and CTF, 2015[170]). It is also important that patients are offered face-to-face alternatives if they are not comfortable receiving care remotely through telemedicine. Furthermore, telemedicine services will not completely substitute for face-to-face care, so the interface between telemedicine and face-to-face care needs to be carefully considered. This is especially pertinent given the wide disparity in access between conventional and digital care pathways. While telemedicine services are typically easily accessible, sometimes within minutes, access to face-to-face services is often hindered by distance, travel time, mobility, office hours, and possibly long waiting lists. Patients might find this differential difficult to understand.

3.2. Policy makers should be facilitators promoting the spread of best practices

79. Countries where telemedicine services are most advanced are those that have clear regulations and guidance, appropriate and sustained financing and reimbursement, and good governance. Importantly, they are facilitators of telemedicine development and use: they create the conditions for good practices to spread, they "help it happen" (see Figure 3.1). As mentioned, successful telemedicine interventions tend to emerge from health care providers seeking to improve care quality and meet their patients and communities' needs and preferences. Yet, for innovations to emerge and spread, a supportive policy environment is needed. Communities are best placed to define local priorities, identify needs and preferences and select health initiatives that best suit their context, while ministries are best placed to define national priorities, and identify, assess and disseminate best practices. Countries where telemedicine use is most advanced are countries where policy makers are facilitators, enabling the spread of best practices through knowledge transfer and dissemination (see Figure 3.1).

Figure 3.1. Policy makers should facilitate the spread of best practices in telemedicine

Countries where telemedicine services are most advanced are those that "help it happen"



Source: Adapted from Figure 2 in (Greenhalgh et al., 2004[171]).

80. There are dangers in top-down approaches. Change happens at the level of health care workers. When policy makers and institutions push for certain solutions, there is a risk of failure if solutions do not meet the needs of patients and health care professionals. With health workers often stretched, there is a risk of change fatigue, to the detriment of initiatives that actually have benefits. Large scale ICT projects tend to fail at a higher rate than smaller ones, and most large, complex, multi-year projects can be broken down into multiple small projects (The Standish Group, 2015[154]). One of the world's largest public ICT projects in health care – the United Kingdom's NPfIT – was officially dismantled almost 10 years after its launch, significantly over budget and with many of its services undelivered (Justinia, 2017[172]). The government press release announcing the end of the project stressed that a centralised top-down approach was ultimately inappropriate and that future IT projects in the National Health Service would be driven by local decision makers, to better suit their needs and capacity (Justinia, 2017[172]).

81. One important way in which governments can enable the spread of good practices is through knowledge aggregation, sharing and dissemination. In the **United Kingdom**, Global Digital Exemplars – health care providers that have been recognised as using digital technologies and information to improve care quality – share their experiences with other providers through blueprints developed to allow quick and effective knowledge sharing. Exemplars, and "fast followers" seeking to use the blueprints, are supported by a central budget, from which any investments have to be locally matched. In **Norway**, task forces composed of providers who have successfully established telemedicine services in their municipalities, can provide advice to other municipalities who have an interest in a given initiative. The release of national or regional annual reports on the state of telemedicine, as in **Denmark**, the **Netherlands** and **Canada**, can also provide an opportunity to advertise the benefits of successful projects and disseminate good practices. Cross-country programmes, from **European** initiatives – such as RENEWING HeALTH, TeleSCoPE, MOMENTUM, United4Health, Thalea and ELECTOR – to **Nordic** initiatives – such as the VOPD priority project that is part of the Swedish Presidency Programme of Nordic Council of Ministers 2018 – are also effective ways to spread good ideas across national borders.

82. Health care policy makers can engage with stakeholders to set and promote interoperability standards, and legislate or incentivise providers to adhere to those standards (Oderkirk, 2017[135]). More broadly, governments can promote effective use of digital health technologies among providers and patients by fostering strategic investments in infrastructure (e.g. broadband access in rural areas), ensuring everyone has the skills needed to benefit from the digital transformation, and raising awareness of digital risks (OECD, 2019[1]). To support innovation while maintaining high quality and safety standards, regulators can experiment using, for example, risk-based approaches or performance-based regulation, as well as use regulatory "sandboxes" to promote the flexible application or enforcement of policies, enabling new models of care to be tested with fewer regulatory requirements (OECD, 2019[1]). The Care Quality Commission, in England, has recently invited innovators and services that involve digital clinical triage to join its regulatory sandbox. Establishing guidelines and public guidance can also reduce uncertainty and help fill regulatory voids. Medical colleges in most Canadian provinces have published telemedicine bylaws or policies. In Mexico, the CENETEC has reference tools for telehealth and provides legal documentation for health workers. The Norwegian Centre for E-health Research collects, produces and communicates knowledge for eHealth policy making. Portugal has established a rich network to support the use of telehealth and telemedicine (see Box 3.1).

Box 3.1. Telemedicine promotion through governance: an example from Portugal

Portugal has made strong and sustained efforts to provide guidance and support for telemedicine programmes, promoting clarity of roles and ownership of processes. The Ministry of Health's SPMS (Shared Services of Ministry of Health) provide services in the areas of purchasing and logistics, financial services, human resources and systems, and ICTs, to entities of the National Health Service, to centralise, optimise and rationalise the procurement of goods and services.

Within the SPMS, the CNTS (National Telehealth Centre) promotes innovation and the use of ICTs, encouraging synergies via a network that brings citizens closer to health providers. By coordinating, contributing to regulations and providing services, the CNTS supports the regular practice of telehealth at national level..

The CNTS oversees the Telehealth Promotion Network, which is composed of Regional Telehealth Coordinators (from Regional Health Administrations) and Internal Telehealth Promoters (from health care units). The Coordinators promote the use of telehealth in their region's health care units by supporting, coordinating and potentially supervising the transformations needed for wider use of telehealth. The Promoters encourage telehealth activities within frontline health care providers.

The SPMS and CNTS are also responsible for drafting the *Plano Estratégico Nacional para a TeleSaúde* (The National Strategic Plan for Telehealth) for discussion with the Ministry of Health. The National Strategic Plan for Telehealth is aligned with the National Health Plan, the Government Programme, and the Health 2020 policy framework and strategy. The CNTS also provides resources to assist health care workers in the implementation and management of telehealth services, including a tool kit to help providers adopt teleconsultations.

The use of telemedicine and telehealth is further enabled through numerous strategies, documents and technologies, including: the ENESIS (National Strategy for the Health Information Ecosystem); the SIMPLEX and particularly Simplex + Health (National Programme of Modernisation of the State, in the area of health); the RIS (Health Informatics Network); the PEM (Medical Electronic Prescription); the RSE (Electronic Health Record) which is accessible to citizens; a referral system built-in to the EHR; a platform for real-time teleconsultations (EHR Live!); and the eBoletim (Digital Vaccine Record).

Source: OECD Snapshot Survey on Telemedicine (2019) and interviews with country experts.

3.3. Transition to a learning health system to fully benefit from telemedicine

83. Telemedicine services have the potential to deliver great benefits for patients and health care systems but there are risks as well (Iacobucci, 2018[180]). This balance needs to be made explicit, and evaluations must be performed rigorously and regularly to guarantee that potential benefits are maximised and possible risks are minimised. The challenge is how to evaluate telemedicine interventions in a way that combines a rigorous assessment of the causal effect of the intervention on the outcomes (internal validity) with an adequate appreciation of the contextual and organisational factors that mediate that causal effect (external validity). Achieving both high internal and external validity is very challenging, but it is essential in the context of telemedicine services. As noted, telemedicine interventions are both technological and service innovations, allowing providers to fundamentally rethink and reorganise processes, procedures and services in line with health care workers, patients and communities' needs and preferences. Successful telemedicine services tend to be tailored to a specific setting and population. They also tend to evolve rapidly as patients and providers learn how to use them and adapt them to their

contexts. With these types of interventions, it is not only important to be able to attribute the outcomes to a specific intervention, but also to be able to pinpoint how and why the intervention achieved those outcomes (Barratt et al., 2016[174]). Evaluations must shed light on both the outcomes and the processes.

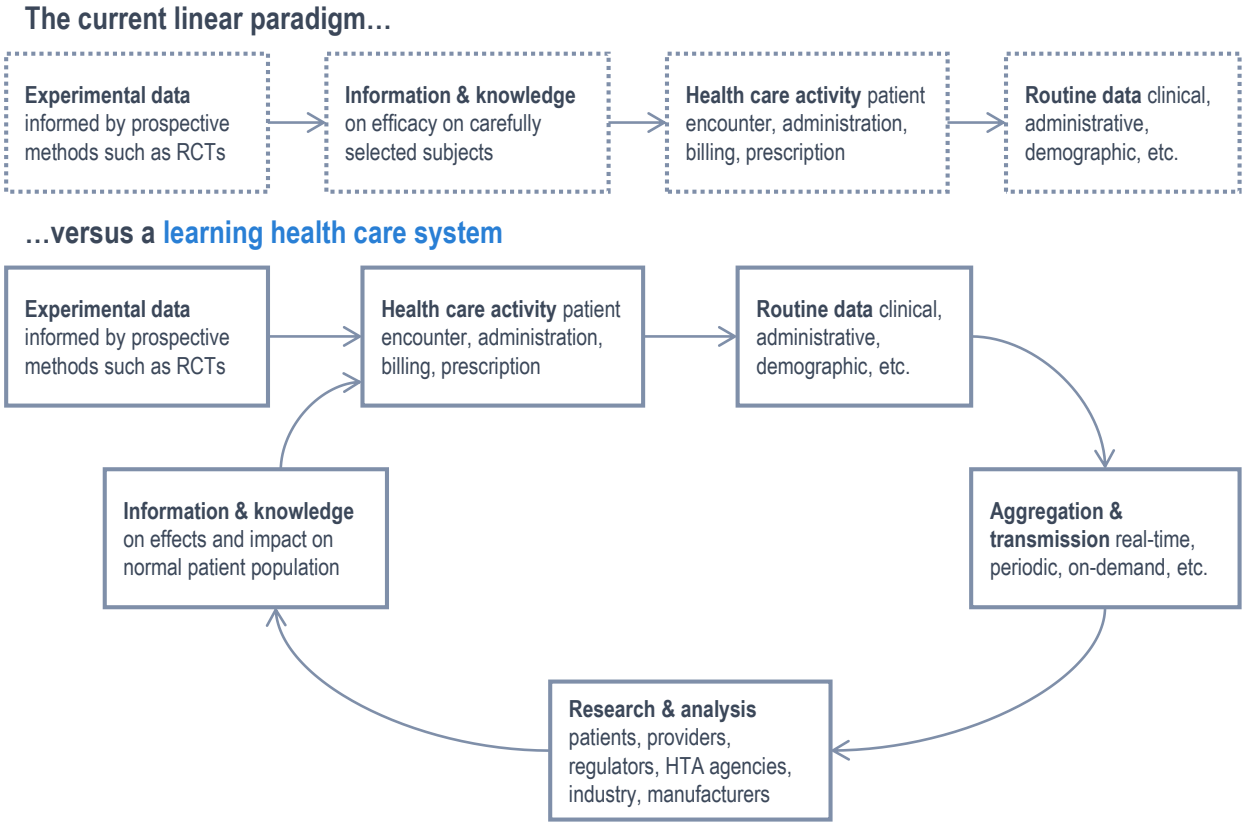
84. RCTs, widely considered the "gold standard" of effectiveness research (OECD, 2019[158]), are built on the notion that when contextual factors are removed (i.e. controlled for) and patients are randomised to alternative treatment groups, differences in outcomes can be attributed to the interventions (Blackwood, 2006[173]). RCTs have high internal validity, but for their findings to be generalisable, the interventions being assessed need to be standardisable: they must be applied in any other setting in the same exact way. Telemedicine interventions are not fully standardisable, so evidence from RCTs should be combined with "real-world" data – routinely collected patient-level data – to capture the effects of these interventions. While there are extensive guidelines on conducting RCTs, guidance on how to produce evidence from clinical practice is still developing (OECD, 2019[158]). The **European Commission** is particularly active in this area, with several initiatives to expand health technology assessments (HTAs), including IMPACT HTA10, PECUNIA and HTx. The last one, HTx, is particularly relevant as it seeks to facilitate the development of methodologies to deliver more customised information on the effectiveness and cost-effectiveness of complex and personalised combinations of health technologies, including Artificial Intelligence and Machine Learning systems. The **World Health Organization** and the **International Telecommunication Union** are also working in this area, and have established a Focus Group on Artificial Intelligence for Health, which is developing a benchmarking process for health artificial intelligence models that can act as an international, independent, standard evaluation framework (Wiegand et al., 2019[175]).

85. In the context of telemedicine specifically, the Model for Assessment of Telemedicine (MAST), developed in **Denmark** is an evaluation framework used in multiple large cross-country European telemedicine initiatives using a multidisciplinary process to evaluate the medical, social, economic, and ethical aspects of telemedicine in a systematic, unbiased, robust manner (Kidholm et al., 2017[176]). The multidisciplinary assessment includes health needs, safety, clinical effectiveness, patient perspectives, economic aspects, organisational aspects and socio-cultural, ethical and legal aspects. In the **United Kingdom**, the National Institute for Health and Care Excellence has published an Evidence Standards Framework for Digital Health Technologies, including telemedicine (NICE, 2019[177]). The **Canadian** Agency for Drugs and Technologies in Health suggests that cost-consequence analyses – a type of full economic evaluation in which costs and outcomes are listed separately in a disaggregated format – can be useful in the context of more complex interventions, with effects outside the health care system (e.g. carbon emissions) (CADTH, 2017[178]). A cost-consequence analysis is also useful when there are many non-clinical consequences beyond the health care sector (e.g. patient travel costs). In **Spain**, the Ministry of Health, Consumer Affairs and Social Welfare has published detailed guidance on the design, evaluation and implementation of telemedicine services (Serrano Aguilar and Yanes López, 2006[179]).

86. Importantly, evaluation is just one element. More broadly, a culture of continuous learning is needed to benefit fully from telemedicine. Health care systems need to transition to learning health care systems (see Figure 3.2) in which evidence is both applied and developed as a natural product of the care process (Institute of Medicine, 2007[179]). The Agency for Healthcare Research and Quality, in the United States, describes learning health care systems as (AHRQ, n.d.[180]):

- Having leaders who are committed to a culture of continuous learning and improvement.
- Systematically gathering and applying evidence in real-time to guide care.
- Employing ICT to share new evidence with clinicians to improve decision-making.
- Promoting the inclusion of patients as vital members of the learning team.
- Capturing and analysing data and care experiences to improve care.
- Continually assessing outcomes, refining processes and training to create a feedback cycle for learning and improvement.

