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Strengthening public health in the Netherlands

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Aletta Jacobs School of Public Health

Strengthening public health in the Netherlands

Lessons from global public health system

Final report - 23 June 2022

Simon van der Pol - Amrit Sandhu - Jochen Mierau - Danielle Jansen

This report was commissioned by the *Raad voor Volksgezondheid & Samenleving*. The Hague, the Netherlands

“I will prevent disease whenever I can, for prevention is preferable to cure.”

Modern Hippocratic Oath (Lasagna, 1964)

Managementsamenvatting

Publieke gezondheid kan worden gedefinieerd als: “de wetenschap en kunst van het bevorderen van gezondheid, het voorkomen van ziekte en het verlengen van het leven door de georganiseerde inspanningen van de samenleving”. Het is één van de drie belangrijkste subfuncties van de gezondheidszorg, naast eerstelijnszorg en specialistische zorg. Om de gezondheid wereldwijd te verbeteren, is het belangrijk lessen te trekken uit de verschillende internationale stelsels voor de publieke gezondheid. In dit rapport werden de volgende landen en regio’s met elkaar vergeleken: Denemarken, Engeland, Italië, Letland, Nederland, Australië, British Columbia (Canada) en Singapore. Vier bouwstenen (bestuur, genereren van middelen, financiering en dienstverlening) binnen het *“Health System Performance Assessment”* (HSPA)-kader, zoals gedefinieerd door de WHO, werden gebruikt om de stelsels voor volksgezondheid te vergelijken, met behulp van literatuuronderzoek en twee rondes van vragenlijsten die naar nationale deskundigen werden gestuurd.

De publieke gezondheid omvat verschillende overheidsdepartementen, en dit wordt weerspiegeld in de gezondheidsdoelstellingen die de onderzochte landen willen bereiken: deze variëren van gezondheidsgerelateerde doelstellingen tot arbeidswetgeving en vervoersdoelstellingen. Het bestuur van de stelsels voor volksgezondheid lijkt niet in alle gevallen geschikt om te opereren binnen dit zeer brede terrein en is vaak meer gericht op gezondheidszorg dan op gezondheid in het algemeen. Tot de beroepsbeoefenaren die werkzaam zijn in de volksgezondheid behoren gezondheidswerkers, zoals verpleegkundigen, artsen en psychologen, maar ook beleidsmakers, epidemiologen, gezondheidseconomen en managers. De uitgaven voor preventieve gezondheidszorg vormen in de meeste landen slechts een fractie van de totale uitgaven voor gezondheidszorg. Ten slotte kan de dienstverlening worden onderverdeeld in twee niveaus: het individuele niveau, waar een burger bijvoorbeeld gevaccineerd kan worden, en het beleidsniveau, waar programma’s ter bevordering van de publieke gezondheid worden opgesteld en uitgevoerd.

Een sterk stelsel van publieke gezondheid heeft het potentieel om de samenleving als geheel te versterken, vooral als gezondheid een integraal onderdeel wordt van de besluitvorming in alle overheidsdepartementen. Financiering voor preventie moet worden gezien als een investering in de gezondheid van morgen en niet zozeer als een uitgave op de Rijksbegroting, zoals momenteel het geval is. Momenteel hebben veel landen moeite om de volledige reikwijdte van de publieke gezondheid in hun gezondheidsstelsel op te nemen, ook al zijn er samenwerkingsverbanden tussen de verschillende overheidsdepartementen gaande. Een belangrijke les voor Nederland is dat breed gedragen gezondheidsdoelen essentieel kunnen zijn om verschillende departementen op één lijn te krijgen en beleid te maken dat daadwerkelijk effect heeft. Regeringen moeten verantwoordelijk worden gehouden voor de resultaten van hun gezondheidsbeleid, niet alleen voor hun inspanningen, en de financiering moet gaan naar programma’s die het gewenste effect hebben, of dat nu op individueel niveau of op bevolkingsniveau is.departementen op één lijn te krijgen en beleid te maken dat daadwerkelijk effect heeft. Regeringen moeten verantwoordelijk worden gehouden voor de resultaten van hun gezondheidsbeleid, niet alleen voor hun inspanningen, en de financiering moet gaan naar programma’s die het gewenste effect hebben, of dat nu op individueel niveau of op bevolkingsniveau is.

Executive summary

Public health can be defined as: “the science and art of promoting health, preventing disease and prolonging life through the organized efforts of society”. It is considered one of the three major sub-functions of healthcare service delivery, next to primary care and specialist care. To improve public health worldwide, it is considered important to derive lessons from the various public health systems internationally. In this report, the following countries and regions were compared: Denmark, England, Italy, Latvia, Italy, the Netherlands, Australia, British Columbia (Canada) and Singapore. Four building blocks (governance, resource generation, financing, and service delivery) within the Health System Performance Assessment (HSPA) framework as defined by WHO were used to compare public health systems, using literature searches as well as two rounds of questionnaires sent to national experts.

Public health includes various government departments, and this is reflected in the health goals that the countries surveyed aim to achieve: these vary from health-related goals to labour laws and transport goals. The governance of the public health systems seems not in all cases able to cope with this wide scope and is often focussing more on healthcare than health in general. Professionals working in public health include healthcare professionals, such as nurses, doctors, and psychologists, but also policy makers, epidemiologists, health economists, and managers. Spending on preventive health is only a fraction of total health expenditure in most countries. Finally, service delivery can be separated into two levels: the individual level, where a citizen may receive services such as vaccinations, and the policy level, where programmes to promote public health are drafted and executed.

A strong public health system has the potential to strengthen society as a whole, especially in the case when health becomes an integral part decision making throughout all government departments. Funding for prevention should be seen as an investment in the health of tomorrow and not so much as a budgeted expense, as is currently the case in the Netherlands. Currently, many countries struggle to incorporate the full scope of public health within their health system, even though collaborations between the various departments of governments are ongoing. An important lesson for the Netherlands is that widely supported goals can be essential to get various departments aligned and make policies that have impact. Governments should be held accountable for the outcomes of their public health policies, not only for their efforts, and funding should flow to programmes that have the desired impact, whether that is provided at the individual level or at the population level.

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Table of contents

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1. Synthesis and recommendations

Around the world, public health systems are challenged by various factors, such as limited resources, both in monetary terms[1] and qualified personnel[2]; a growing importance of prevention, including the reduction of health disparities between citizens of different social-economic status[3], rising healthcare costs[4], the resurgence of infectious diseases due to the COVID-19 pandemic[5] and a growing threat of antimicrobial resistance[6].

The Dutch Council for Health and Society (Raad voor Volksgezondheid en Samenleving in Dutch, RVS) is preparing an advisory report on the structure and implementation of a system for public health that is capable of dealing with future challenges. To inform this advice, the Aletta Jacobs School of Public Health was asked to compare international public health systems, including legal, organisational, and financial differences.

The recent COVID-19 pandemic has led to a renewed drive to strengthen health systems on the national[4] as well as the global level[5,7]. Increased investments in the public health system can be regarded as a collective insurance against the future threats mentioned above. Comparative research is an important element in health system strengthening: what are best practices in public health internationally, and what can we learn from this in the Netherlands?

