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Investing in health systems to protect society and boost the economy: Priority investments and order-of-magnitude cost estimates

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Investing in health systems to protect society and boost the economy

Priority investments and order-of-magnitude cost estimates

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Key findings

1. COVID-19 is the most significant public health emergency in more than a century, caused a global economic crisis, and has long-term repercussions across society. COVID-19 continues to claim lives, many are suffering ill health (physical and/or mental) due to the virus, and health systems are struggling to recover from the massive disruption. This unprecedented crisis has highlighted the urgent need for smart investments to strengthen health system resilience. There is a need to *protect* people's underlying health, through enhanced preventive care and the ability to reinforce natural defences in acute times; to *fortify* the foundations of health systems, by ensuring adequate core equipment and exploiting the potential of health information; and to *bolster* health professionals working on the frontline, by ensuring sufficient numbers of doctors and nurses. Smart health investments provide countries with the agility to respond not only to evolving pandemics but also to other health and societal shocks.

2. This report identifies a set of priority investment areas needed to strengthen health system resilience. It then produces order-of-magnitude estimates of the expected costs of such investments, drawing extensively from existing OECD data and analytical studies. The return from such investments extends far beyond the direct health benefits. More resilient health systems are at the core of stronger, more resilient economies – enabling substantial economic and societal benefits by avoiding the need for stringent and costly containment measures in future crises with healthier and better prepared societies.

3. These priority investments represent an estimated 1.4% of GDP, on average across OECD countries (and ranging from 0.6-2.5%). This order-of-magnitude estimate is set in the context of the pre-pandemic situation. That is, it is calculated in relation to the level of health expenditure observed in 2019. The total cost of these investments equates to around 9% of the total OECD expenditure on health in 2019, or USD 627 billion (USD 460 per capita). This figure is similar to public funding across the OECD for prescription drugs in 2019. One might look at the 0.9 percentage point jump in the health spending to GDP ratio in 2020 and 2021 as an already significant step towards meeting this target. However, the increase in health spending in 2020 and 2021 relative to GDP was driven both by a significant fall in GDP and by the rapid surge in additional funding to the health sector to respond to the crisis. Much of this additional expenditure was drawn from unplanned funds to firefight the pandemic, rather than long-term planned investments to strengthen resilience.

4. Previous work by the OECD Health Division (OECD, 2017[1]) has highlighted an enormous potential to make savings by tackling wasteful spending and realise efficiency gains across the health sector. A combination of targeted spending and measures to reduce wasteful spending could mitigate the overall increases in health spending in the medium to long-term.

5. Finally, the various investments need to be considered over different, although in some cases linked, timescales. For example, while increasing the availability of medical equipment and infrastructure could in theory be done in the short-term, expanding the number of health care professionals to operate such equipment is not something that can be easily remedied overnight.

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1 Introduction

6. With the world well into its third year since the onset of the pandemic in early 2020, COVID-19 continues to have a huge and lasting impact, placing acute pressures on health systems that were often overstretched even before the pandemic. The ensuing health crisis caused major economic disruption, from which most countries are only now beginning to emerge. The pandemic has clearly shown that if health systems are not strong enough to respond to major unexpected shocks, there will be cascading health and economic consequences. Targeted investments are therefore needed to strengthen resilience, reinforcing the foundations of countries' health systems and their agility to respond to evolving pandemics and other emerging shocks.

7. This OECD Health Working Paper identifies key investment areas needed to strengthen health system resilience and provides broad order-of-magnitude estimates of the expected costs of these investments to facilitate further discussion. The return from such investments extends beyond the health benefits of fewer lives lost and reduced morbidity. More resilient health systems are also at the core of stronger, more resilient economies – enabling substantial economic and societal benefits from avoiding stringent and costly containment measures and other disruptive effects in future health crises.

8. After more than two full years of the pandemic, reported COVID-19 cases had totalled around 500 million across the world, with over 6 million deaths registered. These numbers are underestimates given that many COVID-19 cases have gone and continue to go unreported, especially in lower- and middle-income countries. Moreover, those who have recovered from the acute phase may go on to experience longer-term health consequences. In addition, the pandemic has caused delays to urgent treatment or postponement of follow-up care for those with other healthcare needs, as well as increasing the burden of mental ill-health among some groups (OECD, 2021[2]).

9. This unprecedented public health crisis also led directly to a major economic crisis. For the OECD economy, there was a 4.7% drop in GDP in 2020 with the subsequent rebound observed in 2021 merely bringing the size of the OECD economy back to around 2019 levels. The appearance of the much more transmissible Omicron variant at the end of 2021 resulted in further economic uncertainty.

10. Strengthening health system preparedness and broader resilience is therefore critical. Nevertheless, as countries contend with the disruption wrought on health systems and the wider economy, understanding where health investments should be targeted is key to strengthening health system resilience – to COVID-19, and just as importantly, new potential shocks. Well-chosen health investments reinforce the ability of health systems to manage and contain emerging infectious pathogens or other unexpected shocks, as well as their capacity to continually provide high quality health services for all healthcare needs. They also build resilience in populations, particularly vulnerable population groups, by protecting and improving their underlying state of health. The return from such investments extends beyond the health benefits of fewer lives lost and more efficient health systems. More resilient health systems are needed to build stronger, more resilient economies – enabling substantial economic and societal benefits from healthier and productive populations and from minimising stringent and costly containment measures in future crises.

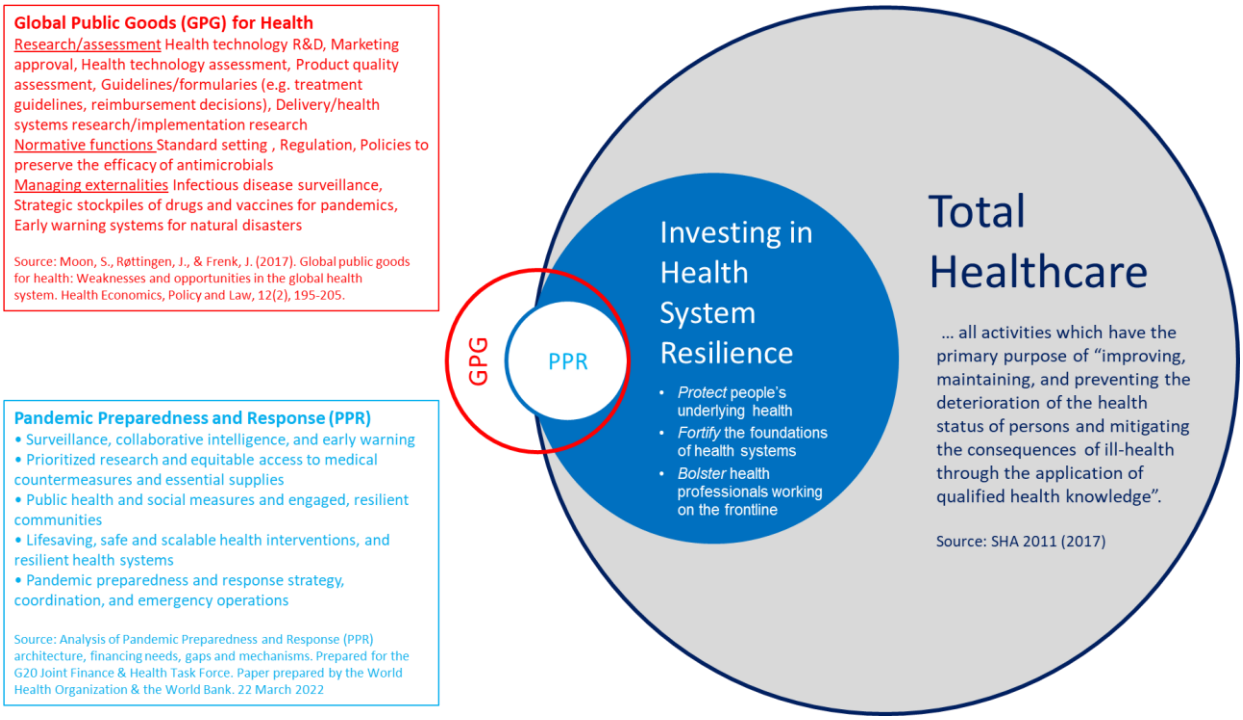
11. As countries have considered how best to 'build back better' and get their economies back on track, boosting investment in health systems has been seen as a priority area. Large commitments in public spending were made in almost all OECD countries, often justified by the need to create new jobs, given

the severe consequences of the pandemic on labour markets (OECD, 2020[3]). One advantage of boosting spending on health and long-term care is that this can translate into a significant boost to employment. Such jobs can be offered across all localities, rather than being concentrated in capital cities or commercial centres, and for a wide variety of skill sets (Buchan, Dhillon and Campbell, 2017[4]).

12. This paper identifies key investment areas that will strengthen health system resilience and provides broad order-of-magnitude estimates of the expected costs of these investments. Costing is based on a macro-approach that draws heavily on OECD Health Statistics and recent reports, supplemented by third-party sources on more detailed epidemiological data and unit costs for major inputs. Such costing results – expressed in relation to 2019 pre-pandemic levels of GDP – give a sense of the scale of investments needed to strengthen health system resilience in OECD countries, with a costing range that reflects expected cross-country differences in these costs. Note that the scope of this analysis is centred on the health system, and on national spending rather than international initiatives. For important national and international policy changes beyond the health system, notably in the interconnection between people, plants, animals, and their shared environment (One Health), see, for example, (Pan-European Commission on Health and Sustainable Development, 2021[5]).

13. An assessment of the gaps in pandemic preparedness was requested by G20 leaders to the G20 Joint Taskforce on Health and Finance in 2020 and subsequently updated. The key message from this G20 taskforce, prepared in cooperation with international organisations including the World Health Organization (WHO) and the OECD, highlighted the need to invest nationally, regionally, and globally in Pandemic Preparedness and Response (PPR) as well as in the foundations of health systems. In particular, it illustrated the vulnerabilities in the international community's ability to prevent, detect and respond effectively to pandemic threats (https://pandemic-financing.org/report/high-level-summary/). Building on the spending needs of low- and middle-income countries identified by the G20 taskforce, this working paper goes beyond the preparedness-specific costs identified in the G20 report and in subsequent reports, to analyse more broadly the overall health system investments needed to build resilience – from a national perspective (Figure 1).

Figure 1. Relationship between spending on resilience and pandemic preparedness, at the national and international levels



Source: OECD Secretariat.

14. That is, the concept of resilience underpinning this analysis embraces but goes beyond preparedness. Resilience is understood as the ability of systems to *anticipate, absorb, adapt* and *recover* from major shocks such as COVID-19 (OECD, 2020[6]). Therefore, resilience is not simply about minimising risk and avoiding shocks but recognising that these shocks will happen. Such shocks are defined as high consequence events which have a major disruptive effect on society. Along with COVID-19, this includes other highly infectious pathogens or emerging diseases. It also covers natural or human-caused disasters that can lead to massive surges in healthcare needs. The investment areas and indicative cost estimates in this paper are relevant for both combatting COVID-19 and other major emerging shocks.