Figure 3.2. A transition to learning health care systems is needed to benefit fully from telemedicine



Source: (OECD, 2019[7])

87. What is needed to transition into a learning health care system is also what is needed to maximise the benefits of telemedicine and limit the risks. A culture of continuous learning and improvement requires targeted and sustained funding (including for temporary loss of productivity as health care workers adjust), reimbursement mechanisms that reward rather than disincentivise new and innovative care models, and the adoption of technical, legal and strategic elements needed to harness all sources of data – experimental and "real-world" – for public benefit (OECD, 2019[183]).

4 Conclusions

88. As economies, governments and societies across the globe are going digital, also patients and health care providers, workers and services are going online. Most individuals in the OECD are now comfortable using digital technologies in their daily routines and expect the same level of responsiveness and ease of use in health care. Providers and policy makers are also exploring new models of care enabled by digital technologies, with the expectation that these will help them meet growing patient demands with quality care and at sustainable cost. While a majority of OECD countries allow at least some form of telemedicine, policies vary widely in terms of the types of telemedicine allowed, the funding and payment schemes used, distance and geographical requirements, eligibility of health care workers to participate, target patient groups and consent, and integration with existing more traditional face-to-face health care services. Despite growing interest in, and increasing use of, telemedicine services, these remain limited as a share of total health care activity. In part, this is due to an uncertain policy environment.

89. Telemedicine is being used across the OECD to deliver health care in a wide range of specialties (e.g. neurology, psychiatry), for numerous conditions (e.g. stroke, COPD) and through varied means (remote monitoring, store and forward, real-time videoconsultations). While this broad heterogeneity in contexts and applications does pose challenges to evaluation, there is a growing body of evidence that health care can be safely delivered via telemedicine and be effective, even leading to better patient outcomes than conventional face-to-face care. Telemedicine services can also be cost-effective in different settings and contexts, especially when services are centred on the needs and preferences of patients and communities. Despite the potential benefits, throughout the OECD, there are important barriers to wider use of telemedicine, many related to public policy. Providers and patients seeking to make use of telemedicine services face regulatory uncertainty, patchy financing and reimbursement, and vague governance mechanisms. Many within the health care system are often resistant to telemedicine services that they see as just more top-down initiatives, technical solutions in search of problems, with no appreciation for the community's needs, preferences, and competing priorities. As for patients, those that most stand to benefit from telemedicine are also often those that are least likely to be able to access and make use of it, due to inequalities in health and digital literacy, as well as socio-economic factors.

90. Telemedicine services have the potential to improve effectiveness, efficiency and equity in health care, but they can also introduce new risks and amplify existing inequalities. Policy makers seeking to maximise the potential benefits and limit the possible risks of telemedicine services can:

- **Ensure that only telemedicine services that improve health care quality and provide clear benefits to patients are pursued**. Telemedicine services should emerge as a way to meet needs and preferences of patients and communities.
- **Facilitate wider and appropriate telemedicine use, helping local and emergent best practices spread across health care systems**. By having clear regulations and guidance, sustained financing and payment, and sound governance, policy makers can create the conditions for good telemedicine practices to spread through knowledge sharing and dissemination.
- **Promote a transition to learning health care systems** in which a culture of continuous learning and improvement, rewarding new and innovative care models, and harnessing all sources of data for public benefit can help reap the benefits of telemedicine and other digital technologies.

Annex A. Country participation in data collection

Table A.1. Country participation in snapshot survey and semi-structured interviews

Country	Snapshot survey	Semi-structured interviews
Argentina	Participated	Participated
Australia	Participated	Participated
Austria	Participated	Did not participate
Belgium	Participated	Did not participate
Canada	Participated	Participated
Chile	Did not participate	Did not participate
Costa Rica	Did not participate	Did not participate
Czech Republic	Participated	Participated
Denmark	Participated	Participated
Estonia	Participated	Did not participate
Finland	Participated	Did not participate
France	Did not participate	Did not participate
Germany	Participated	Did not participate
Greece	Participated	Did not participate
Hungary	Participated	Did not participate
Iceland	Participated	Participated
Ireland	Participated	Participated
Israel	Participated	Did not participate
Italy	Did not participate	Did not participate
Japan	Participated	Did not participate
Korea	Did not participate	Did not participate
Latvia	Participated	Did not participate
Lithuania	Participated	Participated
Luxembourg	Participated	Did not participate
Mexico	Participated	Participated
Netherlands	Participated	Participated
New Zealand	Did not participate	Did not participate
Norway	Participated	Participated
Poland	Participated	Did not participate
Portugal	Participated	Participated
Slovak Republic	Participated	Did not participate
Slovenia	Participated	Participated
Spain	Participated	Did not participate
Sweden	Did not participate	Did not participate
Switzerland	Did not participate	Did not participate
Turkey	Did not participate	Did not participate
United Kingdom	Participated	Did not participate
United States	Participated	Did not participate
Number of countries participating / total	*29 / 38*	*13 / 38*

The Secretariat thanks the country experts who participated in the semi-structured interviews.

Table A.2. Country experts who participated in semi-structured interviews

Country	Experts
Argentina	Fernando Plazzota, Hospital Italiano de Buenos Aires
Australia	Jeff Ayton, Australian College of Rural and Remote Medicine Alan Taylor, Australasian Telehealth Society
Canada	Edward M. Brown, Ontario Telemedicine Network
Czech Republic	Lenka Lhotská, Czech Institute of Informatics, Robotics, and Cybernetics
Denmark	Mathias Boberg Christensen, Ministry of Health
Iceland	Sigurður E. Sigurðsson, Akureyri Hospital and University of Akureyri Sigridur Jakobinudottir, Ministry of Health
Ireland	Sarah Murphy, Department of Health Niall Sinnott, Department of Health
Lithuania	Anonymous, Ministry of Health
Mexico	Monica Armas Zagoya, Secretaria de Salud de Zacatecas
Netherlands	Chris Flim, Ministry of Health, Welfare and Sport
Norway	Thor Steffenson, Norwegian Directorate of Health. Espen Mikkelsen, Oslo kommune (Oslo municipality) Pia Braathen Schønfeldt, Ministry of Health and Care Services
Slovenia	Mate Beštek, National Institute of Public Health
Portugal	Micaela Monteiro, Centro Nacional de TeleSaúde Patricia Loureiro, Centro Nacional de TeleSaúde Maria Cortes, Centro Nacional de TeleSaúde Rafael Franco, Centro Nacional de TeleSaúde

Annex B. Umbrella review

Background and motivation

91. The number of peer-reviewed articles on telemedicine is growing at such a pace that it is virtually impossible for stakeholders to keep track of the literature. A search of Google Scholar using the search term "telemedicine" returns 495,000 records (34,000 records since 2015, an average of over 23 articles per day since 2015). The same search term returns 28,452 records on PubMed. When the term "systematic review" is added to the search in PubMed, the number of results is 788. Given these numbers, the best way to explore the literature on telemedicine is to conduct an overview of systematic reviews.

Definitions

92. Telemedicine is the use of telecommunication systems to deliver health care at a distance. Telemedicine can be split into three categories, which can be combined as appropriate: 1) remote monitoring, 2) store and forward applications, and 3) interactive (real-time) telemedicine. Remote monitoring is the use of mobile devices and platforms to conduct routine medical tests, communicate the results to health care professionals in real-time, and potentially launch pre-programmed automated responses. Store and forward systems are similar to remote monitoring applications but are used for clinical data that are less time-sensitive and for which a delay between transmission and response is acceptable (e.g. they have been widely used in dermatology and in regions with poor connectivity that precludes real-time transmissions). Finally, interactive real-time telemedicine involves direct and synchronous communication between health care professionals (e.g. in health care facilities or dedicated telemedicine centres) and patients (e.g. at home or in health facilities).

This definition excludes:

- Applications that do not involve any sharing of data or interactions (whether synchronous – interactive – or asynchronous – store and forward) between the patient and a health care provider/professional.
- Physician education and provider-to-provider communications.

Objectives

93. The field is extremely varied and existing reviews of telemedicine focus on many different topics, including combinations of different populations/problems, interventions/exposures, comparisons, and outcomes (or PICOs). The purpose of this overview of reviews is to capture the main themes in a diverse and rich literature marked by significant heterogeneity. The research questions are:

- What PICOs are being explored by systematic reviews of telemedicine?
- What is the impact of telemedicine on the outcomes included in the reviews?
- What are the main barriers and enablers of telemedicine discussed in the reviews?
- What are the main themes coming out of the systematic reviews?
- What is the strength of the evidence and general quality of the literature on telemedicine?

94. An umbrella review constitutes an appropriate methodology to answer these broad questions while maintaining a rigorous (and reproducible) process of study selection, appraisal and synthesis.

Review protocol

The review protocol builds on (Smith et al., 2011[184]), and was undertaken by two reviewers (NE & TCOH).

Sources and search strategy

95. Four online databases, Pubmed/Medline, the Centre for Reviews and Dissemination, and the Cochrane library were searched using a combination of controlled terms and free text (e.g. "Telemedicine (MESH terms)" and "systematic reviews or meta-analysis"). Hand searches, or searches based on expert opinion were not conducted.

Inclusion and exclusion criteria

96. In order to be included in the umbrella review individual studies had to:

- Be a systematic review and/or meta-analysis, have a clearly defined research question (or questions), well defined sources and search strategies, along with a priori inclusion and exclusion criteria, appraisal of individual studies in a systematic way, and a summary of the evidence.
- Focus on telemedicine as defined above.
- Have been published on or after 1 January 2014.
- Be available online (full manuscript).

97. Due to the fast growing pace of the literature, and technological advances made in the last decade, only systematic reviews published in the last five years (since 01 January 2014) were included in this umbrella review. Non-English language reviews, reviews where the full manuscript was unavailable, unpublished reviews, and reviews that focused on non-OECD countries were excluded.

Data collection and analysis

98. One reviewer (NE) screened all titles and abstracts identified from the searches for inclusion based on the inclusion criteria. Citations were coded as 'included', 'excluded' or 'unclear' as appropriate. Agreement was sought from the second author (TCOH) who either agreed or disagreed on what reviews to include. All disagreements were resolved through discussion.

Data extraction and management

99. One reviewer (NE) extracted data from all included reviews using a predefined data extraction form. The following information was extracted from reviews:

- Review title and authors.
- Number of primary studies included in the review.
- Countries of primary studies.
- Specialty/disease area of review.
- Type of telemedicine intervention used (i.e. telemonitoring, real-time or store-and-forward).
- Population, setting, interventions and comparisons (PICOs) relevant to telemedicine interventions.
- Qualitative outcomes relevant to this umbrella review.

- Quantitative outcomes and statistical summaries including pooled effects (e.g. risk ratio (RR), odds ratio (OR), mean difference (MD), standard mean difference (SMD)) as reported in individual reviews and their corresponding confidence intervals. The number of studies and participants contributing data to each pooled effect was also extracted where available.
- Results of any subgroup or sensitivity analysis conducted by review authors relevant to the primary outcomes of this review.
- Authors' conclusions and impact on outcome of interest for the umbrella review.
- Quality of included primary studies in review where reported.

Assessment of methodological quality of included reviews

100. The quality of included reviews was not assessed. However, care was taken to include only systematic reviews that met pre-specified criteria of rigour e.g. extensive searches and appraising the quality of included primary studies.

Quality of primary studies within reviews

101. The quality of primary studies within reviews was not assessed, but study quality was reported according to review authors' assessment of primary studies where available.

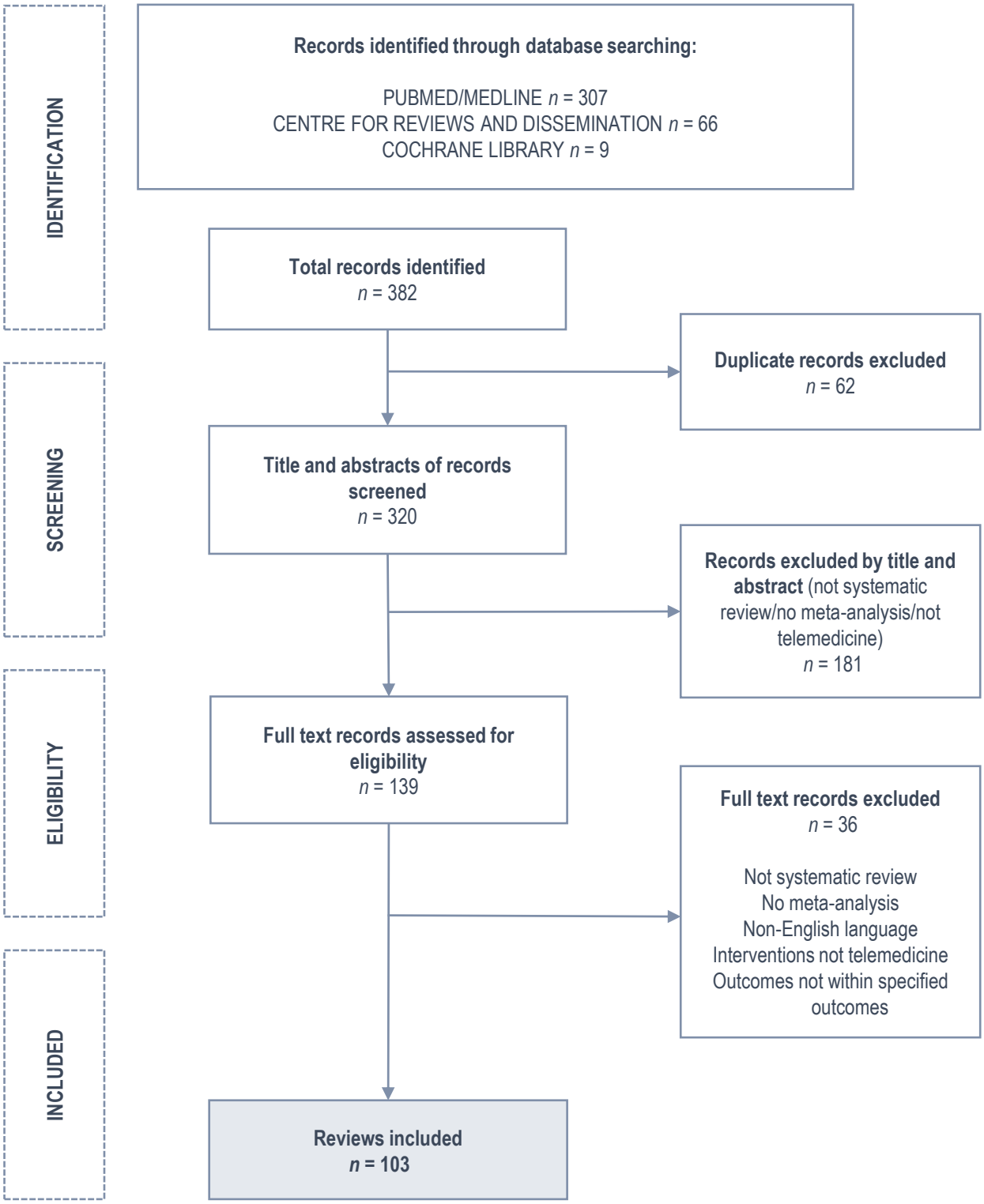
Data synthesis

102. The synthesis focused on four areas of interest: effectiveness, cost-effectiveness, patient experience, and implementation. The unit of analysis for this review is the systematic review and/or meta-analysis and not individual primary trials or studies included in the systematic reviews and/or meta-analyses. The focus of data presentation was descriptive, with tabular and graphical presentations where appropriate. Due to heterogeneity of populations, interventions and outcomes (PICOs) in the included systematic reviews, no attempt was made (e.g. meta-analysis) to compare telemedicine interventions across reviews or across review populations.