1.1 Public health defined

The definition of public health is very broad: "the science and art of promoting health, preventing disease and prolonging life through the organized efforts of society"[8]. This broad definition allows countries to design public health in a way that fits their society. In this international comparison we see that all included countries have tailored their public health systems to their respective settings and needs. However, many countries struggle to incorporate the full scope of public health within their health system, even though collaborations between the various departments of governments are ongoing. While there is not much debate on the key public health activities, there are often differences when considering if some activities (i.e., health promotion) or intersectoral action (i.e., collaboration on urban planning) fall within the defined boundaries of the public health system. This lack of clarity leads to uncertainty in key actors that should be held accountable for the public health system performance itself.

A health system with a broad scope, that incorporates health through all government policies may better represent all factors which influence health system outcomes. A health system with a narrow approach on the other hand may make it easier to identify stakeholders responsible for the systems performance, however, may overlook important factors (i.e., education, employment) that do impact health system goals[9]. There is a clear distinction between the fields of "medicine", which emphasizes disease treatment and care on the individual level, and "public health", which concerns health promotion and prevention on the population level. "Health" is a broad term, historically defined by the World Health Organization (WHO) as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity"[10] and more recently as "the ability to adapt and to self-manage"[11]. It may be tempting to narrow down public health to the health sector, closely aligned with medicine, without applying a more comprehensive view considering citizens' health in all policies. Although we see an increased interest in the Netherlands in including health in matters such as urban planning, housing, and education, this is not always included by default. **We recommend applying a broad perspective as this is necessary to benefit from the full potential of public health as a society, including improved health in terms of physical and mental health, but certainly also granting citizens autonomy in their way of living.** To apply this broad perspective, the health capability model by Prah Ruger may

be helpful, which balances an individual's health functioning and the ability to pursue health, i.e., paternalism versus autonomy[12].

1.2 A solid foundation: the four building blocks of public health systems

Four building blocks outline the fundamental functions of a health system, as described by the Health System Performance Assessment (HSPA) framework[9]. Through **governance**, there are appropriate oversight, regulations, coalitions, and strategic policies in place to meet the demands of the country. Governance functions in collaboration with other sectors and stakeholders outside of the health system. **Resource generation** equips a health system with all inputs needed to function. It ensures inputs are produced, procured, and made available or maintained when needed, including adequate human resources and medical equipment. **Financing** is an integral function of a health system which ensures stable and sufficient funds can maintain and support the health system and its beneficiaries. **Service delivery** ensures effective, safe, and health interventions of high quality are delivered in all settings: the community, the GP practice, and the hospital.

1.2.1 Governance

Most included regions have an explicit public health act such as England, the Netherlands, Australia, British Colombia (Canada), and Chile which covers health promotion and protection. Singapore and Latvia have an infectious disease control and epidemiological safety act, respectively. Divided responsibilities on both the national and regional levels is common for public health, although the "regional level" varies between countries depending on their governance system. All countries have a public health vision or plan which is either state or nation specific. Denmark and Italy have national guidelines that can be tailored by each region or municipality. Australia has both national and state specific plans. Chile, Latvia, and Singapore have nation specific guidelines outlining their public health goals and vision. These goals can be tailored to specific populations, an example could be minority populations, such as Aboriginals: there are specific goals and policies to improve the health of the Aboriginal populations in Australia and British Columbia. Although the Netherlands currently has national health goals, these are divided over many different documents and are not always embedded on the municipal and district level. **We recommend having clear national public health goals, with tailored policy on the regional level and subgroup level to achieve these goals. Local decision makers should prioritize their contributions to achieving the national public health goals based on local opportunities and needs.** While drafting these policies, collaboration with various levels of government, health professionals, and public and private organizations is important, and is implemented in all countries to varying degrees. Responsibilities for these health goals should be clearly defined, a good example is Latvia: for every health goal the main responsible institution is detailed, as well as co-responsibilities[13]. This is an important step to ensure accountability within the democratic system. The process to include all important stakeholders in the policy-making process is not formalized in many countries; in general, we believe there is room for improvement there. Promising examples include Latvia, which ensures public involvement through legal mandate, and Italy, Chile, and British Columbia who have discussion forums to encourage stakeholder participation. National data on performance indicators and health status is publicly available through governmental websites for policy makers and researchers for all countries. **We recommend actively monitoring the health goals using the most recent data regarding the underlying indicators on a publicly available webpage.** An example is the English Public Health Outcomes Framework[14]. This requires a well-supported data infrastructure supporting the design, monitoring, and evaluation of public health policy at the national and regional levels. For the Netherlands, there is a monitor available, but this is hardly an inspiring webpage and certainly not easy to understand for lay audiences[15].

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1.2.2 Resource generation

There are various groups of public health professionals involved in the public health system. All countries have expert public health professionals who serve as consultants, frontline workers to deliver care, managers responsible for oversight of programs, and medical officers or professional bodies who have a legislative responsibility to manage public health issues on a broad scale. In Italy, England, Latvia, Netherlands, and Canada, the role of consultants can be fulfilled by epidemiologists, medical technicians, health scientists, quality officers/health inspectors, medical doctors, policy analysists, and environmental specialists. Singapore, Chile, and Australia mainly refer to epidemiologists or policy analysists as their consultants and Denmark relies on its regional councils. The most visible public health professionals are the frontline workers such as nurses, doctors, dentists, nutritionists, psychologists, social workers, and pharmacists. Some countries have specific support for minority groups, such as Aboriginal health workers in Australia. England, Latvia, Australia, and British Columbia have administrators, health service coordinators, and public health directors in their supervisory roles. England, Australia, and British Columbia have an explicit chief medical officer which is an important individual in major public health decisions. This person acts as the principal medical advisor to the government and provides advice on public health to the Minister of Health and other government departments. In Singapore and Chile, there are directors of public health and vice-ministers of public health who similarly are accountable for major public health decisions. **We recommend appointing a person, such as a chief medical officer, who is responsible for ensuring the inclusion of health-related matters throughout the Dutch government, and for reaching the national public health goals.** Some countries offer specific education to train public health professionals, with schools of public health being very prevalent in Anglo-Saxon countries, such as England, Canada and Australia[16]. Ongoing education after starting to work as a public health professional is focussed more on frontline workers than on workers in fields such as policy and epidemiology. Healthcare professionals need to continue their professional development to retain their licence, so this group receives ongoing training in all countries. **In addition to the existing programmes offered by the Netherlands School of Public & Occupational Health (NSPOH), we recommend further developing ongoing professional education programmes for public health policy makers and advisors. Additionally, the Netherlands is one of the few countries without dedicated academic public health programmes (i.e., Master of Public Health); introducing these programmes both for under-graduate and graduate degrees may benefit public health in general.**

1.2.3 Financing

The public health system is funded through national or local taxation schemes in many countries. In Denmark, British Columbia, and Italy, taxes are pooled and distributed to regions or municipalities based on needs and health targets set. Danish municipalities can also gain additional earmarked funding from national sources if needed. In England, the Department of Health and Social Care allocates such funds to the National Health Services for public health spending and local authorities receive funding though a Public Health Ring Fenced Grant based on population needs to meet health goals. The Dutch national government finances the municipalities through a fixed budget based on specific policy programmes to be carried out and the needs of the population. Latvia and Chile have both publicly funded (thought taxation) and out of pocket payments schemes for their health care systems in which some public health programmes such as vaccinations are free whereas patients may be charged for screenings. Public health in Australia is primarily funded through the tax-based health system, resulting in many public health services such as vaccinations and screenings being free of charge). For most countries, specific public health services for target groups are often free of charge for example though childhood vaccination programmes or elderly flue vaccination programmes. Still, compared to medical care, spending on public health is very low: spending on preventive health services ranges from 1% and 3% of all health expenses[17]. In health-economic terms, the willingness-to-pay threshold for government spending on public health interventions such as vaccines is €20,000 per quality adjusted life year (QALY), compared to up to €80,000 for curative care[18,19]. This implies more societal value to interventions that prolong the life of already-ill patients, than preventing disease in the first place[20]. It may be considered unbalanced that curing already existing diseases is prioritized to such a degree over preventing illness. **For the Netherlands, we recommend applying the same willingness-to-pay thresholds to prevention, i.e., ranging from €20,000 to €80,000 based on the burden of disease19.**