15. The remainder of this paper is structured as follows. Section 2 defines the key investments needed to strengthen health system resilience; Section 3 provides broad order-of-magnitude cost estimates for these investments; Section 4 concludes.

2 Defining the key investments needed to strengthen health system resilience

16. Investments for strengthening health system resilience are grouped into three overarching investment pillars. These pillars aim to:

- *Protect* people's underlying health
- *Fortify* the foundations of health systems
- *Bolster* health professionals working on the frontline

17. For each of these three investment pillars, key investments are identified (this Section), then costed (Section 3). The investments are based on emerging evidence of the most effective policies in combatting COVID-19, combined with evidence from experiences with managing previous major health shocks (see the OECD Digital Hub on Tackling the Coronavirus, https://www.oecd.org/coronavirus). Such investments also have the benefit of making health systems better positioned to combat more gradual transitions such as demographic change and the increasing burden of chronic illnesses.

18. While these investments will require resources up front and over time, they offer a substantial return – both in normal times, as well as during the ongoing pandemic or other emerging health shock. This report does not assess the rate of return (see (Patel and Sridhar, 2021[7]) and (Commission on a Global Health Risk Framework for the Future, 2016[8]) for examples of such analysis both during the current COVID-19 crisis and pre-pandemic). Rather, this report focuses on the costs of implementing priority investments into health systems. The exact amount of additional investment needed will vary by country, depending on existing capacities, with each country having specific areas where they will need to invest more, and other areas where additional investment may not be needed. Indeed, into the third year of the pandemic, many countries have already started to make significant inroads into the investment gaps identified. Such cross-country variation is reflected in the range of cost estimates shown in Section 3, notwithstanding that costing reflects broad order-of-magnitude estimates rather than a precise cost-accounting analysis.

Pillar 1: Protect people's underlying health

Investment 1: Enhanced preventive care

19. Preventive care is one of the cornerstones of an effective health system. In broad public health terms, whether interventions are targeted at individuals or populations, the aim is to enhance health status and maintain a state of low risk for diseases, disorders, or conditions. That is, effective preventive care policies limit the occurrence of new diseases and reduce the incidence of existing communicable and non-communicable diseases.

20. At a broad population level, experience from the COVID-19 pandemic has shown that an effective **public health surveillance system** is an important policy lever to improve preparedness, particularly in monitoring and controlling the spread of an infectious disease (OECD, 2020[9]). This requires a well-functioning national and regional public health system with trained staff, an adequate availability of diagnostic laboratory equipment, and a capacity to rapidly ramp up the extent of testing and monitoring as future public health crises arise.

21. COVID-19 has also further demonstrated the importance of strong **infection prevention and control policies in healthcare settings**. This includes health and long-term care workers adopting a number of common-sense precautions, notably: hand hygiene, environmental cleaning, decontamination of medical equipment, aseptic techniques, and injection safety (World Health Organization, 2021[10]). Of particular concern in recent years is an increasing degree of **anti-microbial resistance** (AMR). Combatting AMR protects the efficacy of prospective medicines and limits the risk of hospital-acquired infections for COVID-19 and other patients. Alongside the general infection and control policies above, cost-effective AMR policies include ending the over-prescription of antibiotics, rapid testing for patients to determine whether they have viral or bacterial infections, delays in prescribing antibiotics and promoting better hygiene (OECD, 2018[11]).

22. Investing more in health promotion and disease prevention also improves people's underlying health. Despite clear progress in certain areas, such as preventive cancer screening programmes, policy levers to lower smoking and alcohol consumption and improve healthy diets, much more can still be done to reduce the **major risk factors for health** of alcohol, smoking, opioid use, and obesity. These risk factors not only increase the risk of non-communicable diseases, but also make people much more vulnerable to COVID-19, other infectious diseases, and certain disasters. For example, a recent meta-analysis found that individuals with obesity had, on average, a 113% higher risk of hospitalisation and 48% increased risk of death from COVID-19 (Popkin et al., 2020[12]). Therefore, while the characteristics and related risk factors of a health shock can vary, countries with a smaller share of the population having chronic diseases may find it easier to cope and be more resilient. Moreover, increasing obesity rates risk an explosion of related illnesses and conditions if left unchecked (OECD, 2019[13]). Even prior to the pandemic, NCD initiatives targeting such major risk factors for health have been recognised as essential contributors to global health security (Kostova et al., 2017[14]).

23. Further investments in reducing risk factors for health and combatting chronic diseases are therefore vital. To tackle harmful alcohol consumption, OECD has identified a package of the most effective interventions, including raising alcohol taxation, regulation of alcohol advertising, sobriety checkpoints to counter drink-driving and alcohol counselling in primary care. Additional innovative policies include minimum unit pricing (MUP) and statutory bans on alcohol advertising targeting children (OECD, 2021[15]) (OECD ref). For obesity, food labelling, advertising restrictions and mass media campaigns are some of the key policies already implemented – to differing extents – in many OECD countries. Additional policy measures which show promise encompass menu labelling, prescribing physical activity and workplace wellness programmes. For tobacco, key policies include: increasing excise taxes and prices on tobacco products; implementing plain/standardized packaging with large graphic health warnings on all tobacco packages; enacting and enforcing comprehensive bans on tobacco advertising, promotion and sponsorship; eliminating exposure to second-hand tobacco smoke in indoor workplaces, public places and public transport; and effective mass media campaigns to educate the public about the harms of smoking and second hand smoke (World Health Organization, 2021[16]).

Investment 2: Mass population programmes

24. In addition to the disease prevention interventions outlined above, this investment area relates to some specific mass programmes that protect people's underlying health and enable countries to better cope with acute phases of a health shock. For COVID-19, most notable is the need to develop and maintain

vaccination campaigns. This includes staffing and other associated delivery costs, as well as the costs of the actual vaccines themselves. Note that the expected costs of R&D for new vaccines and treatments for COVID-19 and other emerging pathogens are shown separately (see Box 3.1).

25. Mass vaccination programmes have reduced the risk of serious illness from COVID-19, and consequently hospitalisations. Most OECD member countries have aimed to administer two or three COVID-19 vaccine doses to the vast majority of their population. Moving forward, there is considerable uncertainty regarding how frequently COVID-19 vaccinations will be needed – some researchers cite emerging evidence that three doses is sufficient to provide long-lasting protection from new as well as existing variants, while others emphasise long COVID and the need for annual vaccination campaigns against influenza at least for the more vulnerable groups of the population (Dolgin, 2021[17]) (Rubin, 2021[18]) (Muecksch et al., 2022[19]).

Box 2.1. Research and Development into New Vaccines and Treatments for COVID-19 and Other Emerging Pathogens

Accelerated and sustained research and development (R&D) into new vaccines and treatments has the potential to massively reduce the burden of ill health from Covid-19 and other emerging pathogens, thereby easing pressures on overstretched healthcare services. This requires R&D into basic and early-stage research, typically spent by governments. This is alongside the R&D that translates and applies such knowledge through clinical trials to develop products, typically spent by the pharmaceutical industry. However, in the current crisis, governments have also covered an important share of these product development costs, as well as providing funding for the costs of building manufacturing capacity of some of the leading vaccine candidates currently in phase 3 clinical trials.

Unlike the seven investments costed in this report, R&D costs into COVID-19 and other emerging pathogens have been concentrated in the United States, the European Union and a few other countries that currently dominate R&D spending in the pharmaceutical sector. For example, in 2018, nearly two-thirds of R&D spending in OECD countries occurred in the United States (OECD, 2021[2]).

Whilst the overall costs of ongoing R&D efforts into a COVID-19 vaccine remain uncertain, prior to the COVID-19 pandemic, the World Health Organization (WHO) R&D Blueprint for Action produced cost estimates for 11 priority infectious threats (World Health Organization, 2016[20]). Such estimates are useful in producing order-of-magnitude minimum cost estimates for R&D into developing a single successful vaccine candidate for emerging infectious pathogens. The WHO Blueprint included all costs from preclinical efforts through to Phase III trials, estimating that a successful vaccine would cost between USD 133 million to USD 1.17 billion per pathogen. The variation in costs reflects the degree of knowledge and uncertainty about each pathogen and allows for differential success rates of trials. These estimates were subsequently updated by the Coalition for Epidemic Preparedness Innovations (CEPI), who produced a narrower best estimate range of USD 319-469 million per vaccine, and a total cost of USD 2.8-3.7 billion to progress at least once successful vaccine for each of the 11 priority infectious diseases (Gouglas et al., 2018[21]). Such costs exclude the costs of building large-scale manufacturing capacity, which are also substantial (OECD, 2020[22]).

26. ***Testing*** has proved an important complementary policy prior to and in parallel to vaccination campaigns, particularly during the various peaks of the pandemic. COVID-19 has also shown the importance of ensuring sufficient supplies of ***personal protective equipment (PPE)*** during acute phases of a health shock. While the additional investment in the public health system outlined under Investment 1 provides the foundations for an augmented baseline supply of PPE and more effective deployment of diagnostic testing, as well as strengthening overall surveillance and control functions, all countries will need

to have the capacity to ramp up PPE supplies and testing efforts for future COVID-19 peaks, or indeed for other emerging infectious pathogens.

Pillar 2: Fortify the foundations of health systems

Investment 3: Sufficient core equipment

27. The COVID-19 crisis has seen health care systems and hospitals placed under immense strain. Some countries have lacked sufficient physical resources, notably in terms of hospital beds and other medical equipment to respond to the sudden influx of COVID-19 patients and their subsequent treatment (OECD, 2020[9]). Investing to provide a certain base level of core equipment needs is therefore seen as a prerequisite to strengthening overall health system resilience and continuing to meet standards of care during a health shock. This includes investing in intensive care unit (ICU) and standard hospital beds, and associated technical equipment such as CT scanners, MRI units and ventilators. Having sufficient medical equipment in intensive care units and other settings helps avoid potentially catastrophic delays in diagnosing and treating patients, as well as minimising circumstances where there are more patients than beds. However, ensuring sufficient capacities are available in times of crisis may result in some redundancy in normal times.

28. Such investments are relevant not only for COVID-19 but also many other major health shocks, although the exact package of what would be needed will depend on the exact nature of the shock (e.g., different types of infectious diseases, versus natural disasters or human-caused disasters).

29. Certain types of non-medical equipment are also important, notably computers and other IT equipment. An adequate physical IT infrastructure provides the basis for trained health professionals to better monitor patients' health, both in acute situations and in the long term. Used correctly, telemedicine can make care more responsive, leading to increased quality and efficiency. The availability of earlier and more accurate indications of symptoms, signs and signals can help improve therapy and medication adherence, thereby avoiding costly interventions later. For people with multiple chronic diseases who require care over prolonged periods, remote delivery of care can greatly enhance access to appropriate services, in particular for people with limited ability and those living in remote areas. All of which requires adequate infrastructure.