Results

103. Figure B.1 summarises the review selection process in a PRISMA flow diagram. The combined searches yielded 320 citations, of which 181 citations were not directly relevant to the outcomes of the review and were excluded at the title and abstract screening stage. Full texts were reviewed for 139 studies to assess eligibility, and 103 were eventually included in this review. Excluded citations and reasons for exclusion of full text reviews at the eligibility stage were documented. Following an initial assessment at the screening stage, it was agreed by the reviewers that on the topic of effectiveness, the umbrella review would focus only on systematic reviews and meta-analyses, while for other topics (cost-effectiveness, patient experience and implementation) there was no such criterion. This decision was made to limit the number of articles for data synthesis and to allow for a quantitative synthesis on the topic of effectiveness.

Figure B.1. Study selection (PRISMA) flow diagram



Note: funding for the databases DARE and NHS EED of the Centre for Reviews and Dissemination ceased at the end of March 2015. Bibliographic records were published on DARE and NHS EED until 31st March 2015. The Centre's HTA database continues to be updated.
Source: OECD analyses

Description of included reviews

104. Characteristics of the 103 included reviews are summarised in Table B.2 through to Table B.5. A total of 89 reviews addressed specific specialty or disease areas, while 14 reviews did not. Reviews that assessed more than one disease or specialty area were included as double listings in Table B.1 below.

Table B.1. Specialty areas of included reviews

Specialty area/focus	Included reviews	Number
Cardiology	(de la Torre-Díez et al., 2015[117])*, (Feltner et al., 2014[59]), (Flodgren et al., 2015[2])*, (Gorst et al., 2014[143])*, (Greenhalgh, A'Court and Shaw, 2017[145]), (Grustam et al., 2014[190]), (Hameed, Sauermann and Schreier, 2014[191]), (Hamilton et al., 2018[192]), (Huang et al., 2015[45]), (Kepplinger et al., 2016[193]), (Kitsiou, Paré and Jaana, 2015[194]), (Klersy et al., 2016[195]), (Kotb et al., 2015[56]), (Lee et al., 2018[196]), (Lundell et al., 2015[63]), (Merriel, Andrews and Salisbury, 2014[197]), (Rawstorn et al., 2016[67]), (Van Spall et al., 2017[60]), (Widmer et al., 2015[87])	19
Neurology & Mental Health	(Berrouiguet et al., 2016[185]), (Berry et al., 2016[162]), (Deady et al., 2017[73]), (Elbert et al., 2014[114]), (Gehring et al., 2017[186]), (Grist, Porter and Stallard, 2017[151]), (Linde et al., 2015[75]), (Meurk et al., 2016[160]), (Musiat and Tarrier, 2014[109]), (Nair et al., 2018[70])*, (Oosterveen et al., 2017[187]), (Rathbone and Prescott, 2017[77]), (Seyffert et al., 2016[76]), (Stratton et al., 2017[69]), (Thabrew et al., 2018[188]), (van Beugen et al., 2014[74]), (Vigerland et al., 2016[189])*, (Wootton, 2016[78])	18
Endocrinology	(Alvarado et al., 2017[198]), (Greenwood, Young and Quinn, 2014[161]), (Huang et al., 2015[199]), (Joiner, Nam and Whittemore, 2017[55]), (Liu et al., 2017[50])*, (Macdonald, Perrin and Kingsley, 2018[146]), (Ming et al., 2016[52])*, (Raman et al., 2017[200])*, (Rasekaba et al., 2015[53])*, (Su et al., 2016[201]), (Tchero et al., 2017[54]), (Toma et al., 2014[46]), (Wickramasinghe et al., 2016[148]), (Zhai et al., 2014[47])	14
Respiratory Medicine	(Brunton, Bower and Sanders, 2015[202]), (Cruz, Brooks and Marques, 2014[203]), (Cruz, Brooks and Marques, 2014[204]), (Gorst et al., 2014[143])*, (Hui et al., 2017[88]), (Liu et al., 2017[50])*, (López-Villegas et al., 2016[205]), (McLean et al., 2016[90]), (Udsen, Hejlesen and Ehlers, 2014[206]), (Zhao et al., 2015[89])	10
Rehabilitation	(Adamse et al., 2018[207]), (Agostini et al., 2015[65]), (Block et al., 2016[208]), (Cottrell et al., 2017[61]), (Hakala et al., 2017[209]), (van Egmond et al., 2018[62])	6
Dermatology	(Bruce, Mallow and Theeke, 2018[210]), (de la Torre-Díez et al., 2015[117])*, (Finnane et al., 2017[211]), (Fuertes-Guiró and Girabent-Farrés, 2017[124]), (Snoswell et al., 2016[115]), (Udsen, Hejlesen and Ehlers, 2014[206])	6
Obstetrics	(Ming et al., 2016[52])*, (Nair et al., 2018[70])*, (Raman et al., 2017[200])*, (Rasekaba et al., 2015[53])*, (Sherifali et al., 2017[86])	5
General Medicine	(Dario et al., 2017[64]), (Direito et al., 2017[81]), (Kelly et al., 2016[212])	3
Geriatric Medicine	(Kampmeijer et al., 2016[213]), (Kapadia et al., 2015[214]), (Marx et al., 2018[83])	3
Oncology	(Cox et al., 2017[215]), (Liptrott, Bee and Lovell, 2018[131]), (Seiler et al., 2017[68])	3
Gastroenterology	(Huang, Reich and Fedorak, 2014[216]), (Jackson et al., 2016[123])	2
Ophthalmology	, (de la Torre-Díez et al., 2015[117])*, (Toma et al., 2014[46])	2
Paediatrics	(Lee et al., 2016[217]), (Vigerland et al., 2016[218])*	2
Bariatric Medicine	(Hutchesson et al., 2015[219])	1
Primary care	(Bashshur et al., 2016[156])	1
Rheumatology	(McDougall et al., 2017[220])	1
Not specified	(Akiyama and Yoo, 2016[111]), (Bradford, Caffery and Smith, 2016[221]), (Caffery et al., 2017[37]), (Guise, Anderson and Wiig, 2014[222]), (Iribarren et al., 2017[223]), (Ito et al., 2017[224]), (Jeon and Park, 2015[49]), (Liddy, Drosinis and Keely, 2016[225]), (Michaud et al., 2018[116]), (Radhakrishnan et al., 2016[159]), (Ross et al., 2016[157]), (Sanyal et al., 2018[226]), (Slater et al., 2017[227]), (Speyer et al., 2018[228])	14

Note: * indicates a double listing
Source: OECD analyses

105. Included reviews were categorised according to the outcomes of interest to this umbrella review. A total of 57 reviews addressed the effectiveness of different telemedicine interventions, 19 focused on cost-effectiveness, 15 addressed patient experiences and 18 were on implementation of telemedicine. Some reviews addressed more than one outcome area. Key specialty areas covered in this umbrella review across all outcomes include cardiology with 19 reviews, mental health with 18 reviews, and

endocrinology with 14 reviews. A total of 64 reviews included details of the country of origin of primary studies, with 54 countries represented in these primary studies. Most of the primary studies originated from the United States (548), and Australia (250).

Brief summary of findings

106. This umbrella review identified a diverse and growing body of literature on telemedicine. By maintaining broad inclusion criteria for systematic reviews, this review provides a comprehensive summary of the current literature on telemedicine.

107. Fifty out of 57 (87%) effectiveness reviews included in this review found that telemedicine interventions are at least as effective as conventional face-to-face care. In specialty areas such as diabetes management and mental health, all included reviews found that telemedicine interventions were effective. One out of 57 reviews (2%) produced mixed results while six out of 57 (11%) included reviews were uncertain about the effectiveness of telemedicine.

108. Eight out of the 19 (42%) included reviews on cost-effectiveness concluded that telemedicine interventions were cost-effective compared to usual care. Five out of 19 reviews (26%) found that telemedicine may be cost-effective, two out of 19 reviews (10%) were unable to arrive at a conclusion about cost-effectiveness and four out of 19 reviews (21%) found that telemedicine was not cost-effective compared to usual care. Most of the reviews on cost-effectiveness reported shortcomings in the economic literature on telemedicine including a general paucity of economic studies, poor quality of available primary studies, poor outcome reporting, and lack of cost data. Cost-effectiveness is highly context specific, and depends on the accuracy of cost information, specialty area, setting, and health care system. These factors all contribute to the generalisability of findings. For example, some economic evaluations included in reviews only include costs to the health care system and do not include costs that may be incurred or spared by the patients or carers such as travel time, productivity or wage loss, accommodation costs or co-payments (Snoswell et al., 2016[115]). These studies do not provide a comprehensive picture of overall costs or cost savings of telemedicine interventions. Secondly, it is important to take into account the cost of treatments already in place, and how much societal value is placed on the improvement of a particular disorder e.g. the cost-effectiveness threshold.

109. The findings in this review suggest that patients demonstrate high acceptability and satisfaction with telemedicine. Telemedicine affords patients convenience, and independence to manage their conditions at home or within their communities. Cost of devices and technological illiteracy may represent a barrier to patient uptake of telemedicine interventions, especially in low-income populations. Other identified patient barriers to telemedicine associated with high dropout rates and attrition are modifiable from the implementers' perspective and include technical and usability difficulties, as well as training and education. This review also found that telemedicine is feasible and identified several factors that may improve its sustainability.

110. The literature on telemedicine is diverse and rapidly growing. While the literature mainly focuses on effectiveness and acceptability of telemedicine, policy makers appear to be more interested in costs, feasibility and sustainability of telemedicine (Gehring et al., 2017[194]). This review finds that telemedicine interventions are often superior to face-to-face care in many disease and specialty areas. This finding is similar to the conclusion from a recent overview (Shigekawa et al., 2018[229]). This review also finds that patients report high levels of acceptability and satisfaction with telemedicine interventions and that telemedicine may be cost-effective. However, the evidence on cost-effectiveness is limited.

Detailed overview of findings

The following tables include more detailed information on the studies included in this umbrella review.

Table B.2. Overview of included systematic reviews and meta-analyses focussing on effectiveness of telemedicine

Review	Primary studies	Description of review	Intervention	Comparator	Outcomes	Findings and conclusions	Quality of evidence
(Adamse et al., 2018[207])	16	To review the effectiveness of telemedicine on chronic pain, compared to or in addition to usual care.	◦Telemedicine additional to usual care or no intervention ◦Replacement of usual care	No intervention	◦Pain ◦Physical activity ◦Activities of daily living (ADL) Quality of life (QoL)	Telemedicine compared to no intervention is effective in reducing pain (MD −0.57, 95% CI −0.81; −0.34). Telemedicine in addition to or compared to usual care is as effective for physical activity, ADL or QoL.	Moderate quality
(Agostini et al., 2015[65])	12	To determine whether TR was more effective than usual care to regain motor function, in different populations of patients.	◦Telemonitored exercise training self-monitoring pedometer	Usual care	◦Motor function ◦Upper extremity function ◦Mobility Independence	Effect of TR inconclusive for neurological patients (SMD = 0.08, CI 95% = −0.13, 0.29), but effective for cardiac(SMD = 0.24, CI 95% = 0.04, 0.43) and total knee atrophy (TKA) patients (MD = −5.17, CI 95% = −9.79, −0.55).	Moderate quality
(Cottrell et al., 2017[61])	16	To evaluate the effectiveness of treatment delivered via real-time TR for the management of musculoskeletal conditions, and to determine if real-time TR is comparable to usual care	◦Real-time TR ◦Hybrid	Face-to-face or usual care	◦Pain ◦Physical function (PF)	Real-time TR is effective for the improvement of PF (SMD 1.63, 95%CI 0.92-2.33). In sub-group analyses TR in addition to usual care is more effective (SMD 0.64, 95%CI 0.43-0.85, I^2=10%) than usual care alone, and TR alone is equivalent to face-to-face intervention (SMD MD 0.14, 95% CI −0.10–0.37, I^2 = 0%) for the improvement of physical function. The improvement of pain was comparable between cohorts (SMD 0.66, 95%CI −0.27–1.60, I^2=96%) following intervention.	Assessed but not reported
(Cruz, Brooks and Marques, 2014[230])	9	To evaluate the effectiveness of home-based telemonitoring (HTM) to reduce healthcare utilization and improve health-related outcomes of patients with COPD.	Home-based telemonitoring	Face-to-face or usual care	◦Hospitalization rates ◦Length of hospital stay ◦Emergency department visit rates ◦Healthcare related costs ◦Mortality rates ◦HRQoL	HTM seems effective in reducing hospitalization rates, (RR = 0.72; 95% CI=0.53–0.98; p=0.034), and improves health-related outcomes for patients with COPD; however, no differences in the other healthcare utilization outcomes were observed. HTM appears to reduce respiratory exacerbations, hospitalizations and improves HRQOL, but there is still no clear indication that it reduces healthcare utilization and associated costs.	Low quality