1.2.4 Service delivery

Service delivery is often the broad responsibility of regions, municipalities, local health authorities and local health professionals. They must ensure health promotion and prevention services are available for their population. In Singapore this responsibility is shared amongst the Ministry of Health and the Health Promotion Board. Similarly in Latvia, the Ministry of Health, local governments, non-governmental organizations (NGOs), and private enterprises have a joint effort to deliver public health services. A General Practitioner's (GP) office is regarded as a place for screenings and vaccinations in all countries. However, certain public health programmes such as childhood vaccination programmes are delivered in schools and mass vaccination programs (i.e., pandemic or flu vaccines) are delivered in health centres or health authorities. The Netherlands has child health clinics (*"consultatiebureaus"*) which are specialized facilities for childhood screenings, vaccinations, and parenting support. For the indigenous population in British Columbia, the first nations health authority is responsible for service delivery. In Singapore, Chile, Denmark, and Latvia, public health services can be delivered in primary care facilities as well. Quality assurance for service delivery for health promotion activities, environment, and service providers is found in most countries such as Netherlands, British Columbia, Italy, Australia, England, and Denmark while other countries have more established guidelines on healthcare providers and their practice. **We recommend having approachable and visible public health centres for civilians, whether these are sexually transmissible disease (STD) clinics, child health clinics or embedded within GP practices**. For the Netherlands, child health clinics and municipal health service offices are already available, but they are not very approachable for the public, also compared to other health centres such as pharmacies, primary care centres ("*gezondheidscentra*") or hospitals. The approachability and visibility of public health services may be improved by rebranding current offices or integrating more closely with these other health centres. Imagine walking into the local public health office to get a flu shot whenever it suits you or getting tested for STDs at the pharmacy right before doing the groceries. For the policy level, a similar approach may be relevant as well. **We recommend implementing**

transparent (online) points of access for public health policy, targeting lay audiences, health professionals and policy makers. The Singaporean Health Hub provides a nice example, a website with clear information on the various public health programmes, as well as the overall health system[21].

1.3 Aiming for the stars: public health goals

Health system goals and indicators are important to understand the health system's aims and performance. Already, most countries, including the Netherlands, included in the comparison adopted widely supported public health goals to get various government departments aligned and make policies that have the desired impact. For example in Australia the goal is to add at least two additional years of life lived in full health between 2021 and 2030[22]. In the United Kingdom, the 2020 aim was to reduce the smoking prevalence among adults to 12%, the percentage of pregnant women smoking at the time of delivery to 6% and the rate of regular smoking at age 15 to 3% by 2022[23]. In some cases, the goals do not describe outcomes, but outputs, such as the start of a national marketing campaign or the introduction of an innovative programme. This may not be the right approach as the outputs may not translate to the outcomes needed to reach the eventual impact. For example: if the government's aim is to reduce child obesity and the policy output is the availability of healthy snacks in school canteens, it is not necessarily true that this also contributes to the outcome that children have a healthy diet, see also the example in Figure 1.

Figure 1 Example of a public health goal, including a potential policy output and outcome

What may be necessary to reduce child obesity is free healthy lunches in schools, or a reduction in fast food chains around schools, or sugar taxes, or a combination of these measures. In terms of the building block framework as described before, the output describes something happening in the four building blocks - governance, resource generation, financing, and service delivery – the outcome is an intermediate objective, and the goal is a final goal as also displayed later in this report (Figure 2). Of course, often assumptions or findings from previous research do not hold up in practice, and outputs do not have the desired impact on reaching outcomes or goals. Using a flexible approach, policies can be quickly adapted to generate new outputs that aid in reaching the goals. **We recommend to held governments not only accountable for the realization of the outputs, but also for the outcomes and goals[24]. Using close monitoring of indicators by means of a well-established data infrastructure, policies can be dynamically adapted if the outputs do not contribute to reaching the desired outcomes.**

Optimalisation of the four building blocks combined are necessary to reach the outcomes: governance should be aligned, on all levels of government, there should be sufficient staff, resources, and funding available, and the intervention should be delivered effectively. To return to the previous example and assuming that the availability of healthy snacks is effective to let children eat healthy, within governance the goal should be well defined and embedded within the local government, with both schools, parents, and maybe even local farmers on board. As for resource generation, there should be processes in place to ensure that the healthy snacks are sufficiently available, fresh, and free of pesticides. The funding should be available so that the price of the healthy snacks is competitive, maybe even free. Finally, there should be someone to sell or give away the healthy snacks, capable of aiding the children in consuming the snacks. We

do believe that doing this comprehensively requires focus, having too many goals will not work as citizens, public health professionals, and policy makers will lose track. A public health officer, such as a chief medical officer, can ensure the government stays on track with their established health goals and objectives. These individuals can be held accountable for the outcomes of public health and must ensure the government makes the right decisions to benefit the population.

1.4 Public health redefined

We started off by investigating the building blocks of the health system and worked towards the impact each of the countries wants to make. For a moment, let us consider an opposite approach starting with the main goals of the health system and how all the building blocks should be arranged to maximize the impact of the public health system. From the various included countries, we see that most of the goals focus on health improvement and equity within the health system. The main benefit of the public health is that, unlike the field of medicine, you do not have to wait for citizens to become patients, i.e., get ill. This truly enables to focus on health broader than the absence of disease; to focus on preventing disease instead of curing it; and to focus on reaching all citizens, instead of only those that pro-actively seek medical care. To reach these goals, a mission-based approach may be needed[25], where the public sector actively collaborates with the private sector, each acting to their strengths. The central mission of the Dutch Ministry of Health, that the Dutch live at least five years longer in good health, and the differences in health between the lowest and highest socio-economic groups have decreased with 30% in 2040, of a good example of a mission[26]. The scope is broad and requires active participation from all stakeholders in the Netherlands. For the public health system specifically, a separate vision is most important, notably that the burden of disease due to a unhealthy lifestyle and unhealthy environment is reduced with 30% in 2040[26]. Reaching these goals requires a clear agenda-setting role from the government. Policies should be in place to ensure that the health system's building blocks fully support the government mission. Additionally, all relevant layers of government and departments should contribute towards reaching these goals.