Investment 4: Well-harnessed health information

30. The current pandemic has shone a light on the consequences to public health of inadequate investment in health data and governance. Beyond the capital investments in physical IT infrastructure (Investment 2), better use of the health data produced is critical. This reflects ongoing deficiencies that exist in the health sector– a sector where the correct decisions can have considerable impacts, but which remains 'data rich but information poor'. Improved IT linkages are also needed to be move information to where it was needed, not only within the health system but also externally; for example, facilitating whole of government decision making by balancing information on health system capacity versus containment and mitigation decisions.

31. Judicious use of routine health data improves containment and mitigation efforts, including early warning systems, and ensures patients receive the right care for their needs (including the wider adaptation of telemedicine) and are adequately followed up. To strengthen trust in digital health solutions, there is a need to ensure that the use of such personal data is responsible and well informed. This includes enabling privacy and ensuring personal data protection, digital security, and promoting the interoperability and governance of health data.

32. The OECD report 'Health in the 21st Century' concluded that health lags behind many other parts of the economy in harnessing the potential of data and digital technology, 'missing the potential to save a significant number of lives and billions of dollars' (OECD, 2019[23]). The study pointed to the need for a long overdue digital transformation. This is important for not only combatting COVID-19 and other emerging health shocks, but also in light of ageing populations, a growing chronic disease burden and rising health expenditure.

33. To effectively harness health information, standardised electronic health records (EHRs) with patient portals are needed, supplemented by greater use of mobile technologies (digital contact-tracing apps). Record linkages allow the information value of health data to grow by connecting health care treatments to outcomes and putting health events into context. At the onset of the pandemic, the majority of countries limited data linkage to only four health datasets (hospital in-patients, mental hospital in-patients, cancer registrations and deaths). The follow-up of COVID-19 patients will demand improved linkages, particularly to monitor the use of health care services and outcomes of Long-COVID patients including primary care, emergency care, medications use, hospitalisations, long-term care, and deaths. More broadly, the ability to link data sets at individual level is essential to improve clinical care, health surveillance, and research and innovation for all patients and care needs.

34. Such reforms require investing in better software and streamlined operational processes, improved IT skills of health workers and employing enough data scientists within health systems. Such investments to improve the use of data can also reduce ineffective and wasteful spending on health.

Pillar 3: Bolster health professionals working on the frontline

Investment 5: Sufficient health and long-term care professionals

35. At the heart of health system resilience is a stronger frontline. With around one in every ten jobs in the economy being in health or social care, there have never been as many health and care professionals working in OECD countries as now (OECD, 2021[2]). However, concerns about the retention of staff, and associated labour and skill shortages, continue. In addition to acute staffing challenges highlighted through the current public health shock, many OECD health systems have been accumulating staff shortages over the years. Increased pressure from demographic change, population demands and added concerns that the upcoming retirement of an older generation of doctors and nurses might further exacerbate such shortages (OECD, 2016[24]).

36. The COVID-19 pandemic has served as a visible and acute reminder of the need to maintain properly resourced health systems to deliver high-quality patient care at times of need. A recent study in the Lancet, for example, found that countries with higher workforce concentrations of Registered Nurses were strongly associated with reduced mortality rates from COVID-19 (Padula and Davidson, 2020[25]). Even prior to the pandemic, research has shown that nurse staffing levels have a positive impact on quality of care in OECD countries (Amiri and Solankallio-Vahteri, 2018[26]).

37. Moreover, there has been widespread awareness from governments and citizens alike that nursing and care staff deserved better recognition for the skill, responsibility, and empathy they demonstrate on a daily basis. During the first and subsequent waves of the pandemic, health and care workers have been at the frontline, enduring long and difficult working conditions with an increased risk of infection, serious illness, and death. In addition to 'rewarding' the commitment and sacrifices made during the pandemic, there is an ongoing question in a number of countries of how best to recognise nurses and care workers and set salary levels to attract and retain staff as a way to help tackle staffing shortages in the longer run. In France, for example, a COVID-19 bonus after the first wave of the pandemic and increased payments for overtime work of nurses and other workers in hospitals and nursing homes were implemented. To improve recruitment and retention, all health workers in hospitals and nursing homes received permanent

pay rises in 2020 of EUR 183 per month, and a further EUR 45 to 450 per month at the end of 2021/early 2022 (OECD/European Observatory on Health Systems and Policies, 2021[27]).

38. Securing sufficient numbers of skilled health and care professionals – in hospitals (including in ICUs), across different types of primary care facilities, and in long-term care – is therefore essential, with increased salaries also related to increased skill acquisition. A reinforced workforce strengthens service delivery, enabling effective case management of individuals with COVID-19 (or those hospitalised due to other types of health shocks), while also maintaining services at all levels of a health system for other healthcare needs.

Investment 6: Medical reserve

39. Boosting and optimising the capacity of health systems to respond to the surge in the demand for care associated with COVID-19 cases has been one of the major challenges faced by countries, particularly early in the pandemic. As doctors, nurses and other health professionals were mobilised to play the role of first responders, health systems sought ways to rapidly increase the number of staff available. Several countries mobilised inactive and retired health professionals. Other countries turned to military health professionals, to assist in testing, treatment and in the relocation of patients. Countries have also mobilised students in medical, nursing and other health education programmes to provide services to patients or to help in responding to public concerns, for example, manning telephone hotlines or taking on the non-clinical tasks of key clinical staff.

40. Creating a medical reserve can offer a flexible and cost-effective surge capacity that can be called upon in times of high need. Costs relate primarily to recurrent training, to ensure people enlisted in a country's medical reserve maintain the necessary skills to support full-time health professionals, and how both groups can integrate efficiently during a peak in COVID-19 cases or indeed other emerging health shock. Note that estimates do not include additional costs associated with the deployment of surge capacity during a health shock (e.g., per diems and travel allowances).

3 How much will these investments to strengthen health system resilience cost?

3.1 Overall magnitude of costs

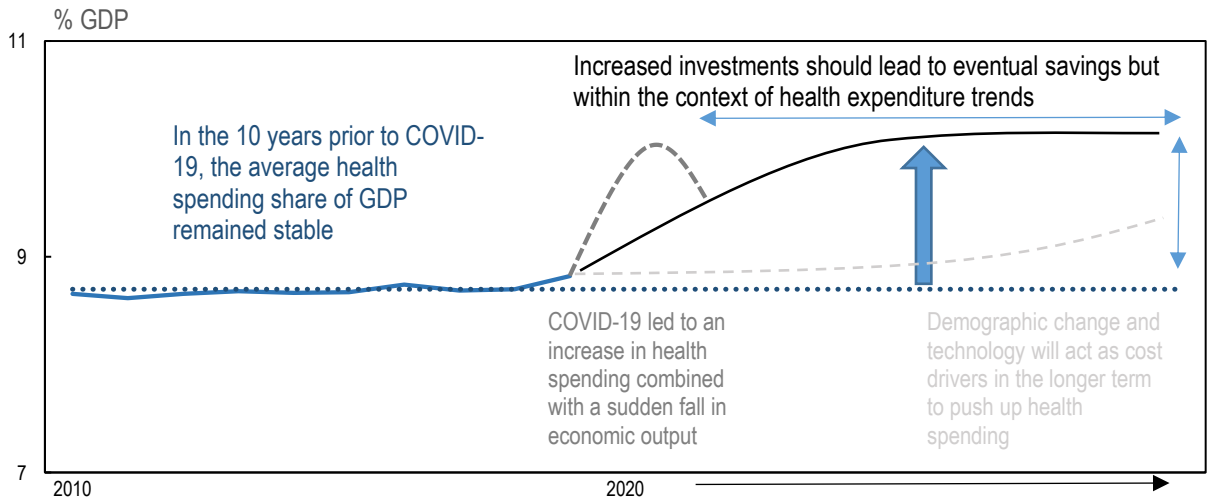
41. Taken together, the seven key investments identified in this report are estimated to be in the order of magnitude of about 1.4% of GDP (of which 0.13% is capital spending), on average, across OECD countries relative to pre-pandemic spending. In other words, if all these investments had been made on top of existing health spending, the average OECD health spending to GDP ratio would have reached 10.1%, compared to the actual baseline average of 8.8% in 2019. The trajectory is based on an increase in the health spending-to-GDP ratio of this magnitude being reached at some point in the medium-term future (Figure 2).

42. One might point to the average 0.9 percentage point jump in the health spending to GDP ratio in 2020 and 2021 (with some countries reporting an increase of more than 2 percentage points) as an already significant step towards meeting this target. However, this large increase was driven as much by a significant fall in GDP as the rapid surge in additional funding to the health sector in response to the crisis. While it is true that some countries have already started to address some of the measures outlined in this paper (for example, increasing salary levels for nurses and care workers, or funding additional ICU capacity), an important part of additional expenditures by governments tended to be unplanned financing to fire-fight the pandemic, rather than long-term planned investments to strengthen resilience.

43. Note that only a small proportion of the targeted spending (0.13% of GDP, on average) relates to capital expenditures: that is, core equipment in the health sector covering medical, non-medical equipment and IT infrastructure. However, both the capital and current spending identified refer to permanent financial allocations to the specific areas (e.g., spending on prevention and public health services would in future account for a minimum of 4% of health expenditure). Therefore, this would result in a step-increase in the overall health expenditure levels rather than a *one-shot* injection of funds. For comparison, the last step-increase in the health spending share of GDP occurred at the time of the Global Financial Crisis in 2008, when average expenditure on health across the OECD increased from about 7.9% prior to the crisis in 2007 to stabilise at around 8.7% of GDP from 2011 onwards.

44. The total investment cost ranges across OECD countries from 0.6% to 2.5%, to an extent depending on how much a country is already spending on some of the investment areas. Note that these are broad order-of-magnitude cost estimates, rather than results based on a precise cost-accounting analysis.

Figure 2. A trajectory: medium-term spending implications of investing in more resilient health systems



Source: Secretariat calculations.

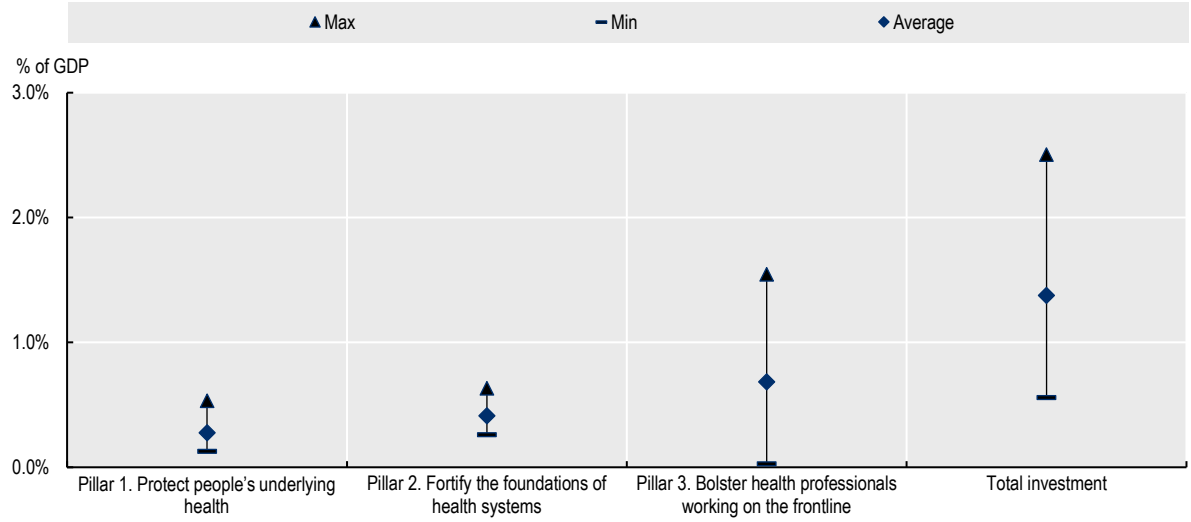
45. Bolstering health professionals working on the frontline accounts for more than half of this investment cost, on average, at around 0.7% of GDP (Pillar 3). Additional spending on preventive care is expected to cost about 0.3% on average (Pillar 1). Together, these can be seen as broadly consistent with recent analysis calling for countries to allocate an additional 1% of GDP for primary health care (WHO 2019). In addition, foundational investments in core equipment and the better harnessing of health information are estimated to cost about 0.4% of GDP on average (Pillar 2).