(Dario et al., 2017[64])	11	To evaluate whether telehealth interventions improve pain, disability, function, and quality of life in non-specific lower-back pain (LBP).	◦telemonitoring (pedometer) ◦web-based programs ◦online support groups ◦telephone interventions	Usual care	◦pain reduction ◦reduce disability ◦improve physical function and quality of life	In chronic LBP, telehealth interventions had no significant effect on pain at short-term follow-up (n=4: 1,089 participants, WMD −2.61 95% CI −5.23 to 0.01) or medium-term follow-up (n=2: 441 participants, WMD: −0.94 points, 95% CI: −6.71 to 4.84) compared with a control group. Interventions combining telehealth and usual care were more beneficial than usual care alone in people with recent onset of LBP symptoms.	Moderate quality
(Deady et al., 2017[73])	10	To review and evaluate the effects of eHealth prevention interventions for anxiety and depression.	◦telemonitoring ◦real-time ◦e-couch ◦web based ◦email support ◦hybrid	Subclinical or nonclinical sample	◦Symptom reduction ◦Depression ◦Prevention	Mean difference between the intervention and control groups was 0.25 (95% CI:0.09, 0.41; p = 0.003) for depression outcome studies and 0.31 (95% CI: 0.10, 0.52; p = 0.004) for anxiety outcome studies, indicating a small but positive effect of the eHealth interventions. However, there is inadequate evidence on the medium to long-term effect of such interventions on the reduction of incidence of common mental-health disorders	High quality
(Direito et al., 2017[81])	21	To compare the effectiveness of mHealth interventions to promote physical activity (PA) and reduce sedentary behaviour (SB) in young people and adults with a comparator exposed to usual care/minimal intervention	◦telemonitoring ◦hybrid	Usual care or minimal intervention	◦moderate to vigorous physical activity (MVPA) ◦walking ◦sedentary behaviour ◦behaviour change techniques	SB decreased following interventions compared to usual care (SMD −0.26, 95%CI −0.53, −0.00). Effects across studies were small to moderate and non-significant for total PA (SMD 0.14, 95 % CI −0.12, 0.41); MVPA (SMD 0.37, 95 % CI −0.03 to 0.77); and walking (SMD 0.14, 95 % CI −0.01 to 0.29).	Moderate quality
(Feltner et al., 2014[59])	47	To assess the efficacy, comparative effectiveness, and harms of transitional care interventions to reduce readmission and mortality rates for adults hospitalized with heart failure (HF).	◦Telemonitoring (TM) ◦Real-time: structured telephone support (STS)	Usual care	◦All-cause readmissions ◦Mortality ◦Heart failure specific readmissions	TM did not reduce all-cause readmission 3 trials (n=434) RR 1.11, CI (0.87,1.42), or mortality (3 trials (n=564) RR 0.93CI(0.25-3.48) rates. STS interventions reduced HF-specific readmission in one high-quality trial (n=182) RR 1.70 CI (0.82-3.51) but not all-cause readmissions 3 trials (n=434) RR 1.11 (0.87-1.42). Although STS reduced HF-specific readmission and	Moderate quality

						mortality, TM is ineffective in reducing risk of readmission and mortality in HF patients.	
(Finnane et al., 2017[211])	21	To synthesize and assess the accuracy and effectiveness of teledermatology to diagnose skin cancer.	◦ Real-time ◦Store and forward ◦telemonitoring ◦hybrid	Usual care or face-to-face	◦Diagnostic accuracy ◦Diagnostic concordance ◦Waiting times ◦Patient satisfaction	The diagnostic accuracy of FTF dermatology consultation remains higher (67%-85% agreement with reference standard, Cohen κ, 0.90) when compared with teledermatology (51%-85% agreement with reference standard, κ, 0.41-0.63), for the diagnosis of skin cancer. Teledermatology is a useful triage tool and consistently reduced waiting times to assessment and diagnosis with high patient satisfaction.	Low quality
(Flodgren et al., 2015[2])	93	To assess the effectiveness, acceptability and costs of interactive telemedicine (TM) as an alternative to, or in addition to, usual care.	◦Real-time ◦Telemonitoring ◦Hybrid	Face-to-face or usual care	◦Mortality ◦Quality of life ◦costs ◦clinical outcomes ◦effect of treatment ◦adverse clinical events	In cardiac patients, TM interventions did not reduce all-cause mortality (16 studies; n=5239; RR:0.89, 95% CI 0.76,1.03, P = 0.12; I2=44%) at six months follow-up. In diabetic patients (16 studies; n=2768) HbA1c% levels were observed in those allocated to TM than in controls (MD -0.31, 95% CI -0.37, -0.24; P< 0.00001; I2=42%, P=0.04) at 9 months follow-up. TM in the management of heart failure appears to lead to similar health outcomes as face-to-face care and can improve the control of blood glucose in those with diabetes.	Moderate to high quality
(Hakala et al., 2017[231])	23	To examine whether a technology-based distance intervention (TBI) promoting physical activity is more effective than a physical activity intervention without the use of technology.	Telemonitoring	Usual care	◦Physical activity levels	8 studies in meta-analysis. TBI were 12% more effective than usual care or minimal control interventions in increasing physical activity (RR:1.12; 95% CI:1.01,1.25, P=0.03). Compared to minimal control interventions, TBI were 19% more effective (RR: 1.19; 95% CI 1.05 to 1.35, P=0.0096). In the interventions targeting patients, use of technology was 25% more effective than non-use (P=0.027). TBI are more effective than usual care in promoting	Moderate quality

						physical activity, especially when interventions are targeted to patients.	
(Huang et al., 2015[45])	15	To determine the effectiveness of telehealth intervention delivered cardiac rehabilitation (CR) compared with centre-based supervised CR.	◦ Home-based telemonitoring ◦ telephone support	◦Centre based programs (Face-to-face)	◦All cause mortality ◦Weight ◦Blood pressure ◦HRQoL	9 meta-analysis. No difference was found between telehealth interventions and centre-based CR in exercise capacity SMD –0.01; 95% CI –0.12–0.10), weight (SMD –0.13; 95% CI –0.30–0.05), systolic and diastolic blood pressure(MD –1.27; 95% CI –3.67–1.13 and MD 1.00; 95% CI –0.42–2.43, respectively), mortality (RR 1.15; 95% CI 0.61–2.19), quality of life and psychosocial state. CR delivered through telehealth interventions have similar outcomes compared to centre-based supervised program in low to moderate risk patients.	Low quality
(Huang, Reich and Fedorak, 2014[216])	6	To review the effectiveness of distance management methods in the management of adult inflammatory bowel disease (IBD) patients.	◦Telemonitoring (TM) ◦Hybrid	Face-to-face or usual care	◦QoL ◦Relapse rate ◦No of clinic visits	TM (3 studies, n=1463) interventions improved quality of life in distance management patients, IBDQ QoL score 7.28 (95%CI: -3.25-17.81) points higher than standard clinic follow-up. There was a significant decrease in the clinic visit rate among distance management patients mean difference -1.08 (95%CI: -1.60--0.55), but no significant change in relapse rate or hospital admission rate. Distance management of IBD decreases clinic visit utilization, but it does not significantly affect relapse, or hospital admission rates.	Moderate to low quality
(Huang et al., 2015[199])	18	To review the published literature on the effects of telecare intervention in patients with type 2 diabetes and inadequate glycaemic control.	◦Telemonitoring (self monitoring)	Routine face-to-face consultations	◦HbA1C levels ◦BMI ◦Hypoglycaemic events	TM significantly improved the management of diabetes. Mean HbA1c values were reduced by −0.54 (95% CI, −0.75,−0.34; P<0.05), mean FPG levels by −9.00mg/dl(95% CI, −17.36, −0.64;P=0.03), and mean PPG levels reduced by −52.86mg/dl (95%CI,−77.13,−28.58;P<0.05) when compared with the group receiving standard care.	Moderate quality

(Hui et al., 2017[88])	12	To identify which information & communication technology features used in mobile apps to support asthma self-management are associated with adoption, adherence, and effectiveness.	◦Telemonitoring ◦real-time ◦hybrid	No intervention or usual care	◦Asthma control ◦Acute exacerbations	Meta-analysis n= 3. TM was effective, compared to no intervention or usual care in improving asthma control (mean difference −0.25 [95% CI, −0.37 to −0.12]).	Moderate quality
(Hutchesson et al., 2015[232])	84	To evaluate the effectiveness of eHealth interventions for the prevention and treatment of overweight and obesity in adults.	◦Telemonitoring	Usual care or minimal intervention (MI)	◦Weight loss ◦weight loss maintenance ◦weight gain prevention ◦weight loss and maintenance	TM intervention groups demonstrated significantly greater weight loss (kg) compared with control (MD −2.70 [−3.33,−2.08], P < 0.001) or MI (MD −1.40[−1.98,−0.82], P < 0.001), and in eHealth weight loss interventions with extra components or technologies (MD 1.46 [0.80, 2.13], P < 0.001) compared with standard eHealth program. eHealth interventions are a treatment option for obesity. There is insufficient evidence for the effectiveness of eHealth interventions for weight loss maintenance or weight gain prevention.	Moderate quality
(Jeon and Park, 2015[49])	38	To review the effect of mobile technology-based interventions in nursing	Telemonitoring using mobile technology	No intervention or usual care	◦Feasibility ◦health related outcomes ◦health behaviour change	37 meta-analysis included. TM intervention had a slightly positive effect on weight reduction (Hedges' g: -0.23, 95% CI: -0.43 to -0.03).	Not reported
(Joiner, Nam and Whittemore, 2017[55])	22	To describe Diabetes Prevention Program (DPP)-based lifestyle interventions delivered via electronic, mobile, eHealth interventions and estimate the effect on weight loss.	◦Telemonitoring ◦Telemonitoring with remote behavioural support.	Face to face DPP interventions	Weight loss	The overall estimate across all the DPP-based eHealth interventions of on mean percentage weight change was − 3.98% (95% CI of − 4.49,− 3.46; I2 = 88.2%). The subtotal estimate across the interventions (n=9) with remote behavioural support was − 4.31% (95% CI− 5.26,− 3.37; I2 = 78.4%), and the subtotal estimate across interventions with face-to-face behavioural support was − 4.65% (95% CI of − 6.63, − 2.67; I2 = 94.5%). There is promising evidence of the efficacy of DPP-based eHealth interventions on weight loss.	Moderate quality

(Kelly et al., 2016[212])	25	To assess the effectiveness of telehealth dietary interventions (TDI) at facilitating dietary change in chronic disease	◦ Video-conferencing ◦Telemonitoring ◦Hybrid	Usual care or no intervention	◦Weight ◦BMI ◦ Blood pressure ◦Serum lipids and glycated haemoglobin	Telehealth dietary interventions were effective at improving diet quality [SMD: 0.22 (95% CI: 0.09, 0.34), P = 0.0007], fruit and vegetable intake [MD 1.04 servings/d (95% CI: 0.46, 1.62 servings/d), P = 0.0004], and dietary sodium intake [SMD: −0.39 (−0.58, −0.20), P = 0.0001].	Low to moderate
(Kepplinger et al., 2016[188])	7	To evaluate the safety and efficacy of IV thrombolysis (IVT) with tissue plasminogen activator (tPA) delivered through telestroke networks in patients with acute ischemic stroke	◦Real-time based on remote clinical and technological evaluation via audio visual video communication	◦ Usual care i.e. patients treated at stroke centre	◦Safety ◦Efficacy	Thrombolysis was largely restricted to the 3-hour time window. Symptomatic intracerebral haemorrhage rates were similar between patients subjected to telemedicine-guided IVT and those receiving tPA at stroke centres (RR = 1.01, 95% CI 0.37–2.80; p = 0.978) with low evidence of heterogeneity (I2 = 37%; p = 0.189). There was no difference in mortality (RR = 1.04, 95% CI 0.74–1.48; p = 0.806) or in functional independence (RR = 1.11, 95% CI 0.78–1.57; p = 0.565) at 3 months between telemedicine-guided and stroke centre thrombolysis.	Assessed but not reported
(Kitsiou, Paré and Jaana, 2015[189])	15	To collect, appraise, and synthesize existing evidence from multiple systematic reviews on the effectiveness of home telemonitoring interventions for patients with chronic heart failure (HF) to inform policy makers, practitioners, and researchers.	◦Home telemonitoring (HT)	Face-to-face or usual care	◦All cause mortality ◦Hospital re-admissions ◦Length of stay ◦Cost-saving ◦Quality of Life	HT interventions reduce the relative risk of all-cause mortality (0.60 to 0.85) and heart failure-related hospitalizations (0.64 to 0.86) compared with usual care. Absolute risk reductions ranged from 1.4%-6.5% and 3.7%-8.2%, respectively. Improvements in HF-related hospitalizations appeared to be more pronounced in patients with stable HF: (HR) 0.70 (95% credible interval [CrI] 0.34-1.5]). Compared with usual care, HT interventions improve survival rates and reduce the risk of HF-related hospitalizations.	Moderate quality
(Klersy et al., 2016[233])	13	To determine whether device telemonitoring (DTM) reduces healthcare utilization over standard of care (SoC),	◦Telemonitoring	◦ Face-to-face or usual care ◦Hybrid	◦Cardiac hospitalizations ◦Unplanned ER visits or cardiac hospitalizations ◦Cardiac death ◦Death Costs	DTM was associated with a reduction in total number of visits [planned, unplanned, and emergency room (ER)] [RR 0.56; 95% (CI) 0.43–0.73, P < 0.001]. Rates of cardiac hospitalizations (RR	Not reported

		without compromising patient outcomes.				0.96; 95% CI 0.82–1.12, P = 0.60) and the composite endpoints of ER, unplanned hospital visits, or hospitalizations (RR 0.99; 95% CI 0.68–1.43, P = 0.96) was similar between the DTM and the SoC groups. In randomized trials, DTM is associated with a marked reduction in planned hospital visits and overall costs, without compromising survival or markedly increasing unplanned hospital visits, ER visits, or hospitalizations.	
(Kotb et al., 2015[56])	30	To determine the comparative impact of different telemedicine options for a specific population such as individuals with heart failure (HF).	◦Telemonitoring ◦Telemonitoring with structured telephone support (STS)	◦Usual care or face-to-face ◦ hybrid	◦All cause mortality ◦All cause hospitalization ◦Hospitalisation due to heart failure	Compared to usual care, STS reduced the odds of mortality (OR 0.80; 95% CrI [0.66 to 0.96]) and hospitalizations due to HF (0.69; [0.56 to 0.85]). Telemonitoring also reduced the odds of mortality (0.53; [0.36 to 0.80]) and hospitalizations related to HF (0.64; [0.39 to 0.95]) compared to usual post-discharge care. Compared to usual care, STS and telemonitoring significantly reduced the odds of deaths and hospitalization due to heart failure.	Moderate quality
(Lee et al., 2016[217])	3	To review the effectiveness of paediatric obesity intervention studies using mobile technology.	◦Telemonitoring mobile interventions e.g. apps ◦Hybrid	Usual care or no intervention	◦BMI ◦Daily exercise ◦intake of sugar-sweetened beverage (SSBs)	Mobile interventions had no significant effect on BMI (g: -0.073, 95% CI: -0.031 to 0.185), or daily exercise and SSB intake; (Hedges' g: 0.189, 95% CI: -0.355 to 0.733; Hedges' g: -0.316, 95% CI: -0.764 to 0.131).	
(Lee et al., 2018[234])	7	To review the effectiveness of telehealth interventions on improving oral anticoagulation management	◦Real-time: telephone communication between provider and patient	◦In person visits: usual care	◦ Major bleeding ◦Any bleeding	(3 Meta-analysis n = 6955) showed significant improvements in the telehealth group for major thromboembolic events (RR 0.43, 95% CI 0.25–0.74, p = 0.002), but no significant difference for major bleeding events (RR 0.83, 95% CI 0.52–1.33, p = 0.44). Telehealth interventions may lower the risk of major thromboembolic events, but not other clinically important outcomes.	Very low quality