A governance should be in place that enables all departments within government to promote health in all policies, laid out in clear goals and responsibilities. This really does require a different system than the field of medicine, where governance lies with the medical professionals whenever possible[9]. The greatest medical advance, sanitation[27], required a collective effort to be achieved, from researchers finding the relation between polluted water and disease, to policy makers deciding that it was worth fundamentally changing the infrastructure of 19th century cities. For resource generation, we would prioritize one of the key assets: public health professionals. Currently, medical education is primarily focussed on treating patients, as opposed to preventing patients and we expect only a small fraction of health professionals is working in public health, although it is quite challenging to quantify this[28]. This is also somewhat related to prestige, still, in the medical field a career as a specialist brings the most authority, even though we may consider it a collective failure that we need so many cardiologists, pulmonologists and orthopaedic surgeons to treat conditions that could have been avoided. **To truly reinvigorate the health of society, the brightest minds, both in the public as well as the private sector, need to be educated in and enabled to contribute to public health.** Financing of public health is inherently different from medicine; usually medical services are budgeted with the aim to reduce an increase in costs as much as possible. Over the years, this has resulted in a focus on implementing cost-effective interventions, usually valued at a cost per QALY, and evidence-based medicine, where non-proven interventions are no longer reimbursed. This budgeting approach makes sense for medicine, to keep the whole system sustainable, but not so much when considering public health. **Public health funding should be considered more like an investment, enabling citizens to lead a fulfilling and productive life, with long-term benefits for educational attainment, labour productivity and overall wellbeing.** We believe the core aim of public health policy should not be to reduce healthcare usage in the future, although this may of course be a positive side effect.

With regards to service delivery, the final building block, having recognizable, low-barrier points of entry into public health services is important, both for citizens and policy makers. This may be separate from the curative health sector but can also be combined with primary care centres or pharmacies for citizens. In the 21st century, an effective digital presence of the public health system can be an important asset, not only for citizens, but also for professionals and policy advisors working in all sectors that collaborate on public health topics. This digital presence should be fuelled by a health data infrastructure to monitor and evaluate health policy at all policy levels.

Contrary to the field of medicine, which mainly incrementally improves the health of patients, public health has the potential to fundamentally improve the health of all citizens. The issues mentioned above are organizational, financial, and societal issues combined. **Having clear goals is key, but it requires support from a public health system that is both effective and accountable. The system should be working towards clear outputs and outcomes, dynamically changing its approach whenever the outputs do not reach the intended outcomes. The responsibility for reaching these goals should be defined and scrutinized by parliaments and regional democratic councils.**

2. Introduction

Everyone, whether we are considering patients, doctors, or policy makers, will agree that it is better to prevent disease, than to cure it. Also, in the focus on keeping global health systems sustainable, prevention is considered an important pillar. Therefore, most countries have a public health system which is focussed on exactly this aspect, in addition to the community care and hospital care systems where patients can turn to in case of illness. These public health systems vary greatly between countries and cover topics such as health promotion, environmental health, child healthcare, vaccination programmes and infectious disease prevention[29–31].

Although everyone will agree prevention is a priority within the health system, this is often not reflected in the expenditure on public health. Expenditure on preventive care in 2019 ranged between 1% and 3% of all health expenses for most Western countries[17]. Previously, concerns have been raised concerning cutbacks on the public health budget[32] and also concerning the availability of reliable data to quantify the investments in public health[28,32]. At the same time, the sense of urgency for well-developed public health systems is increasing, considering a rise in preventable diseases such as obesity in children[33], an ageing population[34] and a potential increase in infectious disease outbreaks, as illustrated by the COVID-19 pandemic. Although many public health measures are unlikely to save healthcare costs in the future, there may often be future benefits such as improved health and enhanced productivity both in paid (i.e., jobs) as well as non-paid activities, such as informal care and education[35]. Standard market mechanisms in the healthcare system seem to drive funding away from prevention to curative care[36]. A process which may be further accelerated in the Netherlands as the willingness-to-pay threshold for prevention usually is €20,000 per QALY, while this is up to €80,000 per QALY for curative care[18]; in effect, applying more societal value to interventions that prolong the life of already-ill patients, than preventing disease in the first place[20].

2.1 The definition of public health

Public health is defined as: "the science and art of promoting health, preventing disease and prolonging life through the organized efforts of society"[8]. It is considered one of the three major sub-functions of healthcare service delivery, next to primary care and specialist care[9]. Public health encompasses a large array of health topics, ranging from services targeting new-borns, to the elderly, and from the eradication of certain communicable diseases to improving social determinants of health[9]. Even civilians who never consult a GP or are admitted to a hospital will encounter the public health system through various stages of their lives: whether they are vaccinated for a range of infectious diseases as a young child, fill in a survey on mental health as an adolescent wear a safety helmet on a building site as a construction worker or see a photograph of smoker's lungs on a pack of cigarettes as a retiree. Virtually all disease areas have a connection to public health, including communicable diseases, non-communicable diseases, social and mental health, maternal and child health, environmental health, occupational health, injuries and violence, antibiotic resistance, and health inequalities[29].

In 2011, the WHO published the Essential Public Health Operations and Services in Europe[29,30]. In this framework, various operations that need to take place within a public health system are described, divided into intelligence, services delivery, and enablers. **Intelligence** covers surveillance and monitoring and response to various diseases and health hazards. **Services delivery** covers health protection, health promotion and disease prevention. **Enablers** are necessities for a well-functioning public health system: governance, workforce, funding, communication, and research.

2.2 Comparing health systems: the HSPA framework

To understand a health system's structure and functioning and to identify which parts of the health system can be strengthened, we can look the building blocks within the Health System Performance Assessment (HSPA) framework as defined by WHO[9]. These have been established to lay the foundation for each well-functioning health system and should be universal regardless of a country's context. All health systems should have effective stewardship, deliver interventions to those who need them, have enough skilled workers to meet a country's demand, and have a sustainable financing system that is inclusive and fair. Strengthening these building blocks will lead to intermediate outcomes such as safe and high-quality care and to good access, which will consequently lead to the attainment of health systems goals, both on a personal level (better health and higher productivity) and population level (less inequity in health) (Figure 2).