Table 3.1. Investing in health system resilience: order-of-magnitude cost estimates, as % of GDP

Investment	Rationale & main cost drivers	Average	Range
Pillar 1. *Protect* people's underlying health		**0.28%**	**0.13-0.53%**
Enhanced preventive care	Improve public health systems, strengthen peoples' underlying health *Public health surveillance, infection prevention/control, combatting major risk factors*	0.10%	0.03-0.26%
Mass programmes	Reinforce people's natural defences, strengthen containment and mitigation *Vaccination programmes, extra testing, and PPE during acute periods*	0.18%	0.06-0.42%
Pillar 2. *Fortify* the foundations of health systems		**0.41%**	**0.26-0.63%**
Sufficient core equipment	Enable health professionals to respond to surges in demand *Hospital beds and other medical equipment, IT infrastructure*	0.13%	0.00-0.34%
Well-harnessed health information	Improve patient monitoring, strengthen containment and mitigation *Software, operational processes, data scientists, IT skills of health workers*	0.28%	0.18-0.34%
Pillar 3. *Bolster* health professionals working on the frontline		**0.69%**	**0.03-1.55%**
Sufficient health and long-term care professionals	Effective case management for affected individuals, care continuity for others *Additional health workers. Higher salaries for nurses and care workers*	0.66%	0.00-1.52%
Medical reserve	Surge capacity that can be called upon in times of high need *Recurrent training for health professionals on medical reserve*	0.03%	0.03-0.03%
TOTAL		**1.38%**	**0.56-2.51%**

Note: see Section 3.2 for methodology behind these cost estimates. These estimates are relative to a 2019 baseline.

Figure 3. Investment range by pillar, as a share of GDP (relative to 2019 baseline)



Source: OECD Secretariat calculations.

3.2 Cost estimates by investment component

46. This section outlines the methodology used to estimate order-of-magnitude costs for each of the seven investments identified in this report, with further details (Sources and methods for cost estimates). The estimates draw heavily on the results from recent analytical OECD studies, as well as using the broad range of country-level data available through OECD Health Statistics. This is further supplemented by third-party sources on more detailed epidemiological data and unit costs for various activities. As such, methodologies combine both top-down macro-level approaches as well as bottom-up unit-level costing.

Pillar 1: Protect people's underlying health

Investment 1: Enhanced preventive care

47. Overall estimates to increase investment in public health and preventive care combine the individual spending required to implement a package of cost-effective measures in order to combat anti-microbial resistance (AMR) and some of the major risk factors (alcohol, obesity, smoking and opioids) with broader aggregate measures of the investments needed to enhance the overall system of preventive care (e.g., to ensure better public health surveillance and infection prevention and control).

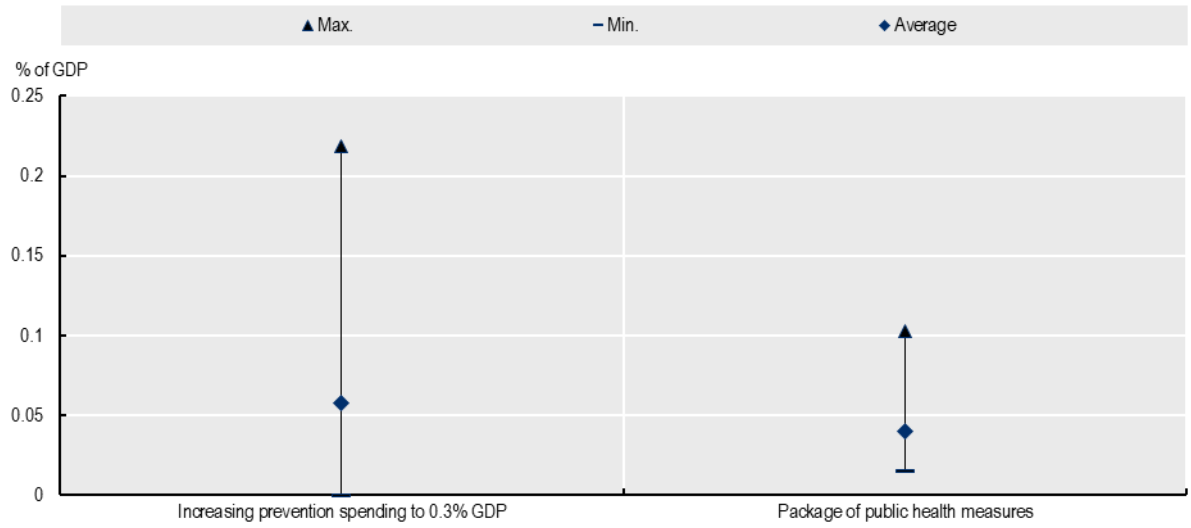
48. For AMR, investment needs are based on the OECD report 'Stemming the Superbug Tide: Just A Few Dollars More', updated to 2019 prices (OECD, 2018[11]). Using advanced analytical approaches – including microsimulation and ensemble modelling techniques – the study allows for precise country-specific costing of the public policy options needed to address AMR, showing that AMR can be reduced significantly and its burden on population health drastically reduced. The report concluded that additional spending on a package of interventions equivalent to an average of USD PPP 2.0 per capita could halt the superbug tide, with a cross-country range of USD PPP 0.04-6.10.

49. To tackle harmful alcohol consumption, estimates are based on the 2021 OECD report 'Preventing Harmful Alcohol Use' (OECD, 2021[15]). The report uses the OECD SPHeP-NCDs model to examine the impact of various alcohol policies on health and the economy. The study found that a mixed package of the most cost-effective interventions would cost on average around USD PPP 2.5 per capita, with a cross-

country range of USD PPP 1.8-2.9. For tackling increasing prevalence of obesity in the population, the OECD report 'The Heavy Burden of Obesity' points to an average per capita cost of USD 9.0 (with a cross-country range of USD 5.5-12.0). For other public health challenges such as tobacco, as well as drug and opioid use, (OECD, 2019[28]), there has been less work to date in assessing the cross-country costs of a suitable package of measures. A level of investment similar to the package of measures to tackle alcohol abuse is therefore assumed, with an estimate of USD PPP 3.0 per capita per year applied across the board. Taken together, the range of public health interventions would amount to a modest increase of between 0.02% and 0.10% of GDP.

50. Cost estimates for population-level investments in preventive care are based on an analysis of national health expenditure data, which shows that only a small fraction of overall health spending is allocated to prevention activities (OECD, 2017[29]). This share has remained relatively unchanged over time with OECD countries reporting around 2.7% of their health spending, on average, going to public health and prevention activities in 2019. In terms of the share of GDP, spending across OECD countries currently varies from less than 0.1% to 0.6%. While a growing body of evidence shows that many health promotion and disease prevention measures can improve health outcomes at relatively low cost, an optimal level of spending on prevention has not been readily established. However, once the cost of the packages of additional public health measures outline above is taken into account (equating to an additional 0.04% of GDP, on average), a conservative spending target for all prevention spending of at least 0.3% of GDP is set. It is considered that this level of spending would match some of the higher performing public health systems among OECD countries and be adequately resourced to meet future crises. The additional annual expenditure requirements would range from 0.00% (for those countries already meeting this target) to 0.22% of GDP, with an average additional cost of 0.06% of GDP, or averaging out at 1% of health spending (Figure 4).

Figure 4. Investing in prevention and public health systems, as a share of GDP



Note: The package of public health measures is based on per capita costings in 2019 prices to tackle AMR, alcohol, obesity, smoking and opioids. This is added to currently reported spending on prevention and then raised to a minimum of 0.3% of GDP to represent additional spending needed to further strengthen public health systems.
Source: OECD Secretariat calculations.

Investment 2: Mass programmes

51. To reach an estimate of the level of expenditure required to perform effective testing and vaccination on an annual basis, unit cost estimates are combined with the share of the population expected to need each of these interventions. These are in addition to investments in core diagnostic, laboratory, and surveillance systems (costed in Investment 3), as well as the R&D costs for new vaccines (Box 1).

52. For vaccines, whilst the purchase cost of a vaccine against COVID-19 particularly early on was variable, media reports[1] suggested a range from as low as USD 3 to over USD 30. As with mass testing, these costs may fall over time. But such costs do not include the associated costs in delivering a vaccination. A comprehensive study investigating the total cost (including the cost of delivery) of vaccinating against 17 pathogens over a lifetime in seven western European countries gave a five-fold cost range of EUR 44 to EUR 226 per pathogen (Ethgen et al., 2016[30]). Narrowing down these estimates to only vaccination costs for healthy individuals (as compared with vaccinations for people with health complications) gave a range of EUR 37-132.

53. For testing, data collated from eight OECD countries of the cost of a PCR test, together with associated delivery and laboratory costs, point to an average per capita cost of around USD 80 (ranging from around USD 55-100). Over time, future unit costs of testing are likely to fall – for example, the supplementary use of antigen tests for COVID-19 can provide an initial result without the need of a laboratory process. In this report, a conservative approach is taken, where such potential cost reductions over time are not accounted for in cost estimates.