(Linde et al., 2015[75])	30	To review whether psychological treatments are effective for treating depressed primary care patients in comparison with usual care or placebo, taking the type of therapy and its delivery mode into account.	◦Real-time cognitive behavioural therapy (CBT) ◦remote therapist led ◦hybrid	◦ Face-to-face, usual care or no intervention	◦Depression scores	Compared with control, SMD was −0.30 (95% CI, −0.48, −0.13) for face-to-face CBT, −0.14 (−0.40, 0.12) for face-to-face problem-solving therapy, −0.24 (−0.47 to −0.02) for face-to-face interpersonal psychotherapy, −0.28 (−0.44 to −0.12) for other face-to-face psychological interventions, −0.43 (−0.62 to −0.24) for remote therapist-led CBT, −0.56 (−1.57 to 0.45) for remote therapist-led problem-solving therapy, −0.40 (−0.69 to −0.11) for guided self-help CBT, and −0.27 (−0.44 to −0.10) for no or minimal contact CBT. Remote CBT interventions seem to yield effects similar to face to face interventions.	Moderate quality
(Liu et al., 2017[50])	13	To examine the potential role of mHealth on vascular risk factor control, including diabetes mellitus, hypertension, hyperlipidaemia, and smoking.	◦Telemonitoring: mHealth interventions	Usual care or no intervention	◦Glycaemic control ◦ Smoking cessation	mHealth resulted in greater Haemoglobin A1c reduction at 6 months (6 studies, n= 663, SMD: −0.44; 95% CI: [−0.82, −0.06], P = 0.02; MD of decrease in HbA1c: −0.39%; 95% CI: [−0.74, −0.04], P = 0.03). mHealth also lead to relatively higher smoking abstinence rates at 6 months (7 studies, n=9514; OR: 1.54; 95% CI: [1.24, 1.90], P < 0.0001).	Moderate quality
(Lundell et al., 2015[63])	9	To investigate the effects of telehealthcare on physical activity level, physical capacity and dyspnoea in patients with COPD, and to describe the interventions used.	◦Home-based monitoring ◦Weekly phone call	◦Usual care	◦Physical activity level (PAL) ◦Physical capacity (PC) ◦Dyspnoea	For PAL, there was a significant effect favouring telehealthcare (MD, 64.7 min; 95% CI, 54.4–74.9). No difference between groups was found for PC (MD, −1.3 m; 95% CI, −8.1–5.5) and dyspnoea (SMD, 0.088; 95% CI, −0.056–0.233). The use of telehealthcare may lead to improvements in PAL, although the results should be interpreted with caution given the heterogeneity in studies.	Low quality
(Marx et al., 2018[83])	9	To determine the efficacy of telehealth methods in delivering malnutrition-related interventions to community-dwelling older adults.	◦Real time (telephone consultation with dietitian or dietetic assistant) ◦Telemonitoring	Usual care	◦Nutrition status ◦ Feasibility ◦Effectiveness ◦ Body weight ◦ Quality of life ◦Cost-effectiveness	Malnutrition-focused telehealth interventions improved protein intake in older adults by 0.13 g/kg body weight per day ([95%CI: 0.01–0.25]; P = .03; 2 studies; n = 200 I2 = 41%) and to improve quality of life (SMD: 0.55 [95%CI: 0.11–	Low quality

						0.99]; P = .01; 4 studies, n=248; I2 = 84%). Telehealth is an effective method to deliver malnutrition-related interventions to older adults living at home, and is likely to result in clinical improvements compared with usual care or no intervention.	
(McLean et al., 2016[90])	8	To identify, summarise and synthesise the evidence for using interactive digital interventions to support patient self-management of asthma, and determine their impact.	◦Telemonitoring: self monitoring	Usual care	◦Change in clinical outcomes ◦Patient reported outcomes of wellbeing or quality of life ◦Cost-effectiveness	3 meta-analysis n= 593. No significant differences and extremely high heterogeneity for Asthma Quality of Life (AQLQ) SMD 0.05; 95%(CI) 0.32, 0.22: I296.8) and asthma control (SMD 0.21; 95 % CI −0.05, .42; I2=87.4). Removal of the third study indicated significant improvement for both AQLQ (SMD 0.45; 95 % CI 0.13, 0.77: I2=0.34) and asthma control (SMD 0.54; 95 % CI 0.22, 0.86: I2=0.11). Digital self-management interventions for adults with asthma show promise, with some evidence of small beneficial effects on asthma control.	Low quality
(Merriel, Andrews and Salisbury, 2014[192])	13	To assess the effectiveness of telehealth interventions in the primary prevention of cardiovascular disease in adult patients in community settings.	◦ telemonitoring ◦real-time	Face to face, usual care or self help	Effectiveness: ◦reducing systolic bp◦cholestrol◦30 smoking status at baseline	3 meta-analysis showed no clear evidence of reduction in overall risk of CVD (SMD − 0.37%, 95% CI − 2.08, 1.33). There was weak evidence for reduction in systolic blood pressure (SMD − 1.22 mm Hg 95% CI − 2.80, 0.35) and total cholesterol (SMD − 0.07 mmol/L 95% CI − 0.19, 0.06). There was no change in n cholesterol or smoking rates. There is insufficient evidence to determine the effectiveness of telehealth interventions in reducing overall CVD risk.	Moderate quality
(Ming et al., 2016[52])	7	To perform an updated and comprehensive systematic review and meta-analysis of the literature to determine whether telemedicine solutions offer any advantages compared with the standard care for women with diabetes in pregnancy.	Telemedicine: Telemonitoring	Usual care	◦Effectiveness: Maternal glycaemic control	Telemedicine interventions showed a modest statistically significant improvement in HbA1c, mean HbA1c of women using telemedicine was 5.33% (SD 0.70) compared with 5.45% (SD 0.58) in the usual care group; a mean difference of −0.12% (95% CI −0.23% to −0.02%). When this comparison was limited to women with gestational	Moderate quality

						diabetes mellitus (GDM) only, the mean HbA1c of women using telemedicine was 5.22% (SD 0.70) compared with 5.37% (SD 0.61) in the standard care group, mean difference −0.14% (95% CI −0.25% to −0.04%). There is insufficient evidence that telemedicine is superior to usual care for women with diabetes in pregnancy; however, there was no evidence of harm.	
(Nair et al., 2018[70])	10	To review the effectiveness of telemedicine interventions to address maternal depression	◦telemonitoring ◦real-time (telephone)	◦waitlist ◦usual care ◦hybrid	◦Depression scores	5 meta-analysis: (I2 = 74.2%; X2 = 14.63; df = 4; p = 0.06). Effect sizes ranged between −0.69 and −4.03. Interventions delivered via telemedicine effectively alleviate maternal depression symptoms, improving treatment efficacy.	Moderate quality
(Oosterveen et al., 2017[195])	45	To evaluate the effectiveness of eHealth behavioural interventions aiming to improve smoking rates, nutrition behaviours, alcohol intake, physical activity levels and/or obesity (SNAPO) in young adults	◦Telemonitoring ◦Real-time (telephone counselling)	◦waitlist ◦no intervention ◦hybrid	◦Effectiveness	Significantly lower mean number of drinks consumed/week in brief web or computer-based interventions compared to controls (MD − 2.43 [− 3.54, − 1.32], P < 0.0001, n = 10). This review provides some evidence for the efficacy of eHealth SNAPO interventions for young adults, particularly in the short-term and for alcohol interventions but there is insufficient evidence for their efficacy in the longer-term, as well as which mode of delivery is most effective.	Moderate quality
(Raman et al., 2017[235])	11	To compare the effects of different methods and settings for glucose monitoring for women with GDM on maternal and foetal, neonatal, child and adult outcomes, and use and costs of health care.	Home-monitoring: ◦telemonitoring ◦self-monitoring ◦continuous glucose monitoring	◦Home monitoring ◦Continuous glucose monitoring	Effectiveness: ◦telemedicine ◦ self monitoring	Telemedicine versus standard care for glucose monitoring (5 studies), no clear differences between the telemedicine and standard care groups for the mother: for pre-eclampsia or pregnancy-induced hypertension (RR) 1.49, 95% CI 0.69 to 3.20; n=275 4 studies); caesarean section (RR 1.05, 95% CI 0.72 to 1.53; n=478, 5 studies). Evidence from 11 RCTs assessing different methods or settings for glucose monitoring for GDM suggests no clear differences for the primary outcomes or other secondary outcomes assessed in this review.	Low quality

(Rasekaba et al., 2015[53])	4	To evaluate the effect of telemedicine on GDM service and maternal, and foetal outcomes.	Telemonitoring: self monitoring for gestational diabetes management	Usual care, face to face GDM (gestational diabetes management clinic)	◦ Effectiveness	Telemedicine intervention groups showed a SMD for glycaemic control -0.18 [-0.50, 0.14], (1-h and 2-h) post-prandial BGL -0.02[-0.36, 0.32], and caesarean deliveries 0.48 [0.10,2.35] compared to usual care. Telemedicine has the potential to streamline GDM service utilisation without compromising maternal and foetal outcomes.	Moderate quality
(Rathbone and Prescott, 2017[77])	27	To study the efficacy, usability, and feasibility of mobile apps and SMS messages as mHealth interventions for self-guided care.	Telemonitoring: ◦mobile apps ◦hybrid	Usual care or no intervention	◦Feasibility ◦Effectiveness ◦Efficacy ◦Usability ◦Feasibility	mHealth interventions show improvement in physical health and significant reductions of anxiety, stress, and depression. Within-group and between-group effect sizes ranged from 0.05-3.37 (immediately post-test), and 0.02-0.27 (6-month follow-up). Usability and feasibility of mHealth interventions, where reported, also gave promising, significant results.	Low to moderate quality
(Rawstorn et al., 2016[67])	11	To determine the benefits of telehealth exCR (exercise based cardiac rehabilitation) on exercise capacity and other modifiable cardiovascular risk factors compared with traditional exCR and usual care, among patients with coronary heart disease (CHD).	◦Telemonitoring or real-time telemedicine	◦Face-to-face or usual care (centre based)	◦Physical activity level ◦Maximal aerobic exercise capacity ◦Exercise adherence	Physical activity level was statistically significantly higher following telehealth exCR compared with centre-based exCR (SMD=9.84, 95% CI 8.05 to 11.64, and usual care (fixed effect SMD=0.29, 95% CI 0.07 to 0.50,). Exercise adherence was statistically significantly higher following telehealth exCR (SMD=0.75, 95% CI 0.52 to 0.98). Telehealth exCR appears to be at least as effective as centre-based exCR for improving modifiable cardiovascular risk factors and functional capacity, and could enhance exCR utilisation by providing additional options for patients who cannot attend centre-based exCR.	Moderate quality
(Seiler et al., 2017[68])	15	To evaluate existing eHealth/mHealth interventions developed to help manage cancer-related fatigue (CRF); and summarize the best available evidence on their effectiveness.	Real-time: ◦Online interventions ◦Telemonitoring: Smart phone apps	Usual care, face-to-face, or no intervention	◦ Cancer-related fatigue ◦HRQoL	9 meta-analysis. eHealth studies revealed a statistically significant beneficial effect on CRF (r = .27, 95% CI [.1109 – .4218], P < 0.01). Therapist-guided eHealth interventions were more effective then self-guided interventions (r= .58, 95% CI: [.3136 – .5985, P < 0.001). Small to	Low quality

						moderate effects were also observed for HRQoL (r = .17, 95% CI [.0384 – .3085], P < 0.05) and depression (r = .24, 95% CI [.1431 – .3334], P < 0.001). eHealth interventions appear to be effective for managing fatigue in cancer survivors with CRF.	
(Seyffert et al., 2016[76])	15	We assessed the effectiveness of internet-delivered cognitive behavioural therapy (iCBT) for insomnia.	◦Telemonitoring and real time: Internet delivered CBT	Waitlist	◦Sleep efficiency and severity of insomnia ◦length of sleep ◦sleep quality ◦time in bed ◦nocturnal awakenings	Sleep efficiency was 72% at baseline and improved by 7.2% (95% CI:5.1%, 9.3%; p<0.001) with internet-delivered cognitive behavioural therapy versus control. Internet-delivered CBT resulted in a decrease in the insomnia severity index by 4.3 points (95% CI: -7.1, -1.5; p = 0.017) compared to control. The severity of depression decreased by 2.3 points (95% CI: -2.9, -1.7; p = 0.013) in individuals who received internet-delivered cognitive behavioural therapy compared to control. There were no statistically significant differences between sleep efficiency, total sleep time, and insomnia severity index for internet-delivered versus in-person therapy with a trained therapist.	Moderate quality
(Sherifali et al., 2017[86])	10	To assess the effectiveness of eHealth technologies for weight management during pregnancy and the postpartum period and to review the efficacy of eHealth technologies on health behaviours, specifically nutrition and physical activity.	telemonitoring: ◦mobile phone ◦web-based, email, personal digital assistant, handheld computer, home computer, or tablet app.	Usual care or educational intervention	◦ weight management in pregnant women or weight loss ◦in postpartum women ◦ changes in glycaemic status ◦physical activity	In postpartum women, eHealth intervention resulted in a significant reduction in weight (−2.55 kg, 95% CI −3.81 to −1.28) after 3 to 12 months; but six studies found a non-significant reduction in weight gain for pregnant women (−1.62 kg, 95% CI −3.57 to 0.33) at approximately 40 weeks. This review found evidence for benefits of eHealth technologies on weight management in postpartum women only.	Moderate quality
(Speyer et al., 2018[228])	43	To describe telehealth interventions delivered by allied health professionals and nurses in rural and remote areas, and to compare the effects of telehealth	◦ Real time: video conference, telephone or internet based	◦Usual care ◦real-time (telephone)	1) Effectiveness	17 meta-analysis. No significant differences for interventions adopting a physical approach between telehealth and standard treatment (z(1)=0.335, p=0.737, g=0.178, 95% CI=–0.861–1.216). There were significant differences	High quality