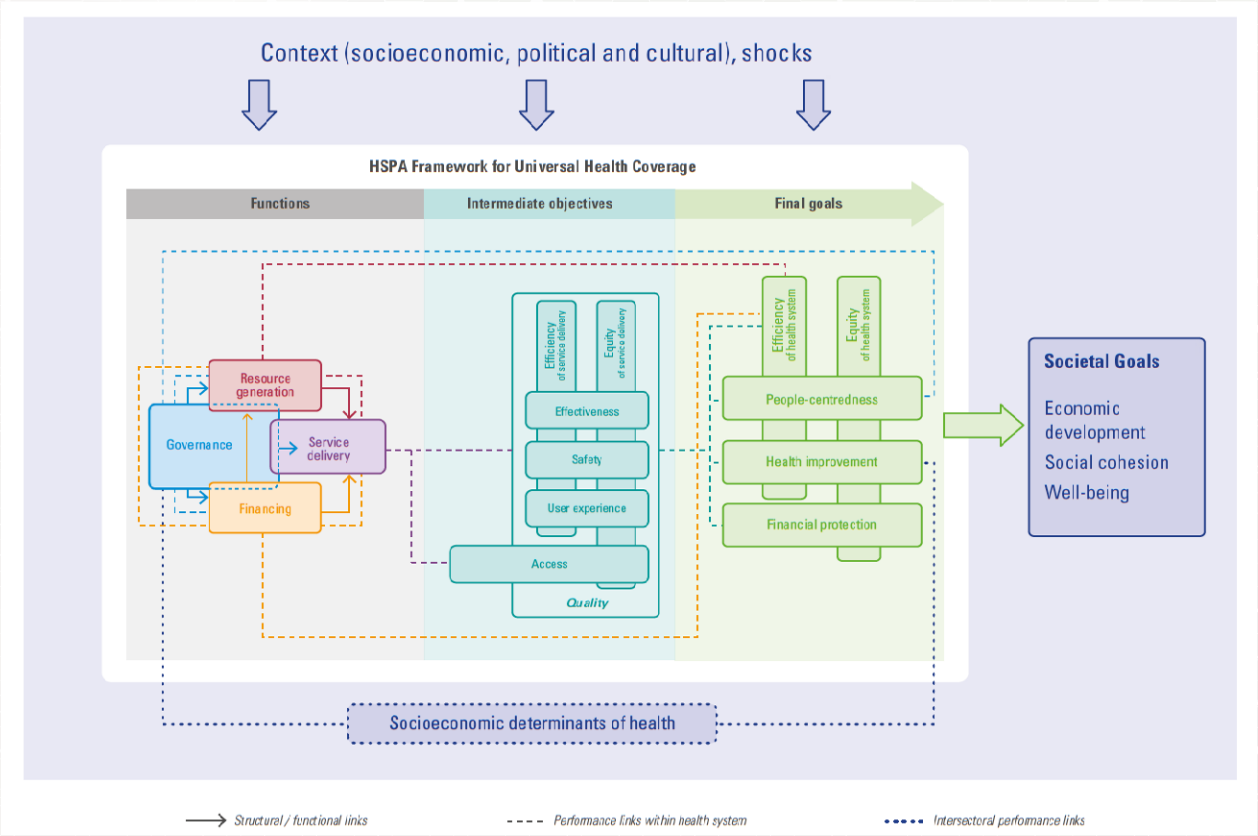

Figure 2 the WHO health system performance assessment (HSPA) framework[9]

Governance is one of the most important core functions within the health system as it lays the foundation for resource generation, financing, and service delivery functions. Through governance, there are appropriate oversight, regulations, coalitions, and strategic policies in place to meet the demands of the country. Governance functions in collaboration with other sectors and stakeholders outside of the health system. Therefore, governance is not solely dependent on the health sector alone but also those that surround it (e.g., education and environment). It can be viewed through four subfunctions: policy and vision, stakeholder voice, information and intelligence, legislation, and regulation.

Resource generation equips a health system with all inputs needed to function. It ensures inputs are produced, procured, and made available or maintained when needed. For example, adequate human resources (health workforce) that are sufficient, well-trained, responsive, and able to achieve the best health outcomes given their circumstances. Other sub-functions such as infrastructure and medical equipment, and pharmaceuticals and other consumables are important physical resources for a strong health system.

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Financing is an integral function of a health system which ensures stable and sufficient funds can maintain and support the health system and its beneficiaries. As such it is closely linked to each of the other building blocks. For example, it can provide governance the appropriate monetary resources needed to implement policy or ensure there are adequate funds for human and physical resources needed for the public. It is also key in enabling interactions between various actors in the health system and can be broken down into three sub-functions explaining the flow of financial resources through the health system: revenue raising, pooling resources, purchasing goods and services.

Service delivery directly impacts intermediate health system objectives and the achievement of health system goals. It ensures effective, safe, and health interventions of high quality are delivered in all settings: the community, the GP practice, and the hospital. As service delivery is an outcome of governance, financing, and resource generation, the performance of this block will reflect the performance of the others.

These building blocks outline the fundamental functions of a health system, as such, its performance can also be assessed in relation to the goals that are set. The intermediate objectives and final goals are an important part of the HSPA framework. All health systems aim to improve the health of the population it serves, to provide care that is person centered by incorporating the citizens needs and rights, and to protect individuals from catastrophic spending to maintain health. The pursuit of these goals is influenced directly by the building blocks or indirectly through intermediate outcomes. For example, governance can directly influence people centredness if it involves them in the decision-making process whereas service delivery acts indirectly on the final goals through delivering effective and accessible services to achieve health improvements in the population. Thus by understanding a health system's function, intermediate objectives, and final outcomes, its strengths and weaknesses can be identified.[9]

2.3 Aims of this project

For this comparison, the research question is: where does the Dutch public health system differ from public health systems in other countries with different constituent principles and systems, and what can we learn from these other systems? As public health is very broad, we focus primarily on what interventions and policy domains are considered to be part of public health systems internationally, how these are governed and funded, and what opportunities we see to improve public health. We select various countries and compare their performance using the WHO HSPA framework. The information we gather through this model are used to answer six sub questions for each of the public health systems:

1. What is considered "public health", what are the commonalities and differences?
2. What percentage of the Gross Domestic Product (GDP) is spent on prevention?
3. Which domains are included in the public health system, in addition to healthcare?
4. Which building blocks lay the foundation to each health system and how?
5. Which limitations or tensions are known?
6. What is the role of the public health services within the health system? Is this primarily an executive, signalling or advising role?

The systematically collected information on different public health systems can be used to inform and inspire policy makers and advisory councils, including the RVS, on potential changes that can be made to national public health systems, based on evidence from abroad. For the scientific community, this project is novel as, to the best of our knowledge, there are no international comparisons of public health systems available. Additionally, the updated HSPA framework has not been applied before, as it was published very recently, and may guide future comparisons of health systems.

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3. Methods

3.1 Country selection

In addition to the Netherlands, four European countries and four non-European countries or states, were selected for the comparison. These countries were selected based on guidance from the European Observatory on Health Systems and Policies, which involved consulting several public health experts in health systems as well as looking at geographical spread of the countries. This led to the selection as displayed in Table 1.

To collect up-to-date and country-specific information, two national experts in public health, referred to as "country agents" were approached for each country to complete a questionnaire designed to gather information regarding the building block model (see Appendix I for the full questionnaire).

European	Global
Italy Denmark	Australia Chile
England (United Kingdom) Latvia	Singapore British Columbia (Canada)

Table 1 overview included countries in comparison

3.2 Data collection

Prior to receiving the data from the country agents, a scoping literature search was performed on Google and PubMed to find relevant literature on public health and the tracer themes for each of the countries. Additionally, relevant governmental websites (e.g., ministry of health) were searched to ensure up-to-date information. This search strategy included both scientific and non-scientific sources. The information collected in the literature search was used to pre-fill the questionnaire sent to the country agents and to interpret the results.

3.2.1 Expenditure data

To answer the sub question on spending on preventative health, the most recent data on health expenditure (year 2019) was extracted from the Organisation for Economic Co-operation and development (OECD)[17] and WHO[37]. The database includes health expenditure data for many countries and can be used to filter on various functions of the health system, including preventive care, which roughly translates to public health[38]. Additionally, within preventative care the various subfunctions were explored. In this analysis, only government and compulsory financing schemes were included, which excludes out-of-pocket and voluntary financing. Singapore was not included in these analyses, as this country was not included in the OECD data; instead of data for British Columbia and England, data were reported for the Canada and United Kingdom, respectively.

3.2.2 Demographic data

To place the included countries into context, demographic data were collected, from sources such as the World Bank[39], WHO[40], OECD[17], the central intelligence agency (CIA)[41] and a map from MapChart[42]. Data from the most recent year were used. For British Columbia and England, localized data were not always available. In these cases, data for Canada

and the United Kingdom were reported. The following indicators were included:

- Population
- Population 65 years and over
- Governance system
- Life expectancy at birth
- Healthy life expectancy
- Type of health system (e.g., single payer, insurance)
- Gross Domestic Product (GDP) per capita, in international dollars, corrected for purchasing power parity (PPPs)
- Health expenditure as a percentage of GDP
- Spending on prevention, as a percentage of overall health expenditure
- Out-of-pocket spending on health, as a percentage of overall health expenditure

3.3 Questionnaire

The HSPA framework as published by the WHO's European Observatory of Health Systems and Policies was used to develop a questionnaire that focusses on the four main functions of health systems: **governance**, **resource generation**, **financing**, and **service delivery**[9]. The questions were phrased so that the answers would contribute to a broad understanding of the public health system. An overview is displayed in Table 2. We asked feedback on this approach from two health system experts of the European Observatory on Health Systems and Policies.