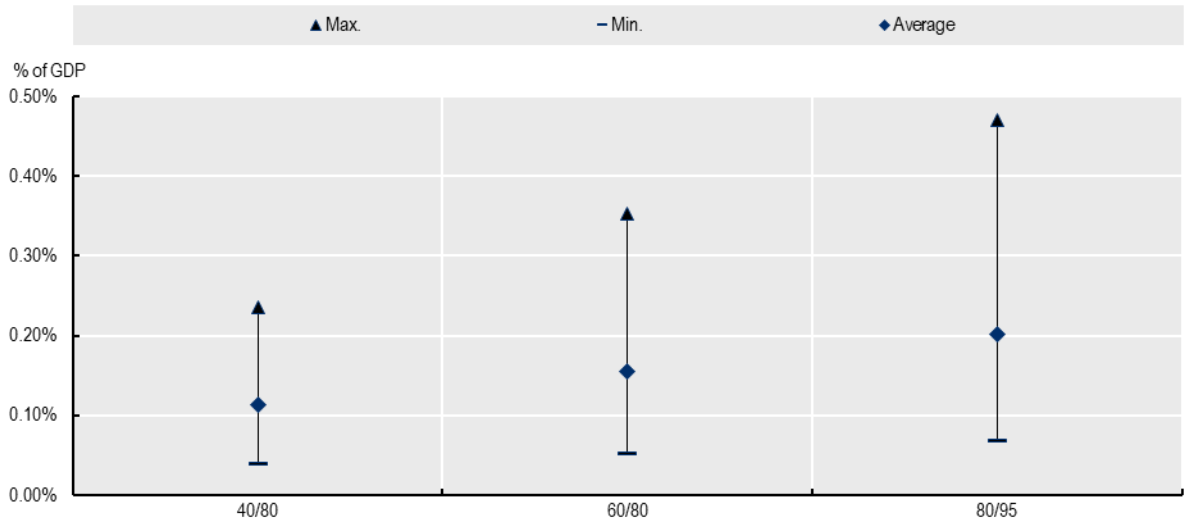
54. An alternative approach of per capita costs takes the innovative COVID-19-related expenditure categories introduced under the regular international health accounts collection. To date, reporting is limited to a handful of countries mostly covering only 2020 and therefore primarily refers to spending on population testing and tracing, rather than vaccination. Of seven OECD countries (that were affected to varying extents by COVID-19 in 2020), the per capita spending on testing ranged from USD PPP 7-146, with an average of USD PPP 45[2]. Canada has also published spending on both COVID-19 testing and vaccination for 2021, which equated to a similar level of USD PPP 49 for testing and USD PPP 134 per capita for vaccination (CIHI, 2022[31]).

In terms of the proportion of the population (and corresponding age groups) needing to be tested or vaccinated over a certain time period, a one-to-one relationship is assumed for simplicity between mass testing and vaccinations. That is, as vaccinations are gradually scaled up, testing is concurrently scaled down at the same rate. Further, any COVID-19 vaccine is assumed to confer time-limited immunity similar to the influenza vaccine, and thus it is assumed an annual dose will need to be administered. Given the great uncertainty around vaccine availability and effectiveness in reducing severity of disease, and the needed levels of diagnostic testing, a range of scenarios is examined. A low scenario assumes 40% of the population aged under 65 years are tested or vaccinated against COVID-19 each year, with 80% coverage for the population aged 65 years and above. A mid-point scenario assumes 60% coverage for people aged under 65 years, and 80% coverage for older populations. A high scenario assumes 80% coverage for people aged under 65 years, and 95% coverage for people aged over 65 years. For further sensitivity analysis, the high coverage scenario (80/95) is costed, but where COVID-19 vaccines are only needed every two years. For testing, these are an estimate of overall volume (as some people may need to be tested more than once in a year).

[1] See, for instance: https://www.ft.com/content/80f20d71-d7eb-4386-b0f2-0b19e4aed94d

[2] Based on the total number of tests reported in Our World in Data for these seven countries, the cost per test was around USD PPP 100.

Figure 5. Estimated additional annual cost of mass testing and/or vaccination programmes, as a share of GDP

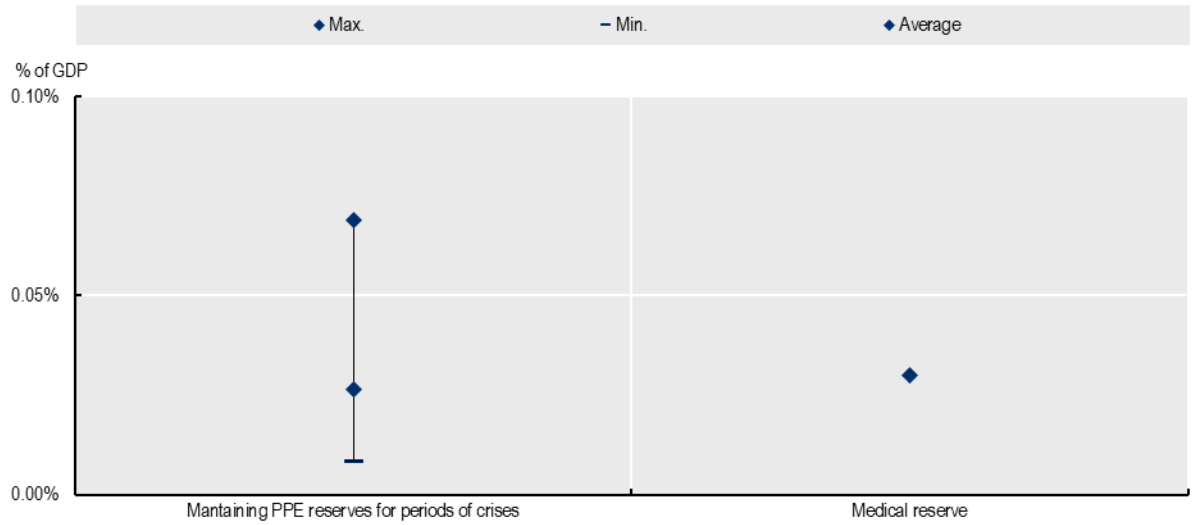


Note: the three scenarios are based on an average unit cost for testing or vaccinating of USD 100, applied separately to two groups of the population. The labels 40/80, 60/80 and 80/95 refer to the share of the population aged under 65 years and over 65 years to be tested or vaccinated. Note that a further scenario of high coverage (80/95) but every two years would cost close to the low coverage (40/80) annual test/vaccine dose scenario.
Source: OECD Secretariat calculations.

55. Whilst the necessary level of immunisation required varies depending on the pathogen and therefore is difficult to assume, the mid-point scenario of 60/80 coverage is taken as a coverage level to normality, i.e., one that should adequately reduce severe illness and death, and consequent hospital admissions. Combining this population coverage with an assumed annual unit cost of USD 100 for diagnostic testing and/or vaccination, the additional spending required is equivalent to 0.15% of GDP on average, ranging from 0.05 to 0.35%. The full range of cost scenarios based on different coverage assumptions are shown in Figure 5.

56. For maintaining adequate stocks of PPE to manage acute phases of a health shock, estimates of additional spending needs are based on having sufficient PPE supplies in hospitals, primary care, and long-term care facilities for a 100-day wave of COVID-19 (or other emerging pathogen with an equivalent degree of infectiousness). The quantities of specific PPE needed are based on an epidemiological model developed by Johns Hopkins University – of additional PPE needs over and above what is needed in normal times (Johns Hopkins University, 2020[32]). They calculate that, on a per capita basis, 10.28 gloves, 0.97 isolation gowns, 0.54 medical-grade masks and 0.17 N95 masks will be needed during a 100-day wave (on average) with sustained suppression measures in place. Added in this report are needs for face shields and goggles. Multiplied by unit cost estimates from the World Health Organization (World Health Organization, 2020[33]) with a 10% price mark-up, this translates into an average cost of USD 10.75 per capita to provide sufficient PPE within different health and long-term care settings.

Figure 6. Surge control: investing in adequate PPE needs and a medical reserve force, as a share of GDP



Note: The costs of a medical reserve force are included here as part of the surge response mechanism but is included and described as Investment 6 under Pillar 3: Bolster health professionals working on the frontline.
Source: OECD Secretariat calculations.

Pillar 2: Fortify the foundations of health systems

Investment 3: Sufficient core equipment

57. There are no hard and fast guidelines or international benchmarks regarding the optimal level of medical equipment, with large variability across OECD countries in, for example, the number of ICU beds, CT scanners and MRI units. Indeed, some of this spending may be unnecessary, and needs to be weighed up against the opportunity cost of equipment not being sufficiently utilised during routine periods. Still, what is clear is the critical importance of maintaining some spare capacity to deal with surges – too little investment in medical equipment will lead to strains in service provision and preventive care efforts, thereby undermining health system resilience.

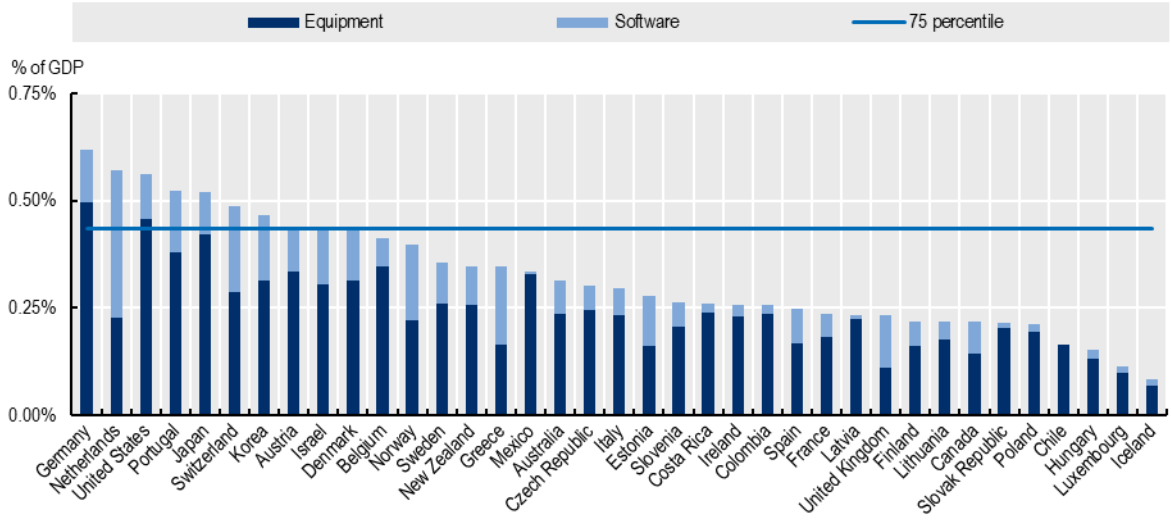
58. On average, OECD countries have been investing around 0.25% of GDP each year on equipment in the health and social sector (Figure 3). This figure covers a broad range of capital spending on transport, machinery, and equipment (both medical and non-medical) as well as IT hardware across all providers, offering a reasonable proxy for levels of investment in physical resources in the health system. Based on the scenario that all OECD countries should reach the 75-percentile level in terms of annual investment in equipment, this would result in an average increase as a share of GDP of 0.08% (0.00-0.21%).

59. A parallel approach is taken in determining the level of capital spending needed to maintain responsive health information systems, beyond the physical ICT hardware; that is, spending on the development of software and databases in the health and social sector. Pre-pandemic levels of investment in intellectual property products was typically less than 0.1% of GDP. An increase in capital spending to bring the level up to the 75% percentile (or 0.12% of GDP) would equate to an average increase of 0.05% (0.00-0.12%).

60. Any requirement for additional investment in building infrastructure (e.g., hospitals, clinics, etc.), beyond the current pipeline is not included. Capital spending on construction is expected to remain at least

at current levels. This equates to around the same level as current capital spending on equipment, i.e., another 0.25% of GDP, on average[3].