		interventions with standard face-to-face interventions.				for interventions using a combination of cognitive and physical approaches between telehealth and standard treatment, with a moderate effect favouring telehealth-delivered interventions (z(7)=2.159, p=0.031, g=0.500, 95% CI=0.046–0.955).	
(Stratton et al., 2017[69])	32	To conduct a systematic review and meta-analysis evaluating the evidence for the effectiveness and examine the relative efficacy of different types of eHealth interventions for employees.	◦ Telemonitoring: web-based CBT and mobile apps	Usual care	◦ Depression ◦ Anxiety ◦ Stress	23 meta-analysis. eHealth interventions suggested a small positive effect at both post intervention (g = 0.24, 95% CI 0.13 to 0.35) and follow up (g = 0.23, 95% CI 0.03 to 0.42). The Stress Management interventions differed by whether delivered to universal or targeted groups with a moderately large effect size at both post-intervention (g = 0.64, 95% CI 0.54 to 0.85) and follow-up (g = 0.69, 95% CI 0.06 to 1.33) in targeted groups, but no effect in unselected groups.	Moderate quality
(Su et al., 2016[201])	49	To assess the overall effect of telemedicine on diabetes management and to identify features of telemedicine interventions that are associated with better diabetes management outcomes.	◦ Telemonitoring ◦ Real-time	Usual care	◦ Mean change in HbA1c	Results favoured telemedicine over conventional care (g = −0.48, p < 0.001) in diabetes management. The beneficial effect of telemedicine were more pronounced among patients with type 2 diabetes (g = −0.63, p < 0.001) than among those with type 1 diabetes (g = −0.27, p = 0.027) (Q = 4.25, p = 0.04).	Moderate quality
(Tchero et al., 2017[54])	10	To evaluate whether telemedicine can be effective in diabetic foot patient care.	◦ Real-time telemedicine (video consultation)	Usual care	◦ Healing time	2 meta-analysis. Telemedicine and control groups had statistically similar healing time (43 vs 45 days; P = .83), healing time ratio adjusted for age (1 vs 1.4; P = .1), unhealed ulcers or loss to follow-up (3 of 20 vs 7 of 120; P = .13), and amputations (12 of 193 vs 14 of 182; P = .59). The odds of complete ulcer healing were statistically similar between the telemedicine group and controls (OR= 0.86; 95% CI = 0.57-1.33; P = .53).	Yes, but no clear conclusion
(Thabrew et al., 2018[196])	5	To assess the effectiveness of e-health interventions in comparison with attention	◦ Real-time: iCBT ◦ telemonitoring ◦ Hybrid	◦ Placebo ◦ Usual care	◦ Depression symptoms ◦ Anxiety symptoms ◦ Treatment acceptability	It could not be determined whether e-health interventions were clearly better than any comparator. For change in	Very low quality

		placebos, psychological placebos, treatment as usual, waiting-list controls, or non-psychological treatments for treating anxiety and depression in children and adolescents with long-term physical conditions.				depression symptoms versus any control (SMD -0.06, 95% CI -0.35 to 0.23). For change in anxiety symptoms versus any comparator, (SMD -0.07, 95% CI -0.29 to 0.14). For treatment acceptability, (SMD 0.46, 95% CI 0.23 to 0.69).For quality of life, (SMD -0.83, 95% CI -1.53 to -0.12). The very low-quality of the evidence means the effects of e-health interventions are uncertain at this time, especially in children aged under 10 years.	
(Thomas et al., 2014[110])	45	To synthesize literature to evaluate teleglaucoma, its diagnostic accuracy, healthcare system benefits, and cost-effectiveness.	◦ Real-time: Teleglaucoma	Face-to-face or no comparator	◦ Cost-effectiveness◦ Diagnostic accuracy	Teleglaucoma is more specific and less sensitive than in-person examination. Pooled estimates of sensitivity was 0.832 [95% CI 0.770, 0.881] and specificity was 0.790 [95% CI 0.668, 0.876]. The relative odds of a positive screen test in glaucoma cases are 18.7 times more likely than a negative screen test in a non-glaucoma cases. Additionally, the mean cost for every case of glaucoma detected was $1098.67 US and of teleglaucoma per patient screened was $922.77 US. As a result teleglaucoma saves costs to patients and costs to the health care system as a whole.	Moderate quality
(Toma et al., 2014[46])	34	To summarise the current evidence surrounding the role of online social networking services in diabetes care.	◦ Real-time telemedicine (through social media networks)	No intervention, usual care	◦ HbA1c ◦ Patient satisfaction ◦ Frequency of transmission	Significant reduction in HbA1c favouring the telemedicine intervention group, WMD 0.46% (95% CI [−0.58, −0.34], P < 0.00001). Significant mean difference of −0.45% (95% CI [−0.60, −0.29], P < 0.00001) favouring the intervention group was observed in the change in HbA1c between baseline and follow-up. Online SNS (social networking services) provide a novel, feasible approach to improving glycaemic control, particularly in patients with Type 2 diabetes.	Moderate quality

(van Beugen et al., 2014[74])	23	To describe and evaluate the effectiveness of guided iCBT interventions for chronic somatic conditions on general psychological outcomes, disease-related physical outcomes, and disease-related impact on daily life outcomes. The role of treatment length was also examined.	Telemedicine: ◦ real-time ◦telemonitoring: i**C**BT (internet-based cognitive behavioural therapy)	◦usual care or face-to-face ◦information based psychoeducation	◦Effectiveness ◦psychological outcomes	Guided iCBT was shown to improve all outcome categories with small effect sizes for psychological outcomes (range 0.17-0.21) and occasionally larger effects for disease-specific physical outcomes (range 0.07 to 1.19) and disease-related impact outcomes (effect size range 0.17-1.11). Interventions with a longer treatment duration (>6 weeks) led to more consistent effects on depression. Guided ICBT appears to be a promising and effective treatment for chronic somatic conditions to improve psychological and physical functioning and disease-related impact.	Moderate quality
(van Egmond et al., 2018[62])	23	To study the effectiveness of physiotherapy with telerehabilitation on postoperative functional outcomes and quality of life in surgical patients.	TR: ◦web-based ◦real-time (telephone) ◦wireless monitored exercise	Usual care (face-to-face)	◦Effectiveness ◦Quality of Life (QoL)	7 meta-analysis, SMD for QoL for was 1.01 (95% CI 0.18,1.84), indicating that QoL increased with TR compared with usual care. The heterogeneity expressed with I2 was high at 97%. Physiotherapy with telerehabilitation has the potential to increase quality of life, is feasible, and is at least equally effective as usual care in surgical populations.	Moderate quality
(Van Spall et al., 2017[60])	53	To compare the effectiveness of transitional care services in decreasing all-cause death and all-cause readmissions following hospitalization for heart failure (HF).	Telemonitoring: remote monitoring of weight, vital signs or other indices of functional status with or without follow-up telephone calls	Usual care (face-to-face)	Clinical outcomes: ◦All-cause mortality and all-cause readmission rate ◦Cost of care	Telemonitoring (9 studies) did not significantly decrease all-cause mortality compared to usual care (RR 0.90, CI 0.68-1.19) nor all cause readmission (IRR 0.82 CI 0.62-1.08). Similarly, telephone support did not decrease all-cause mortality (RR 0.82 CI 0.62-1.08) nor all cause readmission (IRR 0.86 CI 0.64-1.15). Compared with usual care, telemedicine interventions reduced overall healthcare system costs. For telemonitoring, net healthcare saving per patient: USD 3136 (95% CI1559–4713)(4 studies); and for telephone support per patient: USD12570 (95% CI10121–15019) (3 studies).	Yes, but not reported

(Vigerland et al., 2016[218])	25	To perform a comprehensive, systematic review of the literature in the field of iCBT for children and adolescents and investigate for which childhood psychiatric and somatic conditions iCBT has been tested	◦Telemonitoring ◦Real-time: structured telephone calls to assess patient's clinical condition and provide support	Usual care	◦Sleep efficiency ◦Depressive symptoms ◦OCD ◦BMI	Twenty-four studies (N = 1882) were included in the meta-analysis and iCBT yielded moderate between-group effect sizes when compared with waitlist, g = 0.62, 95% CI [0.41, 0.84]. The results suggest that CBT for psychiatric and somatic conditions in children and adolescents can be successfully adapted to an internet-delivered format.	
(Widmer et al., 2015[87])	51	To assess the potential benefit of digital health interventions (DHIs) on cardiovascular disease (CVD) outcomes and risk factors compared with non-DHIs.	Telemedicine: ◦ real-time (web-based) ◦telemonitoring	Usual care	◦CVD outcomes including revascularization, stroke, rehospitalisation ◦Risk factors including weight loss, BMI, blood pressure, LDL-cholesterol	9 meta-analysis, digital health interventions significantly reduced CVD outcomes (RR, 0.61; 95% CI, 0.46-0.80; *P*<.001; *I2*=22%). Concomitant reductions in weight (−2.77 lb [95% CI, −4.49 to −1.05 lb]; *P*<.002; *I2*=97%) and body mass index (−0.17 kg/m2 [95% CI, −0.32 kg/m2 to −0.01 kg/m2]; *P*=.03; *I2*=97%) but not blood pressure (−1.18 mm Hg [95% CI, −2.93 mm Hg to 0.57 mm Hg]; *P*=.19; *I2*=100%) were found in these DHI trials compared with usual care.	
(Wootton, 2016[78])	18	To synthesize the current literature on remote treatment for OCD using a meta-analytic approach.	Telemedicine: ◦real-time ◦telemonitoring (Internet delivered, telephone, video conference, cognitive behavioural therapy)	◦ Waitlist◦ Face to face	Effectiveness	Within-group findings indicate that remote treatment for OCD produces a decrease in symptoms of a large magnitude (g = 1.17; 95% CI: 0.91–1.43). Between-group findings indicate that remote treatment for OCD is more effective than control (g = 1.06; 95% CI: 0.68–1.45) and outcomes are not meaningfully different from face-to-face treatment (g = − 0.21; 95% CI: − 0.43–0.02).	
(Zhai et al., 2014[47])	47	To evaluate the clinical effectiveness and cost effectiveness of telemedicine approaches on glycaemic control in patients with type 2 diabetes mellitus.	Real time: telephone	◦ Usual care ◦telemonitoring	◦ Clinical effectiveness: change in HBA1C ◦ Cost-effectiveness	A small, but statistically significant, decrease in HbA1c following TM intervention was observed compared to conventional treatment (MD = −0.37, 95% CI = −0.49 to −0.25, Z = −6.08, P < 0.001). Optimization of telemedicine approaches could potentially allow for more effective self-management of	Moderate quality

						disease in type 2 diabetes patients, though evidence to-date is unconvincing.	
(Zhao et al., 2015[89])	11	To examine the effectiveness of telemedicine in relieving asthma symptoms.	◦ SMS ◦ internet based self management program ◦telephone counselling	◦ usual care ◦ face-to-face	◦ asthma symptom score change	6 meta-analysis, No significant difference in asthma symptom score change between the telemedicine and control groups (pooled g=0.34, 95% CI=−0.05 to 0.74, Z=1.69, p=0.090). Telemedicine interventions do not appear to improve asthma function scores, but other benefits may be present.	Moderate quality

Note: TR=telerehabilitation, SMD=standard mean difference, MD=mean difference, CI=confidence interval, WMD=weighted mean difference, HR=hazard ratio, RR=relative risk, OR=odds ratio; quality of the evidence is that reported by the authors of the systematic reviews and meta-analyses included in this umbrella review.
Source: OECD analyses

Table B.3. Overview of included systematic reviews and meta-analyses focussing on cost-effectiveness of telemedicine