3.3.1 Selection of tracer themes

As public health is a broad area, we focus on six of "tracer themes"; a selection of themes considered to provide a comprehensive overview of various areas of focus of the public health system. The themes were determined since they cover three important aspects of the public health system: collective prevention, infectious disease control, and youth health care. **Urban planning** concerns the development of the public space, which can be adapted to encourage citizens to use healthy modes of transportation[43]. Also related to urban planning is **particulate matter**, which are very small particles in the air, and is an important indicator for air pollution, which is estimated to cause 7 million deaths annually[44]. **HPV** can cause various types of cancer and genital warts, causing almost 8 million years of life lost in 2008[45], which can largely be prevented using screening programmes[46] and vaccination[47]. **Influenza** is a viral disease with a high burden of disease, affecting citizens of all ages. In the public health setting, annual vaccination programmes for the elderly can prevent disease, while the public health system has an important role in preparing for pandemic influenza[48]. In **Child Screening Services**, children are screened and vaccinated, thereby detecting and preventing diseases; improving health outcomes in the long term[28]. **Mental health** programmes are important to support citizens coping with mental diseases and to prevent mental health problems in the long run[49].

3.4 Procedure

Country agents were consulted in two rounds. In the first round, the questionnaire was sent to the country agents. If sufficient scientific literature was available from the literature search, the questionnaires were pre-filled by the main investigators, with the explicit request to check this information. In the second round, clarification questions were asked if necessary. Input was asked primarily for the overall public health system, but country agents were also asked to provide specifics for the tracer themes. In both rounds, country agents were asked to provide references to relevant literature if possible.

Table 2 overview of the country agent questionnaire (round 1)

Funtion	Subfunction	Questions for the public health system overall	Specifics regarding the tracer themes
1. Governance	1. Policy and vision	• Is there national health sector policy/ strategy/ plan with goals and targets? • What is the public health vision, including long-term measurable goals? • Does the public health policy / strategy / plan clearly mention indicators allowing for regular monitoring and evaluation? If yes, which indicators? • Does the public health policy / strategy / plan include multisectoral coordination? If yes, how?	• Urban planning • Particulate matter • HPV • Influenza • Mental health • Child screening services
	2. Stakeholder voice	• Do key stakeholders participate during the preparation of new public health policies / strategies / plans and the review? If yes, which stakeholders are involved? • Can you provide one great example of collaboration between the various stakeholders on a public health topic? • To what extent are communities, NGOs, and the private sector involved? • Which mechanisms and dialogue platforms are in place to ensure involvement of key stakeholders in the health decision-making process?	
	3. Information and intelligence	• Are relevant data collection database available, such as health surveys, birth and death registration, census, health facility reporting, health system resource tracking? • Can you provide a website where these data ae publicly available? • How is data sharing arranged between various layers of government? • How is data sharing arranged between various providers of public health services?	
	4. Legislation and regulation	• Which legislation is applicable to the public health system? • Are existing health laws aligned with the government's health policies and plans? • To what extent are measures taken to effectively implement and enforce health legislation?	

2. Resource generation	1. Health workforce	• Which professionals are involved in the public health system? • Do public health professionals receive training regarding vulnerable populations? • Are there systems for continuing professional development available for public health professionals? • If the previous answer was yes, please explain which professional development is available?	• Urban planning • Particulate matter • HPV • Influenza • Mental health • Child screening services
	2. Infrastructure and medical equipment	• Which organizations are involved with public health? • Where are public health services delivered usually? • What is the density of public health facilities?	
	3. Pharmaceuticals and other consumables	• Are pharmaceutical and other consumable available where and when needed?	
3. Financing	1. Revenue collection 2. Pooling 3. Purchasing	• How is the public health system financed? • To what extent are out-of-pocket funds requested? • How are the funds allocated to the public health providers? • Are funds sufficient and stable? • Is revenue collection and pooling equitable? • To what extent is the payment of providers driven by information on the health needs of the population they serve?	• Urban planning • Particulate matter • HPV • Influenza • Mental health • Child screening services
4. Service delivery	1. Public health 2. Primary care 3. Specialist care 4. Social care	• Which is mainly responsible for delivering public health services? • How is the public health system integrated within the overall health system? • How do the professionals working in the public health system collaborate with other health providers? • Which quality assurance measures are in place regarding the delivery of public health services? • Are the services delivered in an equitable manner?	• Urban planning • Particulate matter • HPV • Influenza • Mental health • Child screening services
5. Final questions	-	• What are you most proud of considering the public health system in your country? • If there is one thing you could change in the public health system, what would that be? • Do you have any final comments relevant for this study	

4. Results

4.1 Country agent responses

Two country agents for all nine included countries responded on the first round of questions. For the second round, which included validation and follow-up questions, the country agents from Denmark, England, Italy, Latvia, the Netherlands, Australia, British Columbia, and Singapore responded.

4.2 The focus of public health

As explained in the introduction, public health is defined as: "the science and art of promoting health, preventing disease and prolonging life through the organized efforts of society"[8]. This definition was provided to all country agents, but we were interested in differences in the interpretation of public health and related policies across the nine countries. Some countries had well-defined public health system with clear boundaries whilst others were hard to distinguish from their overall healthcare systems. The differences amongst countries could be due to differences in their interpretations of health systems boundaries and the responsibilities within them[9]. These differences may be most clear from the formal goals and indicators linked to public health that we received from the country agents. In Table 3, an overview of policy documents detailing various public health-related goals and indicators is provided, which could be categorized in 14 different themes. These are: child and maternal health, life expectancy and quality of life, health equity, lifestyle and food, substance (ab)use, communicable diseases, reproductive health, mental health, dental health, non-communicable diseases, safety and the workplace, environmental health, health system strengthening and health workforce. Some of these themes clearly link to the tracer themes, such as child and maternal health, communicable diseases, mental health and environmental health. There are differences between the countries; the focus of the public health goals in Italy includes very explicitly food safety, while Australia very explicitly includes improving the health of minorities.

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Table 3 Public health goals and appropriate policy with relevant indicators for the nine included countries

Indicators	Denmark	England	Latvia	Italy	Netherlands	Australia	British Columbia, Canada	Chile	Singapore
Child and maternal health	Health Promotion Package	The Public Health Outcome Framework	Public Health Policy Guidelines (2020-2027)	National Prevention Plan (2020-2025)		National Action Plan for the Health of Children and Young people	British Columbia's Guiding Framework for Public Health (2017)	National Health Strategy (2021-2030)	Healthy Living Master Plan
Life expectancy and quality of life		The Public Health Outcome Framework Levelling Up White Paper (2022)	Public Health Policy Guidelines (2020-2027)	National Prevention Plan (2020-2025)	Mission Document Health & Care	National Preventive Health Strategy	British Columbia's Guiding Framework for Public Health (2017)	National Health Strategy (2021-2030)	Healthy Living Master Plan
Health equity	Health Promotion Package	The Public Health Outcome Framework	Public Health Policy Guidelines (2020-2027)	National Prevention Plan (2020-2025)	National Health Policy (LNG) 2020-2024	National Preventive Health Strategy	British Columbia's Guiding Framework for Public Health (2017)	National Health Strategy (2021-2030)	Healthy Living Master Plan
Lifestyle and food	Health Promotion Package	The Public Health Outcome Framework The National Food Strategy (2022)	Public Health Policy Guidelines (2020-2027)	National Prevention Plan (2020-2025)	National Prevention Agreement	National Preventive Health Strategy	British Columbia's Guiding Framework for Public Health (2017)	National Health Strategy (2021-2030)	Sport Singapore Vision 2030