Figure 7. Average investment in equipment and software, as a share of GDP, 2016-2019



Note: Refers to the average expenditure on Gross Fixed Capital Formation (GFCF) on machinery and equipment and intellectual property products from 2016-19. Data not available for Türkiye.
Source: OECD National Accounts Table 8A. Capital formation by activity ISIC rev4.

Investment 4: Well-harnessed health information

61. For this investment, the quantification of what needs to be spent is based on comparing investment in the health sector with other comparable sectors. While in the health sector, similar amounts are invested to other comparable sectors in ICT hardware, computers and network infrastructure, notably lower spending is attributed to software and databases, and importantly on the use of ICT services (Figure 8) (Calvino et al., 2018[34]). OECD countries typically invest less than 5% of health budgets on managing information. In other sectors, investment is estimated to be four times higher (OECD, WHO, World Bank, 2018[35]). In too many countries, key national health data remain siloed, fragmented, unstandardised and inaccessible (Oderkirk, 2021[36]). At the onset of the pandemic, South Korea demonstrated how integrated, real-time health information yields key intelligence to detect and test high-risk persons and to allocate and manage scarce health care resources and supplies.

62. To effectively harness health information, standardised electronic health records (EHRs) with patient portals are needed, supplemented by greater use of mobile technologies (such as, for example, digital contact-tracing apps). This requires investing in better software and streamlined operational processes, improved IT skills of health workers and employing enough data scientists within health systems. Such investments to improve the use of data contribute to reducing ineffective and wasteful spending on health.

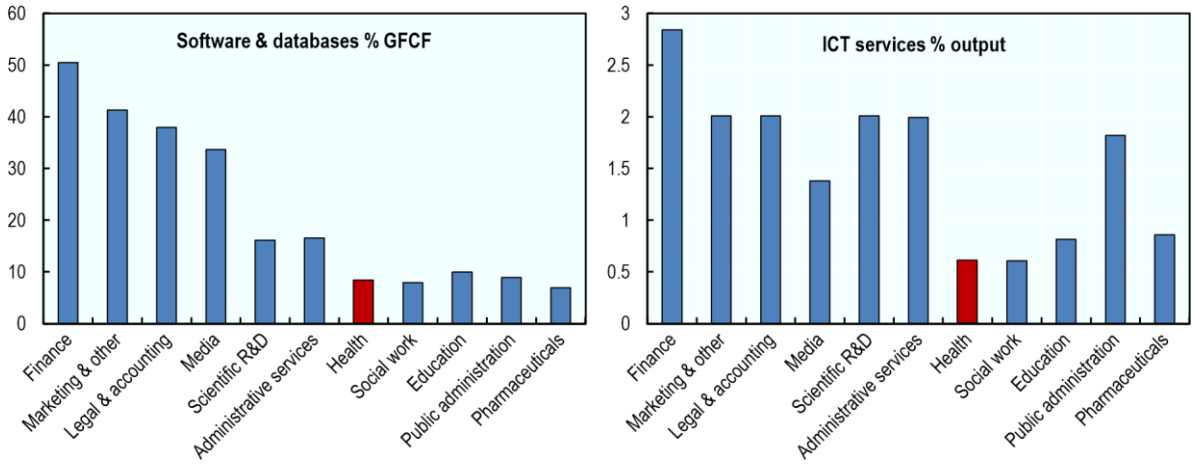
63. Indeed, the OECD report 'Health in the 21st Century' concluded that health lags behind many other parts of the economy in harnessing the potential of data and digital technology, 'missing the potential to save a significant number of lives and billions of dollars' (OECD, 2019[23]). The report concluded that a

[3] Note that if a similar approach to raise investments in buildings to the 90th percentile was taken, then the increase would be similar to that for equipment (a further 0.14% of GDP, ranging from 0.00-0.37%).

conservative doubling of current investment levels is needed to promote more intelligent use of data for information and knowledge, and that this could equate to a healthy return of approximately 3 to 1.

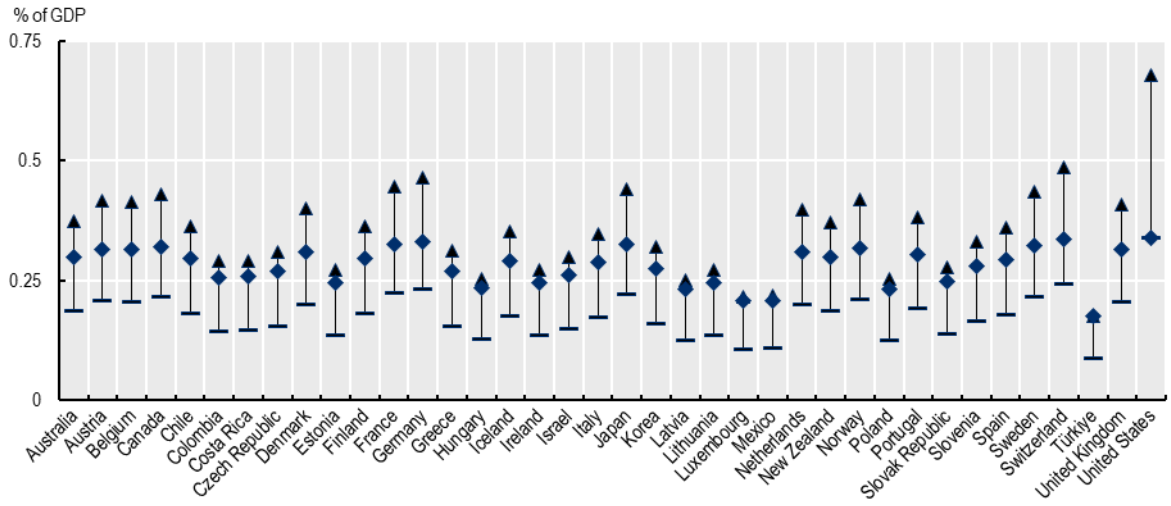
64. Assuming that overall higher spending countries are already more advanced in harnessing their health data and information, an inversely proportional additional investment range of 2-4% of health care expenditure is applied, in line with the OECD report. Using health spending data across OECD countries in 2019, the level of additional investment would equate to 0.26% of GDP (0.18-0.34) (Figure 9).

Figure 8. Expenditure on software, databases, and ICT services by the health sector



Note: Gross fixed capital formation (GFCF) is a measure of spending on fixed assets. Countries covered: Australia, Austria, Denmark, Finland, France, Italy, Japan, the Netherlands, Norway, Sweden, the United Kingdom, and the United States.
Source: Calvino et al. (2018)," A taxonomy of digital intensive sectors", https://dx.doi.org/10.1787/f404736a-en.

Figure 9. Additional spending to harness health information in OECD countries, as a share of GDP



Note: The arrow represents an additional 2-4% of 2019 health spending as a share of GDP; while the diamond indicates the estimated investment need based on overall levels of health spending.
Source: Authors' calculations based on OECD Health Statistics 2021.

Pillar 3: Bolster health professionals working on the frontline

Investment 5. Sufficient health and long-term care professionals

65. Costing the investment needs are broken down into two major cost drivers: (1) the cost of having an adequate number of health and long-term care professionals; and (2) the cost of improving the competitiveness of salaries of key cadres of health and long-term care workers.

Building an adequate health workforce

66. Notwithstanding that many factors determine the optimal density of medical professionals in any one country – demographic and disease patterns, geographical and rural/urban characteristics as well as the organisation of care across providers – a simple international benchmarking provides order-of magnitude cost estimates for increases in staffing required for countries with relatively low numbers of health professionals.

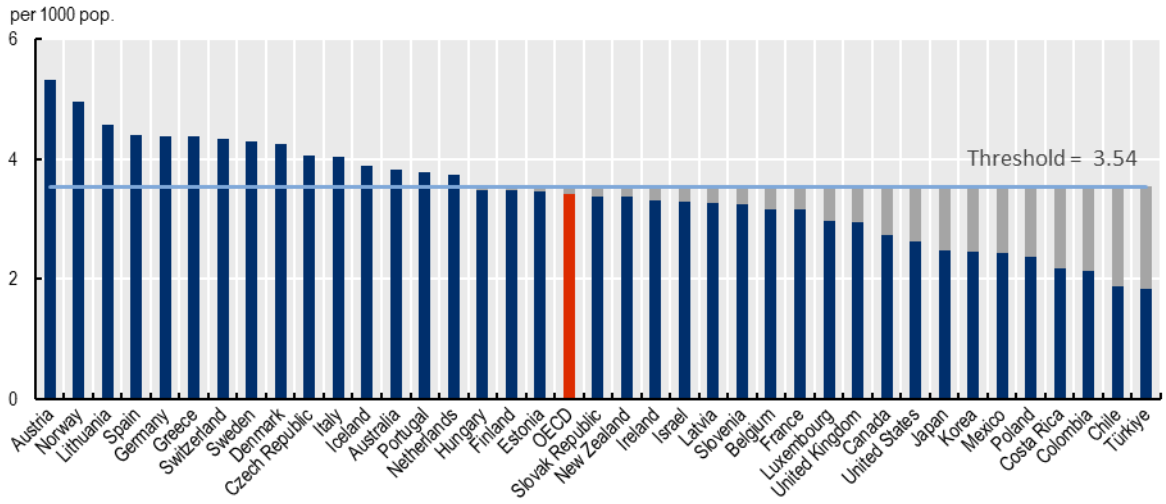
67. Various thresholds for determining health worker densities have been put forward. The 2006 World Health Report identified a minimum health worker density of 2.3 skilled health workers (physicians and nurses/midwives) per 1000 population and this threshold has been used among lower and middle-income countries in monitoring their progress towards meeting the Sustainable Development Goals (SDGs). The *Global strategy on human resources for health: Workforce 2030* report considered an updated threshold of 4.45 health workers per 1000 to reflect the broader range of services targeted by UHC and the SDGs, while acknowledging that OECD health systems go beyond the provision of essential health services and have a density of health workers above this threshold (WHO, 2016[37]). Other thresholds, such as the ILO's updated 4.1 health workers per 1000, and 5.9 skilled health professionals by the Ending Preventable Maternal Deaths initiative have also been embedded in the broader context of social protection and universal health coverage and can be seen as minimum global levels. More pertinent in the context of resilience are the thresholds developed as part of the 2017 GBD study, co-ordinated by IHME (GBD 2017 SDG Collaborators, 2018[38]). The authors estimated that 3 doctors, 10 nurses and midwives, and 0.5 pharmacists per 1000 people were the threshold levels required to ensure access to healthcare and quality services (after which they found diminishing returns). As part of a systematic analysis for the Global Burden of Disease Study 2019 to measure human resources for health in relation to universal health coverage, IHME derived levels of health worker density required to achieve a performance target of 90 out of 100 on the UHC effective coverage index (GBD 2019 Human Resources for Health Collaborators, 2022[39]). The thresholds of 3.54 physicians and 11.45 nurses/midwives per 1000 population were therefore adopted in this study.