Review	Primary studies	Description of review	Intervention	Comparator	Outcomes	Findings and conclusions	Quality of evidence
(Akiyama and Yoo, 2016[111])	17	To determine whether telemedicine is cost-effective in Japan	◦Real-time telemedicine ◦Store and forward ◦Telehomecare	Usual care	Cost-effectiveness	Six studies reported on settings connecting physicians for specialist consultations, and eleven studies on settings connecting healthcare providers and patients at home. The remaining studies measured the benefit of telemedicine only, using medical expenditure saved or users' willingness-to-pay. Studies on teledermatology and teleradiology indicated a favourable level of economic efficiency. Studies on telehomecare gave mixed results. Overall, telemedicine programs in Japan were indicated to have a favourable level of economic efficiency.	Moderate to low quality
(de la Torre-Díez et al., 2015[117])	35	A systematic review of cost-utility and cost-effectiveness research works of telemedicine, electronic health (e-health), and mobile health (m-health) systems.	N/A	N/A	◦Cost ◦Cost-effectiveness	Teleophthalmology effective for reducing the cost of inmate care and reducing blindness caused by diabetic retinopathy. Some cost-effectiveness studies demonstrate that telemedicine can reduce costs, but not all. Studies are limited by lack of RCTs, small sample sizes and lack of quality data.	Not assessed
(Elbert et al., 2014[114])	31	To review the effectiveness/cost-effectiveness of eHealth	Telemedicine: ◦Real-time telemedicine	N/A	◦Effectiveness and cost-effectiveness	20 papers (65%) reported on costs. Seven (23%) concluded that eHealth is effective/cost-effective, 13 (42%) underlined that evidence is promising, and others	High quality

		interventions in patients with somatic diseases to analyse whether, and to what possible extent, the outcome of recent research supports or differs from previous conclusions.	◦Telemonitoring ◦Hybrid			found limited or inconsistent proof. However, a similar percentage of papers concluded that eHealth is effective/cost-effective or evidence is at least promising (65% vs 62%).The majority of these papers show eHealth is effective/cost-effective, or at least suggests evidence is promising, which is consistent with previous findings.	
(Estai et al., 2018[236])	11	To inform future decisions about the benefits of integrating teledentistry into routine health services, by presenting an overview of the evidence for the effectiveness and economic impact of teledentistry.	N/A	N/A	◦Effectiveness and cost-effectiveness of teledentristy	There is emerging evidence supporting the efficacy of teledentistry. However, there is not yet enough conclusive evidence, particularly for its effectiveness, cost-effectiveness and long-term use, to make evidence-based policy decisions on teledentistry.	Moderate quality
(Fuertes-Guiró and Girabent-Farrés, 2017[124])	3	To demonstrate that the opportunity cost is a value to take into account in studies of economic cost in telemedicine, illustrated through the time of the dermatologist's consultation in teledermatology and traditional consultation.	Teledermatology: Real time	◦ Face-to-face or usual care ◦ Store and forward teledermatology and face-to-face consultation	◦ Clinical outcomes and cost ◦ Time spent by dermatologist	It was possible to carry out a meta-analysis of the consultation time, and three articles were selected (n=2945). Teledermatology accounts for more time (7.54 min) than conventional consultation ($p < 0.00001$) and this difference is an opportunity cost of teledermatology of €29.25 per each remote consultation, with a unitary factor cost/time of 3.88€/minute. Teledermatology takes more time than a conventional dermatology consultation, which leads to an opportunity cost, increasing the total cost of consultation.	Not reported
(Grustam et al., 2014[237])	32	To present an overview of the cost-effectiveness of telehealth interventions on chronic heart failure patients	◦ Real-time telemedicine ◦ Telemonitoring◦ Store and forward	Usual care	Telehealth interventions for chronic heart failure patients is: 1) Cost-effective (21/32)	Almost 60% of the reviewed studies showed that telehealth interventions for CHF patients are cost-effective, based on the analysis of the seven studies with low risk of bias, we believe that cost-effectiveness of telehealth in CHF is not ascertained: four studies reported same costs with equal effectiveness, two incurred costs with equal effectiveness and only one on saved costs with increased effectiveness.	Moderate to low quality
(Hameed, Sauermann and Schreier, 2014[186])	9	To analyse the economic impact of chronic HF patients' adherence to treatment recommendations and the cost-effectiveness of	◦ Real-time ◦ store and forward◦ telemonitoring	Usual care	◦ Cost-effectiveness ◦ Adherence	There is currently no evidence that increased patient adherence to pharmacological and non-pharmacological recommendations, supported by using telemedicine services, has led to a reduction in treatment costs (e.g. medical procedures, emergency room admissions, hospitalization, and nursing costs) for HF patients.	Not reported

		telemedicine services for this patient population.					
(Iribarren et al., 2017[223])	39	To review and assess the body of evidence related to economic evaluations of mHealth interventions	◦ Remote monitoring	No intervention or usual care	◦ Cost effective ◦ Economically beneficial ◦ Cost saving	In 29 studies (74.3%), researchers reported that the mHealth intervention was cost-effective, economically beneficial, or cost saving at base case.	Moderate quality
(Jackson et al., 2016[123])	17	To evaluate the impact and cost-effectiveness of eHealth technologies in irritable bowel disease (IBD).	Telemedicine: 1) real-time 2)telemonitoring 3) store and forward	No intervention or usual care	◦ Costs ◦ Patient satisfaction ◦ Feasibility ◦ Quality of life	Telehealth interventions sometimes increase cost, however cost data is lacking. The ability for telehealth to improve patients QoL appears promising	Not reported
(Liddy, Drosinis and Keely, 2016[225])	36	To understand the effectiveness, population impact and costs associated with implementation of eConsult services.	◦ Store and forward ◦ Real time ◦ Telemonitoring	Usual care	◦ Effectiveness ◦ Impact ◦ Cost ◦ Diagnostic concordance	Seven out of 36 included studies provided information on costs. Due to heterogeneity in outcome reporting, the ability to draw broad conclusions on cost-effectiveness is limited.	Moderate quality
(López-Villegas et al., 2016[238])	7	To carry out a systematic review analysing the available evidence on resource use and health outcomes in telemedicine pacemaker monitoring	Telemonitoring	Usual care or no intervention	Effectiveness, safety, reliability and cost of pacemaker telemonitoring	With telemonitoring, cardiovascular events were detected and treated 2 months earlier than with conventional monitoring, thus reducing length of hospital stay by 34% and reducing routine and emergency hospital visits as well. The cost of telemonitoring was 60% lower than that of conventional hospital monitoring. Compared with conventional monitoring, cardiovascular events were detected earlier and the number or hospitalizations and hospital visits was reduced with pacemaker telemonitoring. In addition, the costs associated with follow-up were lower with telemonitoring.	Moderate quality
(McDougall et al., 2017[220])	20	To identify and summarize the published and grey literature on the use of telemedicine for the diagnosis and management of inflammatory and/or autoimmune rheumatic disease.	Telerheumatology	Usual care	Cost-effective	A limited number of studies included some component of a cost analysis (n = 6; 16% of patients); all of these found telemedicine to be cost-effective.	Low quality
(Michaud et al., 2018[116])	12	The aim of this study was to systematically investigate existing literature on the costs of	Home-based telemedicine	Home based face-to-face care	◦ Costs ◦Projected savings	The costs of home-based telemedicine programs varied substantially by program components, disease type, equipment used, and services provided. The overall annual cost of providing home-based telemedicine	Low quality

		home-based telemedicine programs, and to further summarize how the costs ofthese telemedicine programs vary by equipment and services provided				ranged from USD1,352 for heart failure to USD206,718 for congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), and diabetes as a whole. The estimated cost per-patient-visit ranged from USD24 for cancer to USD39 for CHF, COPD, or chronic wound care. All the selected studies indicated that home telemedicine programs reduced care costs, although detailed cost data were either incomplete or not presented in detail. A comprehensive analysis of the cost of home-based telemedicine programs and their determinants is still required before the cost efficiency of these programs can be better understood.	
(Musiat and Tarrier, 2014[109])	95	To review the evidence of the cost-effectiveness and treatment satisfaction of cCBT interventions for mental health.	◦ cCBT (computerized based cognitive behavioural therapy) group ◦ online therapy	◦ Face to face ◦ waitlist	◦ Direct and indirect costs ◦ Societal costs	The results suggest that cCBT interventions are cost-effective and often cheaper than usual care. Limited evidence was found with regard to geographic flexibility, time flexibility, waiting time for treatment, stigma and the effects on help-seeking.	Not reported
(Sanyal et al., 2018[226])	11	To systematically review and appraise the quality of cost-effectiveness or utility studies assessing eHealth technologies in study populations involving older adults.	◦ Telemonitoring ◦ Web-based activities ◦ Telecare	Usual care	◦ Effectiveness ◦ Cost-effectiveness	eHealth technologies can be used to provide resource efficient patient-oriented care. This review identified growing use of these technologies in the management of chronic diseases in study populations including older adults. Given the limitations of these studies, there is a lack of convincing evidence to conclude whether the use of eHealth technologies to deliver health care to older adults will demonstrate value at any acceptable level of investment.	Moderate quality
(Snoswell et al., 2016[115])	11	To summarize and evaluate the current economic evidence comparing store-and-forward teledermatology (S&FTD) with conventional face-to-face care.	Store and forward dermatology	Usual care (face-to-face)	◦ Cost-effectiveness	Current evidence is sparse but suggests that S&FTD can be cost-effective. It appears to be cost-effective when used as a triage mechanism to reduce face-to-face appointment requirements. The cost-effectiveness of S&FTD increases when patients are required to travel farther distances to access dermatology services. Further economic research is required for the emerging S&FTD, which uses dermoscopes in combination with smartphone applications, as well as regarding the possibility and consequences of patients self-capturing and transmitting images.	Moderate quality
(Thomas et al., 2014[110])	45	To evaluate teleglaucoma, its diagnostic accuracy, healthcare system benefits, and cost-effectiveness.	1) Teleglaucoma	Face-to-face or no comparator	◦Cost-effectiveness ◦Diagnostic accuracy	Our results indicated that, teleglaucoma is more specific and less sensitive than in-person examination. The pooled estimates of sensitivity was 0.832 [95% CI 0.770, 0.881] and specificity was 0.790 [95% CI 0.668, 0.876].	Moderate quality

						The relative odds of a positive screen test in glaucoma cases are 18.7 times more likely than a negative screen test in non-glaucoma cases. Additionally, the mean cost for every case of glaucoma detected was $1098.67 US and of teleglaucoma per patient screened was $922.77 US.	
(Udsen, Hejlesen and Ehlers, 2014[206])	6	To review the costs and cost-effectiveness of telehealth for patients with chronic obstructive pulmonary disease (COPD).	Telemedicine: 1) Real-time (telephone) 2) Telemonitoring 3) Store and forward	Usual care	◦Cost ◦Cost-effectiveness	The present study shows that healthcare decision makers seeking large-scale implementation of telehealth in routine clinical practice should be cautious, since the quality of the economic evidence is poor. The clinical effectiveness of a large-scale implementation of telehealth with follow-up exceeding 12 months has not yet been demonstrated	Low quality
(Zhai et al., 2014[47])	47	To evaluate the clinical effectiveness and cost effectiveness of telemedicine approaches on glycaemic control in patients with type 2 diabetes mellitus.	◦ telephone interventions ◦ internet-based	◦ Usual care ◦ Telemonitoring	◦ Clinical effectiveness: change in HBA1C ◦ Cost-effectiveness (ICER)	Cost-effectiveness analysis from two studies revealed ICERs of $491 and $29,869 per capita for each unit reduction in HbA1c, for the telephone- and internet-based interventions respectively. These studies were disparate, both in terms of overall expense and relative cost-effectiveness.	Moderate quality

Note: ICER – Incremental cost-effectiveness ratio
Source: OECD analyses

Table B.4. Overview of included systematic reviews and meta-analyses focussing on patient experience with telemedicine

Review	Primary studies	Description of review	Population/ Setting	Outcomes	Findings and conclusions	Quality of evidence
(Bashshur et al., 2016[156])	86	To present the evidence for the advantages of telemedicine interventions in primary care	All populations in primary care settings	Feasibility/acceptance (35), intermediate outcomes (36), health-outcomes (7), cost (8)	Telemedicine is feasible/acceptable in primary care settings, but varies by population demographics. Telemedicine is more acceptable to patients than providers	Not reported
(Berrouiguet et al., 2016[193])	36	To review the literature regarding the use of mobile phone text messaging in mental health care.	Patients with mental health conditions	Telemonitoring: text message feasible/acceptable for support (15), self monitoring (15), medication reminders and assessment(5), information (6)	Overall, a positive attitude toward text messages was reported. RCTs reported improved treatment adherence and symptom surveillance. Other positive points included an increase in appointment attendance and in satisfaction with management and health care services. Insight into message content, preventative strategies, and innovative approaches derived from the mental health field may be applicable in other medical specialties.	Not reported

(Berry et al., 2016[162])	49	To determine factors that could influence the acceptability of online and mobile phone delivered interventions for severe mental illness (SMI)	Patients with severe mental illness	Acceptability of mobile phone interventions (42)	Telemonitoring via text messaging found to be highly acceptable by patients with SMI	Not reported
(Brunton, Bower and Sanders, 2015[202])	7	To review and synthesise the findings from qualitative studies that investigated user perspectives and experiences of telehealth in COPD management, in order to identify factors which may impact on uptake.	Patients with COPD	Help-seeking/self-care(5), Risk/safety concerns from health professionals (3), Empowerment (2)	Telehealth technologies have the potential to be beneficial in the management of COPD compared to usual care alone by enabling self-care and empowerment but these benefits may be detrimental through increased risk, dependency and burden.	On average papers met 71% of CASP requirements.
(Caffery et al., 2017[37])	14	To examine reported outcomes of health services delivered by telehealth to Indigenous Australians.	Indigenous Australians	Social and emotional wellbeing clinical outcomes, access to health, patient empowerment, health literacy	Telehealth models of care facilitated through partnerships between Aboriginal community-controlled health services and public hospitals may improve both patient outcomes and access to specialist services for Indigenous people.	Low quality
(Cox et al., 2017[239])	22	To identify, appraise, and synthesize qualitative research evidence on the experiences of adult cancer survivors participating in telehealth interventions, to characterize the patient experience of telehealth interventions for this group	Adult cancer survivors	(1) influence of telehealth on the disrupted lives of cancer survivors (convenience, independence, and burden); (2) personalized care across physical distance (time, space, and the human factor); and (3) remote reassurance—a safety net of health care professional connection (active connection, passive connection, and slipping through the net)	Telehealth interventions are convenient and can potentially reduce treatment burden while providing cancer survivors with independence and reassurance.	Yes but not reported
(Cruz, Brooks and Marques, 2014[240])	12	To provide a comprehensive description of the methodologies used in home telemonitoring	775 participants, COPD patients	Patient satisfaction (9), patient training (9), patient compliance (5)	Patients are overall satisfied with home tele-monitoring systems, however systems need to be adjusted to suit the target population and additional training provided to patients.	Moderate quality