Indicators	Denmark	England	Latvia	Italy	Netherlands	Australia	British Columbia, Canada	Chile	Singapore
Substance (ab)use	Health Promotion Package	The Public Health Outcome Framework The Tobacco Control Plan (2017) From Harm to Hope: A 10-year Drugs Plan to Cut Crime and Save Lives (2022)	Public Health Policy Guidelines (2020-2027) Reducing the Prevalence of Alcohol and Drug Use 2023-2025 (Draft)	National Prevention Plan (2020-2025)	National Prevention Agreement	National Preventive Health Strategy	British Columbia's Guiding Framework for Public Health (2017)	National Health Strategy (2021-2030)	Healthy Living Master Plan
Communicable diseases	Health Promotion Package	The Public Health Outcome Framework	Public Health Policy Guidelines (2020-2027)	National Prevention Plan (2020-2025)		National Preventive Health Strategy		National Health Strategy (2021-2030)	
Reproductive health	Health Promotion Package	The Public Health Outcome Framework	Public Health Policy Guidelines (2020-2027)	National Prevention Plan (2020-2025)		National STI Strategy		National Health Strategy (2021-2030)	
Mental health	Health Promotion Package	The Public Health Outcome Framework	Public Health Policy Guidelines (2020-2027)	National Prevention Plan (2020-2025)	National Health Policy (LNG) 2020-2024	National Preventive Health Strategy National Mental Health and Suicide Prevention Plan	British Columbia's Guiding Framework for Public Health (2017)	National Health Strategy (2021-2030) Mental Health Action Plan (2019-2025)	
Dental health		The Public Health Outcome Framework	Public Health Guidelines (2021-2027)	National Prevention Plan (2020-2025)		National Oral Health Plan			Healthy Living Master Plan

Indicators	Denmark	England	Latvia	Italy	Netherlands	Australia	British Columbia, Canada	Chile	Singapore
Non-communicable diseases		The Public Health Outcome Framework	Public Health Guidelines (2021-2027)	National Prevention Plan (2020-2025)	Mission Document Health & Care	National Preventive Health Strategy National strategic framework for chronic conditions		National Health Strategy (2021-2030)	Healthy Living Master Plan
Safety and the workplace	Health Promotion Package		Public Health Guidelines (2021-2027)	National Prevention Plan (2020-2025)		Work Health & Safety Strategy	British Columbia's Guiding Framework for Public Health (2017)		Healthy Living Master Plan
Environmental health		The Public Health Outcome Framework	Public Health Guidelines (2021-2027)	National Prevention Plan (2020-2025)	Healthy Green Environment Programme		British Columbia's Guiding Framework for Public Health (2017)	National Health Strategy (2021-2030)	Health Living Master Plan
Health system strengthening			Public Health Guidelines (2021-2027)	National Prevention Plan (2020-2025)	Mission Document Health & Care	National Preventive Health Strategy Primary Health Care 10 year plan (2022-2032)	British Columbia's Guiding Framework for Public Health (2017)		
Health workforce			Public Health Guidelines (2021-2027)	National Prevention Plan (2020-2025)		National Medical Workforce Strategy			

4.3 Spending on preventative health services in relation to GDP

National spending on the various functions of the health system as a percentage of the GDP are displayed in Figure 2[17]. No data were available for Chile. Spending on preventive care ranged from 0.16% of GDP for Latvia to 0.50% for the United Kingdom. Compared to other functions in the health system, preventive care can be considered to account for a minor contribution to the overall expenditure, compared to curative and rehabilitative care, long-term care, or medical goods. For Singapore no OECD data was available by healthcare function. According to the Singaporean Ministry of Health, 5% of overall healthcare spending is on preventive health services[50]; around 4% of GDP in Singapore is spent on healthcare, so the percentage of GDP spent on preventative healthcare can be estimated at around 0.2%[37].

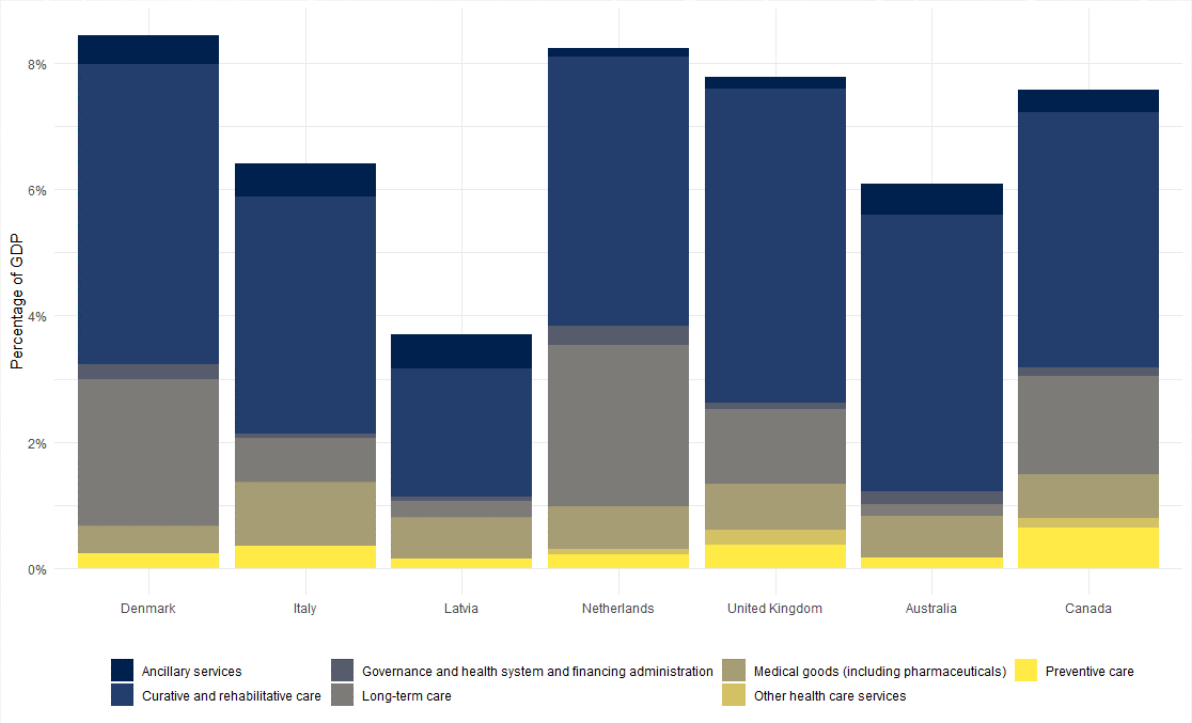

Figure 2 expenditure on health as a percentage of the GDP by country and function in 2019

For the United Kingdom, Denmark, and Latvia more details are available on the subfunctions within preventive care expenditure, which is displayed in Figure 3. The most prominent contributor are healthy condition monitoring programmes, followed by information, education and counselling programmes.