68. Figure 10 and Figure 11 show the density of practicing physicians and nurses (including midwives) across the OECD in 2019 (or latest year), with the threshold levels above indicated by the solid line. Bringing the density of physicians up to 3.54 physicians per 1000 population (and assuming current remuneration levels of physicians) for all OECD countries would require an average investment of 0.15% of GDP (0.00-0.75%). Similarly, the increase in the number of nurses and midwives across OECD countries to reach the threshold of 11.45 per 1000 population, would require an average investment of around 0.33% of GDP (0.00-1.03%).

69. The number of personal care workers in the Long-term care (LTC) sector have also proved to be a key factor in mitigating the effects of the pandemic in the elderly population. Many of the best staffed high-income OECD countries do not rate the availability of LTC workers in their country as satisfactory (OECD, 2011[40]). Comparable data on the number of care workers across OECD countries are patchy but show vast differences reflecting the differing levels of development in formal care structures as well as demographic and cultural effects. In the same vein, establishing an optimal threshold of personal care workers is challenging. One study by the ILO on coverage deficits in long-term care sought to establish a minimum threshold for the provision of care based on the median population weighted value of selected

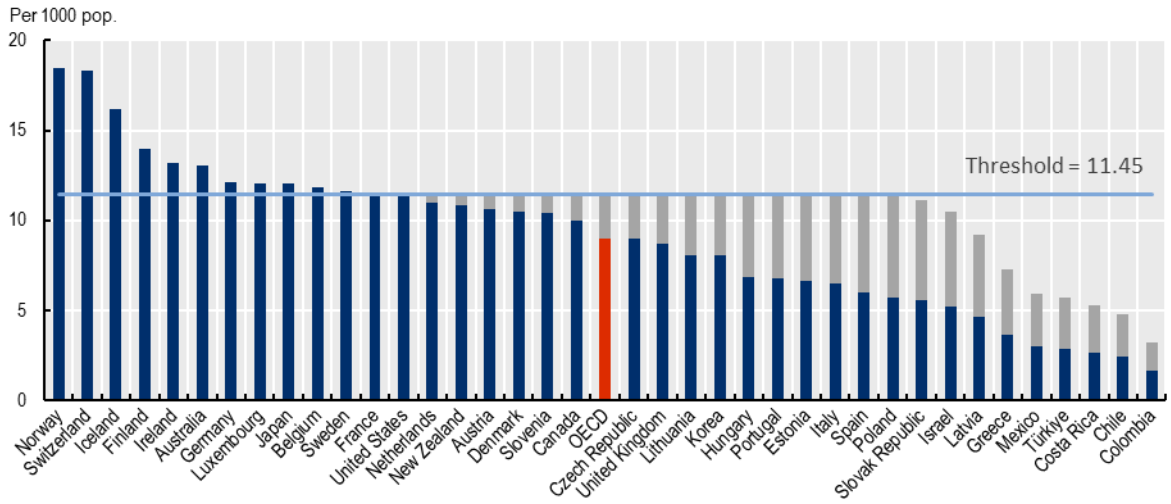
OECD countries (ILO, 2015[41]). This overall level of 4.2 LTC workers from the study was used as a basis to apply an adjusted threshold of 2.8 FTE personal care workers as the target for increases in the care workforce, with a maximum feasible increase in staffing capped at a 100% increase on current levels. This equates to an average investment of 0.04% of GDP (0.00-0.20%). Taken together with physicians and nurses, this amounts to a net increase of more than three and a half million health and care professionals across all OECD countries.

Figure 10. Practising physicians (headcount) per 1000 population, 2019 (or latest year)



Note: Data for countries reporting active or registered physicians rather than practising physicians are adjusted using an OECD average ratio. The grey bar represents the additional physician numbers required to reach the threshold.
Source: OECD Health Statistics 2020.

Figure 11. Practising nurses/midwives (headcount) per 1000 population, 2019 (or latest year)



Note: Data for countries reporting active or registered nurses rather than practising nurses are adjusted using an OECD average ratio. The grey bar represents the additional nurse/midwife numbers required to reach the threshold (with a maximum 100% increase).
Source: OECD Health Statistics 2021.

Raising the competitiveness of salaries for nurses and care workers

70. Estimates of the costs of increasing salaries for nursing and personal care workers utilise OECD data on the current and additional number of health and care workers across various categories, along with reported levels of remuneration for 2019. For nurses and care personnel, the measure used is full time equivalents (FTE) of practising professionals. In the case of missing data on practising nurses, the average OECD ratio of practising nurses to professionally active or licensed to practice is used as an adjustment factor.

71. Levels of remuneration are directly available for hospital nurses in 35 OECD countries. This is combined with data on the relative salaries of different cadres of nurses and carers. Information on average salaries in the United Kingdom and Sweden for Professional nurses, Associate nurses and care workers resulted in the following assumptions regarding salary levels for each group (Table 3.2). The OECD publication 'Who Cares?' corroborates the UK and Swedish data, providing salary comparisons between carers and broader groups of nurses and health workers (OECD, 2020[42]).

Table 3.2. Relative salary level assumptions for nurse and care personnel

Job title	Relative salary level
Professional nurse	1.00
Associate nurse	0.68
Personal carer	0.60
Healthcare assistant/Other	0.68

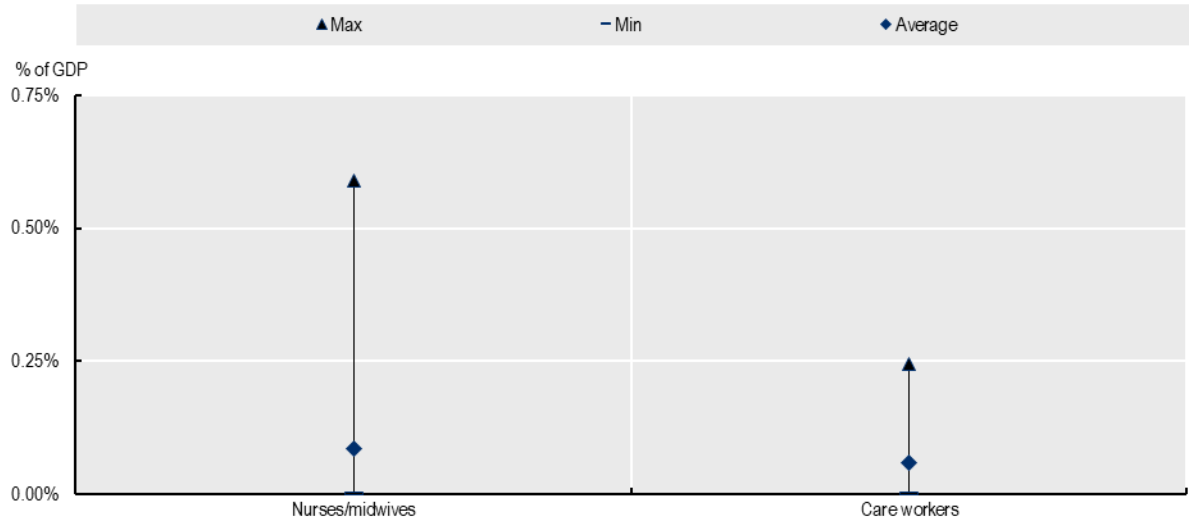
Source: OECD Secretariat calculations based on national sources.

72. Based on available health and LTC personnel numbers (using data for the period 2016-19) and the remuneration assumptions above, the following assumptions are made:

- Increasing salaries to reach the average OECD level of a nurse's salary relative to the average income in the country. On average a hospital nurse's salary is 1.10 relative to the average wage across OECD countries. If in a country, a nurse's salary was 0.96 relative to the average wage, then this would require a 15% increase to reach a level 10% above the average. This is applied to all categories of nurse personnel.
- In the absence of remuneration data for personal care workers, a ratio of 0.6 to a nurse's salary is maintained – i.e., the increase in salary would be in the same proportion as for nurses.
- Finally, the increased remuneration levels apply to both existing and additional numbers of nurses and care workers.

73. Figure 12 shows that increasing the wages of nursing and personal care workers using the average OECD nurse salary level (relative to average national income) as a base corresponds to an average increase of 0.14% of GDP (0.00-0.74%).

Figure 12. Improving the salary levels of nurses and personal carers, as a share of GDP



Note: Estimates are based on the percentage increase in nurses' salary levels to reach a minimum level equating to 10% above the average national wage, as published in the OECD Employment Outlook.
Source: OECD Secretariat calculations.

Investment 6: Medical reserve

58. The cost of creating a flexible medical reserve force will depend on the scope of such a support organisation. Existing organisations such as the Red Cross already providing trained volunteers in certain circumstances. Other organisations such as the US Medical Reserve Corps comprise a network of medical and public health professionals, as well as other community members without healthcare backgrounds, to strengthen public health, improve emergency response capabilities, and build community resiliency. The *Réserve sanitaire* in France is an example of a network of volunteers that has been called on during the current crisis.

59. A more ambitious and formal organisation of volunteers, built along the lines of the UK Army Reserve or the Canadian Army Reserve in terms of size and responsibility, would require a substantially larger budget to cover costs of activities and training, regular staff costs as well as infrastructure and administration costs. Based on the annual budgets for these type of reserve forces, the annualised cost to develop and maintain a Medical Reserve Force are estimated to be in the range of 0.02 and 0.04% of GDP. This excludes any additional costs associated with the deployment of surge capacity during a health shock (e.g., per diems and travel allowances).

4 Conclusions

60. Targeted investments in health systems strengthen resilience to both the ongoing pandemic and emerging future shocks. In doing so, they protect society and stimulate the economy. This report has identified six key investments, grouped into three overarching investment pillars that aim to (1) protect people's underlying health; (2) fortify the foundations of health systems; and (3) bolster health and long-term care professionals working on the frontline.

61. Taken together, the seven investments would equate to an estimated 1.4% of GDP on average (as compared with the 2019 pre-pandemic baseline), with a cross-country range of 0.6% to 2.5%, depending on how much a country is already spending in each of the targeted areas. These estimates are based on such increases in the health spending to GDP ratio being reached and then maintained over time. Such numbers reflect broad order-of-magnitude estimates rather than results based on a precise cost-accounting analysis.

62. Funding such investments requires buy-in from ministries of finance as well as health ministries and social security institutions. Finance ministries have already shown their commitment to combatting COVID-19 in the first year of the pandemic. Moving forward, the return from these targeted health system investments is likely to far outweigh the cost. Indeed, estimates here do not consider potential dynamic effects, whereby these investments can produce efficiency gains in the future. For example, effective interventions in preventive care would eventually reduce the need for healthcare, with consequent cost-savings.

63. Within the health sector, such investments stop the health system from being overwhelmed. In the medium-term, they can also increase efficiency by reducing ineffective and wasteful spending. For example, investing in better health information systems to better use routine health data (one of the seven investments included) is estimated to equate to a return of approximately 3 to 1. Beyond the health sector, such investments will boost the economy. A stronger, more resilient health system helps reduce the stringency of containment and mitigation measures in the future. It also strengthens human capital both now, through a healthier and more productive workforce, and in the future, through less disrupted education.