		interventions for Chronic Obstructive Pulmonary Disease (COPD) and to explore patients' adherence and satisfaction with the use of telemonitoring systems.				
(Gorst et al., 2014[143])	37	To assess levels of uptake of home telehealth by patients with HF and COPD and the factors that determine whether patients do or do not accept and continue to use telehealth.	Adult heart failure or COPD patients	Patients acceptance, abandonment, or perceptions of telehealth. 1) Barriers to telehealth (17) 2) Patient facilitators (27)	Technical problems appeared to be a major issue impacting on the uptake and sustained use of telehealth, with studies reporting little tolerance for poorly working systems, thus it is essential that telehealth equipment is user friendly and functions effectively. Furthermore, users can be unsure of the technology, hence appropriate training and access to support could also support uptake and use.	Mostly moderate and high quality
(Greenhalgh, A'Court and Shaw, 2017[145])	105	To inform policy by making sense of a complex literature on heart failure and its remote management.	Adult heart failure patients	Factors that account for low uptake of eHealth: Patient factors, Staff factors, Team/service factors	The limited adoption of telehealth for heart failure has complex clinical, professional and institutional causes, which are unlikely to be elucidated by adding more randomised trials of technology-on versus technology-off to an already-crowded literature.	Not reported
(Grist, Porter and Stallard, 2017[151])	24	To systematically appraise the available research evidence on the efficacy and acceptability of mobile apps for mental health in children and adolescents younger than 18		1) Efficacy (5) 2) Feasibility and acceptability (8)	Telemedicine interventions delivered through mobile apps is acceptable to children and adolescents with mental health conditions	Not reported
(Hamilton et al., 2018[187])	9	To assess the evidence around mHealth interventions for CR and heart failure management for service and patient outcomes, cost effectiveness with a view to how mHealth could be utilized for rural, remote and Indigenous cardiac patients.	Cardiac patients	Acceptability, usage, engagement and adherence	Telemedicine is acceptable to cardiac patients with high levels of engagement. mHealth delivery of CR and heart failure management is feasible with high rates of participant engagement, acceptance, usage and adherence. The efficacy of mHealth in these studies was comparable to traditional centre-based CR. mHealth delivery has the potential to improve access to CR and heart failure management for patients unable to attend traditional centre-based programs.	Not reported
(Liptrott, Bee and Lovell, 2018[131])	48	To report adult patients' perceptions of the acceptability of, and	Adult cancer patients	Acceptability, satisfaction, opinions and perceptions	Current evidence relating to the acceptability and satisfaction of support delivered by telephone for cancer patients during or after therapy suggests it is convenient, provides positive	Mostly low quality

		satisfaction with, telephone-based interventions during or post-treatment for cancer.			personal experiences, enhances accessibility to HCPs and provides a familiar environment in which to facilitate potentially sensitive healthcare discussions.	
(Musiat and Tarrier, 2014[109])	95	The aim of this study was to review the evidence of cost-effectiveness, geographical and time flexibility, stigma, therapist time, effects on help-seeking and treatment satisfaction of cCBT interventions for mental health	Mental health patients	Cost-effectiveness, Treatment satisfaction	cCBT interventions are cost-effective and often cheaper than usual care. Limited evidence was found with regard to geographic flexibility, time flexibility, waiting time for treatment, stigma and the effects on help-seeking. Personal support in cCBT was found to take many forms, was not limited only to therapists, and seemed to increase treatment adherence and reduce attrition. Treatment satisfaction with cCBT was found to be high, but more research on attrition due to dissatisfaction is required.	Not reported
(Slater et al., 2017[227])	12	To identify, appraise, and synthesize available qualitative evidence on users' experiences of mHealth technologies for NCD management in young people. We explored the perspectives of both end users (young people) and implementers (health policy makers, clinicians, and researchers).	All qualitative studies on young people (in the age range of 15-24 years) with chronic NCDs (end users)	Experiences, acceptance, perceptions of benefit	Our evidence meta-synthesis revealed both complementary and unique user perspectives on enablers and barriers to designing, developing, and implementing mHealth technologies to support young people's management of chronic NCDs. mHealth technologies should be considered as a tool to enable self-management, to improve clinical encounters, and to encourage positive health behaviours. Developing mHealth technologies should involve a genuinely collaborative co-design process between end users and implementers, with the capacity to tailor and adapt technologies to meet person-centred needs. This approach will help to ensure meaningful mHealth solutions for young people, while also supporting implementation efforts.	Moderate quality
(Trettel, Eissing and Augustin, 2018[241])	204	The goal was to identify the use and current state of teledermatology across the world with regard to geographical distribution of published studies, treated indications, research questions, and its reliability in diagnosis and therapy compared to classic face-to-face consultations	Not specified	Validity, concordance or feasibility (154), Effectiveness (33), Costs/Cost-effectiveness/Cost–benefits (24), Quality of life (4), Safety (1)	Teledermatology is a reliable consultation tool in the majority of studies. If specified, telemedicine was used in daily dermatological routine for patient management purposes, to consult patients in peripheral locations, or for medical support in nursing homes or home care settings.	Moderate quality

Source: OECD analyses

Table B.5. Overview of included systematic reviews and/or meta-analyses of implementation of telemedicine

Review	Primary studies	Description of review	Population/ Setting	Outcomes	Findings and conclusions	Quality of evidence
(Alvarado et al., 2017[198])	41	To identify and classify patient barriers to implementing remote health interventions for adult patients with type 2 diabetes in the United States.	Adult patients in the US with type 2 diabetes	◦Low formal education ◦technology illiteracy ◦patient desire for in person contact ◦low perceived value or effectiveness ◦health illiteracy ◦technology is cost prohibitive ◦limited internet access in area ◦ lack of customization to patient preference and needs	Lack of data accuracy, concerns over scalability and technology illiteracy are the most common barriers to remote health monitoring of Type 2 diabetes patients, leading to declining patient engagement.	Not assessed
(Block et al., 2016[242])	137	To review of studies using remote physical activity monitoring in neurological diseases, highlighting advances and determining gaps.	Patients with neurological diseases	Physical activity	Emerging evidence supports the feasibility and effectiveness of telemonitoring in neurological care and neuro-rehabilitation	Not reported
(Bradford, Caffery and Smith, 2016[221])	116	To review and synthesise the available literature regarding telehealth services in rural and remote locations of Australia, and to identify the factors associated with their sustained success.	People living in rural and remote Australia	Factors influencing success and sustainability of tele-health services: vision, ownership, adaptability, economics, efficiency and equipment	Telehealth has the potential to address many of the key challenges to providing health in Australia, with its substantial land area and widely dispersed population.	Not reported
(Bruce, Mallow and Theeke, 2018[243])	16	To present evidence on the use of teledermoscopy to improve the accuracy of skin lesion identification in adult populations.	Adults with skin lesions	◦Diagnostic accuracy ◦Diagnostic reliability ◦Feasibility	There is limited evidence on the effectiveness of teledermoscopy in the accurate diagnosis of skin lesions mainly due to variation in instruments used to capture skin lesion images	Not reported
(Cruz, Brooks and Marques, 2014[240])	12	To provide a comprehensive description of the methodologies used in home telemonitoring interventions for Chronic Obstructive Pulmonary Disease (COPD) and to explore patients' adherence and satisfaction with the use of telemonitoring systems.	775 participants, COPD patients	Patient satisfaction (9), patient training (9), patient compliance (5)	Patients are overall satisfied with home tele-monitoring systems, however systems need to be adjusted to suit the target population and additional training provided to patients.	Moderate quality
(Gehring et al., 2017[194])	20 research studies and 9	To identify implementation foci in research studies and	Children (0-18) for included studies, all	Acceptability (14), Adoption (5),	Studies have largely focused on acceptability and appropriateness, while	Yes but not reported

	government documents. Total (29)	government/organizational documents for eMental healthcare technologies for paediatric mental healthcare.	populations for government documents	appropriateness (10), cost (20), feasibility (2), fidelity (2), penetration, and sustainability(8 govt. documents)	government/organizational documents state goals and recommendations regarding costs, feasibility, and sustainability of eMental healthcare technologies. These differences suggest that the research evidence available for paediatric eMental healthcare technologies does not reflect the focus of governments and organizations. Partnerships between researchers, healthcare planners, and policymakers may help to align implementation research with policy development, decision-making, and funding foci	
(Greenwood, Young and Quinn, 2014[161])	15	To summarize research on telehealth remote patient monitoring interventions that incorporate key elements of structured self-monitoring of blood glucose (SMBG) identified as essential for improving A1C.	Diabetic (type 2) patients using insulin	Satisfaction, Adherence, haemoglobin A1C	Telehealth RPM interventions that incorporate more key elements of structured SMBG appear to have the greatest impact on A1C. It is critical to incorporate purposeful SMBG profiles that allow the individual to change behaviour or the PCP to modify treatment. Engaging persons with diabetes in self-management requires education, an understanding of SMBG profiles and goals, and the opportunity for interactive feedback as they engage in behaviour change.	Not reported
(Guise, Anderson and Wiig, 2014[244])	22	To identify patient safety risks associated with telecare use in homecare services and to investigate whether and how these patient safety risks have been addressed in telecare training.	Adults receiving care at home	Telehomecare systems: evaluation, acceptability, user experiences, implementation. Change in the nature of clinical work (15); Lack of patient and/or staff knowledge and understanding (13); Technology issues (9); Changes to staff workload (8); Accessibility issues (3); Lack of guidelines (3); Patient dependency (3); Patient anxiety (2); Poor system integration (2); Poor patient compliance (2); and nature of	There is a need to better identify and describe patient safety risks related to telecare services to improve understanding of how to avoid and minimize potential harm to patients. This process can be aided by reframing known telecare implementation challenges and user experiences of telecare with the help of a human factors systems approach to patient safety.	Overall acceptable

				homecare environment (1).		
(Irving et al., 2018[245])	39	To explore the quantitative and qualitative framework associated with teledentistry in an effort to uncover the interaction of multiple influences on its delivery and sustainability.		Main themes identified: (1) using information and communication technology (ICT), (2) regulatory and system improvements, (3) accuracy of teledentistry, (4) effectiveness, including increasing access to clinical services, efficiencies and acceptability, and (5) building and increasing clinical capacity of the dental workforce.	Teledentistry provides a viable option for remote screening, diagnosis, consultation, treatment planning and mentoring in the field of dentistry. Rapidly developing information and communication technologies have increasingly shown improving cost effectiveness, accuracy and efficient remote assistance for clinicians. There is high acceptability for teledentistry amongst clinicians and patients alike. Remuneration of advising clinicians is critical to sustainability.	Moderate quality (39)
(Ito et al., 2017[224])	41	To systematically review the Japanese and English language literature relating to the clinical use of telemedicine in Japan.	Not specified	Screening, diagnosis (16),	Japan is actively seeking opportunities to use telemedicine in addressing the healthcare needs of the population. Key focus areas are 1) access to healthcare for rural and remote communities and 2) home telemedicine. Also, the clinically related studies reflect the Japanese cultural focus on disease prevention and surveillance.	Not reported
(Kampmeijer et al., 2016[213])	45	A systematic review of the evidence on the scope of the use of e-health and m-health tools in health promotion and primary prevention among older adults (age 50+).	Older adults (50+)		The successful use of e-health/m-health tools in health promotion programs for older adults greatly depends on the older adults' motivation and support that older adults receive when using e-health and m-health tools.	
(Kapadia et al., 2015[214])	58	To identify the key issues that affect the adoption of ICT in the aged care sector	Older adults	Reliability, usability, cost, health conditions, perceived need for technology, social isolation, confidentiality and security	ICT empowers health professionals to improve operational efficiency, reduce medical errors, and increase capacity for managing limited resources effectively. The availability of ICT enables older people stay independent longer in their home. A key to success for aged people adopting technology is usability and cost.Therefore, developing low-cost and user-friendly technology for older people is the first step towards the successful implementationof ICT	Not reported

(Macdonald, Perrin and Kingsley, 2018[146])	48	To explore the enablers and barriers faced by adults with diabetes using two-way information communication technologies to support diabetes self-management.	Adults with diabetes	1) Technology usage 2) Poor interface and technology design 3) Environment, access and supportive infrastructure	People with diabetes face a number of potentially modifiable barriers in using technology to support their diabetes management. In order to address these barriers, end users should be consulted in the design process and consideration given to theories of technology adoption to inform design and implementation.	Majority were high or unclear risk of bias
(McDougall et al., 2017[220])	20	To identify and summarize the published and grey literature on the use of telemedicine for the diagnosis and management of inflammatory and/or autoimmune rheumatic disease.	Autoimmune and rheumatology patients	1) Cost-effective (6) 2) Diagnosis by telerheumatology effective (7)	Most data relate to the management of inflammatory arthritis during follow-up. Studies to date are at high risk of bias, use predominately VTC TRh, and include physicians as the patient presenter. TM reporting methods varied widely, and rigorous cost analyses are lacking. Most studies viewed TRh favourably, with 1 notably stating a potential for harm.	High risk of bias, 10 out of 20 papers used (73% patients) published in abstract form only
(Meurk et al., 2016[160])	30	To review e-mental health service use for depressive and anxiety disorders to inform policy development and identify policy-relevant gaps in the evidence base		1) facilitating uptake (17) 2) Treatment preferences (6) 3) Governing mechanisms (23)	Successfully establishing e-mental health care within the health system will depend on the skilful coordination of activities within clinical, community, research and development, and policy-making realms.	Thus, while we appraised study quality, policy relevance was our key concern. Yes appraised but not relevant/usable in this context
(Radhakrishnan et al., 2016[159])	16	To identify the barriers and facilitators for sustainability of tele-homecare programs implemented by home health nursing agencies for chronic disease management.	Not specified	Barriers and facilitators for sustainability of telehomecare, main themes: 1) perceptions of effectiveness 2) tailoring to patients 3) nurse-patient communication and collaboration 4) interpersonal communication and collaboration 5) organisation of process and culture 6) quality of telehomecare technology	The findings of this systematic review provide implications for sustained usage of tele-homecare programs by home health nursing agencies and can help such programs realize their potential for chronic disease management.	(16) Moderate quality

(Ross et al., 2016[157])	44	To provide an update and re-analysis of a systematic review of the e-health implementation literature culminating in a set of accessible and usable recommendations for anyone involved or interested in the implementation of e-health.	Primary, secondary and homecare settings	Barriers and facilitators of e-health: cost, complexity, adaptability, implementation climate, external policies, knowledge and beliefs, planning, engaging	Key factors for effective implementation include the need for supportive legislation, recognised standards and the fit of e-health systems with current organisational workflow.	Yes but not reported
(Wickramasinghe et al., 2016[148])	14	To identify enablers and barriers associated with the delivery of telehealth services for diabetes care amongst Indigenous people.	Indigenous diabetic patients	Enablers: 1) Telehealth trained local staff 2) Pre-intervention community engagement 3) Audio-visual material included Barriers: 1) Poor quality images 2) Delayed follow-up 3) Scheduling issues, lack of staff training	In the right circumstances, the delivery of telediabetes services is promising, especially in circumstances where specialist services are not available or difficult to access.	Study design assessment was classified as high (21%), moderate (36%), or low (43%). The ability to adapt the program/study elsewhere was scored high (25%), moderate (50%), and low (25%).

Source: OECD analyses

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