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Annex A. Sources and methods for cost estimates

Table A A.1. Order-of-magnitude cost estimates, by pillar/investment area as % of GDP

Pillar/Investment area	Component	Sources and assumptions	Estimated costs as % of GDP (2019)
Pillar 1. *Protect* people's underlying health		**0.28**	**0.13-0.53**
Enhanced preventive care *Public health surveillance, infection prevention/control, combatting major risk factors*	Per capita cost of package of AMR measures	Based on Community-based and mixed package of interventions from 'Stemming the Superbug Tide: Just A Few Dollars More', (OECD, 2018[10]). Uses microsimulation and ensemble modelling techniques. Equivalent to an average of USD PPP 2.0 per capita, with a cross-country range of USD PPP 0.04-6.10. Updated to 2019 prices using AIC deflator.	0.00-0.02
	Per capita cost of package to tackle alcohol abuse	Based on a mixed package plus of the most cost-effective interventions from 'Preventing Harmful Alcohol Use' (OECD, 2021[14]). Uses the OECD SPHeP-NCDs model. Cost on average around USD PPP 2.5 per capita, with a cross-country range of USD PPP 1.8-2.9. Updated to 2019 prices using AIC deflator.	0.00-0.03
	Per capita cost of package to combat obesity	Based on a mixed package (Menu labelling schemes, Prescription of physical activity by primary care doctors, Workplace wellness programmes) from 'The Heavy Burden of Obesity' (OECD, 2019). Average per capita cost of USD 9.0 for a set of 32 countries (with a cross-country range of USD 5.5-12.0). Average cost is assigned to the missing 6 countries.	0.01-0.07
	Per capita cost of package to tackle tobacco, and other substance abuse	Tobacco, as well as drug and opioid use, (OECD, 2019[27]). A level of investment similar to the package of measures to tackle alcohol abuse is assumed, with an estimate of USD PPP 3.0 per capita per year applied.	0.01-0.03
	Increased spending share to enhance Information, education, and counselling programs, Immunization	Overall population-level investments in public health and prevention activities were around 2.7% of health spending, on average, in 2019. Once the cost of the	0.00-0.22

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	programs, Early disease detection programs, Healthy condition monitoring programs, Epidemiological surveillance and risk and disease control programs, Preparing for disaster and emergency response programs	packages of additional public health measures outline above is taken into account (equating to an additional 0.5% of health spending on average), a minimum spending target of 0.3% of GDP is set to match the higher performing public health systems among OECD countries and be adequately resourced to meet future crises.	
Mass programmes *Vaccination programmes, extra testing, and PPE during acute periods*	Annual unit cost to deliver test/vaccination to population	(1) Unit cost of a COVID-19 vaccine reported in the range USD 3 - 30. (2) Total cost (including cost of delivery) of vaccinating against 17 pathogens over a lifetime in seven western European countries ranged from EUR 44 to EUR 226 per pathogen (Ethgen et al., 2016[29]). For healthy individuals (as compared with vaccinations for people with health complications) EUR 37-132. (3) For diagnostic tests, data from 8 OECD countries of the cost of a PCR test, together with associated delivery and laboratory costs, point to an average per capita cost of around USD 80 (ranging from around USD 55-100). (4) From 2021 JHAQ, seven OECD countries, the per capita spending on testing ranged from USD PPP 7-146, with an average of USD PPP 45. Canada has also published spending on both COVID-19 testing and vaccination for 2021, which equated to a similar level of USD PPP 49 for testing and USD PPP 134 per capita for vaccination (CIHI, 2022[30]). An average unit cost of 100 USD covering all test and vaccination delivery in a year is assumed. While future unit costs of testing and vaccination are likely to fall, cost reductions over time are not accounted for in cost estimates.	0.05-0.35
	Estimating average annual coverage rates	A one-to-one relationship assumed between mass testing and vaccinations. That is, as vaccinations are gradually scaled up, testing is concurrently scaled down at the same rate. Further, any vaccine is assumed to confer time-limited immunity similar to the influenza vaccine, and thus it is assumed an annual dose will need to be administered. A range of scenarios is examined. A low scenario assumes 40% of the population aged under 65 years are tested/vaccinated each year, with 80% coverage for the population aged 65 years and above. A mid-point scenario assumes 60% coverage for people aged under 65 years, and 80% coverage for older populations. A high scenario assumes 80% coverage for people aged under 65 years, and 95% coverage for people aged over 65 years. For further sensitivity analysis, the high coverage scenario (80/95) is costed, but where tests/vaccines are only needed every two years. An estimate of overall volume is assumed (as some people may need to be tested/vaccinated more than once in a year). The mid-point scenario of 60/80 coverage is taken as a coverage level to normality, i.e., one that should adequately reduce severe illness and death, and consequent hospital admissions.	

	Costs of increasing baseline stocks of protective equipment to counter health emergencies	Estimates of additional spending needs are based on having sufficient PPE supplies in hospitals, primary care, and long-term care facilities for one 100-day wave per year. The quantities of specific PPE needed are based on an epidemiological model developed by Johns Hopkins University – of additional PPE needs over and above what is needed in normal times (Johns Hopkins University, 2020[31]). On a per capita basis, 10.28 gloves, 0.97 isolation gowns, 0.54 medical-grade masks and 0.17 N95 masks are needed during a 100-day wave (on average) with sustained suppression measures in place. Added in this report are needs for face shields and goggles. Multiplied by unit cost estimates from the World Health Organization (World Health Organization, 2020[32]) with a 10% price mark-up, this translates into an average cost of USD 10.75 per capita to provide sufficient PPE within different health and long-term care settings.	0.01-0.07
Pillar 2. *Fortify* the foundations of health systems		**0.41**	**0.26-0.63**
Sufficient core equipment *Hospital beds and other medical equipment, IT infrastructure*	Increase minimum capital spending on health and non-health machinery and equipment.	Annual GFCF (Gross Fixed Capital Formation) on machinery and equipment, and intellectual property products for Health and Social sector - OECD National Accounts Table 8A. for 2016-19 Additional capital spending on machinery and equipment is based on countries reaching the 75-percentile level in terms of annual investment in equipment and machinery. Same approach to maintain responsive health information systems, beyond the physical ICT hardware; that is, spending on the development of software and databases in the health and social sector. Any requirement for additional investment in building infrastructure (e.g., hospitals, clinics, etc.), beyond the current levels is not included. That is, capital spending on construction is expected to remain at least at current (2016-19) levels.	0.00-0.23 0.00-0.12
Well-harnessed health information *Software, operational processes, data scientists, IT skills of health workers*	At least double the current spending on data and information.	Based on findings in 'Health in the 21st Century' (OECD, 2019[22]) that a doubling of current investment levels is needed to promote more intelligent use of data for information and knowledge, and that this could equate to a healthy return of approximately 3 to 1. Adjusted to assume that overall higher spending countries are already more advanced in harnessing their health data and information; so inversely proportional additional investment range of 2-4% of health care expenditure is applied, such that the highest spending country (USA) increases spending by 2% of health spending and the lowest spender (TUR) by 4%.	0.18-0.34
Pillar 3. *Bolster* health professionals working on the frontline		**0.69**	**0.03-1.55**
Sufficient health and long-term care professionals	Increase density of healthcare workers (physicians, nurses/midwives) to a set threshold	(1) The 2006 World Health Report indicated a minimum threshold of 2.3 skilled health workers (physicians and nurses/midwives) per 1000 population to ensure progress towards the Sustainable Development Goals (SDGs). The Global strategy	

Additional health workers. Higher salaries for nurses and care workers	Apply (increased) salary levels to current and increased healthcare and personal care workers	on human resources for health: Workforce 2030 updated the threshold to 4.45 health workers per 1000 to reflect the broader range of services targeted by UHC and the SDGs, while acknowledging that 'OECD health systems go beyond the provision of essential health services' (WHO, 2016[36]). ILO's 4.1 health workers per 1000, and 5.9 skilled health professionals under the Ending Preventable Maternal Deaths initiative are set in a broader context of social protection and UHC. (2) For OECD countries, the thresholds developed initially within the 2017 GBD study, co-ordinated by IHME give 3 doctors, 10 nurses and midwives, and 0.5 pharmacists per 1000 people as the levels to ensure access to healthcare and quality services (after which they found diminishing returns). The 2019 Global Burden of Disease Study provided updated thresholds required to achieve a performance target of 90 out of 100 on the UHC effective coverage index. The thresholds of 3.54 physicians and 11.45 nurses/midwives were used were deemed appropriate for OECD countries. (3) For care workers, an ILO study on coverage deficits in long-term care establish a minimum threshold for the provision of care based on the median population weighted value of selected OECD countries (ILO, 2015[38]). The updated median of 4.0 total LTC workers per 100 pop. 65+ was used (adjusted to 2.8 personal care workers (based on an OECD estimate of an average of 70% of LTC workers being care workers in 'Who Cares?', (OECD, 2020)). A maximum increase in nurse/midwives and LTC personal care staffing levels was capped at a 100% increase on current levels. Data from OECD Health Statistics 2021 provided health care worker density estimates for practising physicians, nurses, and midwives in 2019 (or latest year), based on total headcounts. Data from OECD Health Statistics 2021 provided the density for LTC personal care workers in 2019, based on headcounts. In the absence of data on personal care workers, 70% of total LTC workers is taken. Salary levels for physicians based on reported remuneration for salaried physicians in OECD Health Statistics (and additional sources), adjusted to 2019 levels using national average wage inflation, if necessary. Salary levels for nurses/midwives use remuneration levels for hospital nurses in OECD Health Statistics (and additional sources), adjusted to 2019 levels using average national wage inflation, if necessary. For personal care workers, a 60% ratio is applied to nurse salary levels based on average salaries in the United Kingdom and Sweden for Professional nurses, Associate nurses, and care workers. This is corroborated in 'Who Cares?', using salary comparisons between carers and broader groups of nurses and health. All salaries are adjusted to account for employer contribution levels using national	0.00-0.75 0.00-1.03 0.00-0.20

		averages. Salary levels of nurses are increased (if necessary) to reach the average level of a nurse's salary relative to the average national wage across OECD countries. Salaries of care workers are increases pro rata to maintain the same 60% ratio to nurses' salaries.	0.00-0.59 0.00-0.24
Medical reserve *Recurrent training for health professionals on medical reserve*	Cost of maintaining a flexible medical reserve force	Based on the annual budgets for the UK Army Reserve and the Canadian Army Reserve to cover costs of activities and training, regular staff costs as well as infrastructure and administration costs, the annualised cost to develop and maintain a Medical Reserve Force are estimated to be in the range of 0.02 and 0.04% of GDP. Mid-point estimate 0.03% of GDP applied to all countries. Excludes additional costs associated with the deployment of surge capacity during a health shock (e.g., per diems and travel allowances).	0.03
TOTAL		**1.38**	**0.56-2.51**

Note: All estimates are relative to a 2019 baseline.

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