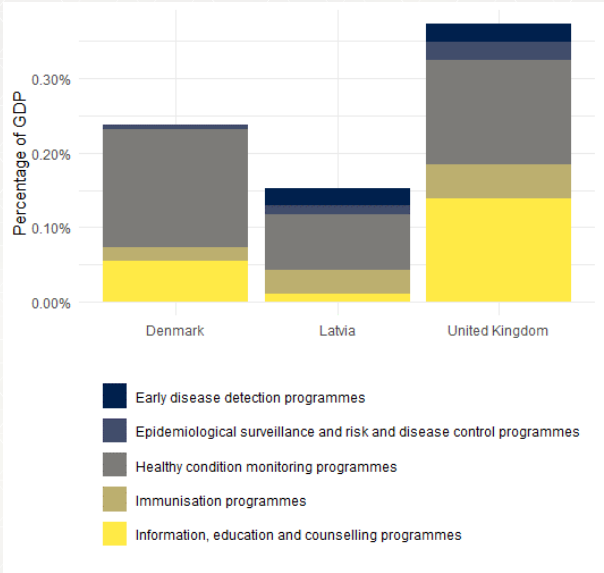

Figure 3 expenditure on preventive care as a percentage of GDP by country and subfunction in 2019

4.4 Intersectoral collaboration in public health

As described in the HSPA framework, intersectoral collaboration is important to deal with factors outside the health system that shape the health of populations[9]. Hence, domains of government not directly focussed on health are often involved in public health policies and programmes. As public health cannot function as a single entity, multisectoral collaboration is often essential to have effective public health policy. Simple, yet common public health measures such as vaccination programmes are often developed in collaboration with the ministry of education to deliver these in schools to children early in life. Collaboration within domains can be seen in various stages of developing, implementing, or enforcing public health policies or programmes. Table 4 highlights the different domains which work in collaboration with the ministries of health on public health in the various countries under consideration.

Some examples on collaboration across domains are the *"Crece Contigo"* in Chile, a law that aims to improve living standards and care for children in the first years of life, a shared responsibility between the Chilean Ministry of Education, Ministry of Social Development and Ministry of Health. Another example is the Comprehensive School Health Programme in British Columbia (British Columbia) which addresses school health and education in a planned, integrated, and holistic manner[51]. This programme is a joint effort between the Ministry of Health and Education, NGO's, health authorities, educational partners, and other key stakeholders (teachers, students, families)[52]. In Latvia, the Ministry of Health has created a National Commission on Smoking Control which aims to fulfil the right to clean, smoke free air for its citizens. It is in collaboration with numerous stakeholders from the public, private and community sectors including but not limited to, the Ministry of Education, state police, the Public Health association, and Public health professionals[53].

Table 4 multisectoral coordination of public health system with different government departments (green = yes)

	Denmark	England	Latvia	Italy	NL	Australia	British Columbia	Chile	Singapore
Education									
Social Development									
Labor & workforce									
Food & agriculture									
Transport									
Justice & crime									
Finance									
Economics									
Environment									
Sport									

4.5 Building blocks of public health

4.5.1 Governance

The governance of public health systems varies between the included countries. Table 5 provides an overview of relevant legislation applicable to public health in the different countries, such as dedicated public health laws and separate acts. In countries such as Latvia, Netherlands, Chile, Italy, and Australia, the right to health is fundamentally established in their constitution. Considering the governance structure, in smaller countries, such as Singapore and Latvia, public health is centralized. The responsibilities of public health goals and performance is thus with the Ministry of Health in these countries. The larger countries commonly have a more decentralized public health system, including Canada, Australia, Chile, and Italy, where the responsibility mainly lies with either provinces or states. Similar to the Netherlands, Denmark, a relatively small country, also is decentralized.

Table 5 overview of public health legislature across countries

Country	Public Health Legislation	Public Health Programmes
Denmark	*"Sundhedsloven"* or Danish Health Care Act*[54]	National Childhood Immunization Programmes New-born & Childhood Screening Programmes Cancer Screening Programmes
England	England Public Health Act*	NHS Vaccination Programme Screening Programme Influenza Preparedness Strategy Healthy Child Programme NSH Long Term Plan Mental Health Workforce Plan
Latvia	Epidemiological safety Law[55] Sexual and Reproductive Health Law	Cancer screening Programme State Immunization Programme Newborn & Childhood Screening Programmes Psychological & Psychotherapeutic Assistance Programmes
Italy	Article 32 of the Italian Constitution**	Gaining Health-Promoting Healthy Choices Programme National Immunization programme Screening Programmes School Based Mental Health Programmes

Netherlands	*"Wet publieke gezondheid"* or Public Health law	National Prevention Agreement National Vaccination Programme Childhood Screening & Prevention Programme Healthy Green Environment Programme
Australia	Public Health Act* (state specific)	National immunization programme National Mental health & suicide prevention strategies Neonatal screening programme Pandemic Influenza Plan National Cancer Screening
British Columbia, Canada	The Public Health Act *[56]	Healthy Child and Youth Development Programme Healthy living programmes (tobacco control, physical activity, diet) Life Time Prevention Programme (screenings & vaccinations) Influenza Prevention Policy Mental Health Promotion & Prevention Newborn Screening Programme
Chile	*"Sistema Elige Vivir Sano"* or Healthy Living Systems Law	Cancer Screening Programme National Immunization Programme Contrapeso ('Against Overweight') Programme Early Child Development Program National Mental Health Plan (2017-2025) Adolescents and Youth Health Programme
Singapore	Infectious Disease Act*[57] Environmental Public Health Act[57]	School Dental Services programme Healthy Lifestyle & Healthy Aging Programmes Student Immunisation & Screening Programme Screening for Life- National Health Screening Programme Anti-smoking Programmes

**Acts give power to Public Health Authority figures to prevent and control infectious disease*

*** Italian constitution highlights right to health protection and equitable health infrastructure for all*

The main health law in **Denmark** is the *"Sundhedsloven"*, the Danish healthcare act, which provides a framework for more specific legislation[54]. This law covers health promotion, protection, as well as treatment [54]. Denmark has not had an overarching health strategy since the programme "Healthy throughout life" from 2002 to 2010. Since then, the Danish Health Authority has provided municipalities with Health Promotion Packages to provide technical guidance to implement effective public health prevention and promotion programmes with performance indicators covering 11 focus areas (Table 3)[58,59]. Public health in Denmark is thus a shared responsibility between the national government, regions, and municipalities [60]. The regions contract healthcare providers, mainly GPs and hospitals, and draft healthcare agreements with the municipalities. Each municipality has its own health policy which is relevant to the needs of the population it serves, and runs general prevention programmes, schools nursing services, and health promotion programmes[60]. The 98 municipalities are organized on the national level within the *"Kommunerns landsforening"*, which represents aims to safeguard the interests of the municipalities as well as assist them with consultancy services needed to function with up-to-date information[61]. Collaboration on health policy in Denmark is mainly governed by the idea of "public corporatism" which includes a wide range of stakeholders, both formally and informally. This entails each stakeholder to be responsible for different parts of health service delivery. For example, regions are specialized in patient care and municipalities are responsible for population level preventative care. most influential factors in this field are the government and medical professionals, although patient organizations also may be consulted. Public health data at the regional, municipal, and hospital level is publicly available for patients, researchers and health care professionals to access[62]

Denmark

Land area	40000 km²
Population (millions)	5.8
Population ≥65 years	20%
Governance system	Parliamentary constitutional monarchy
Life expectancy at birth	81 years
Healthy life expectancy	71 years
Type of health system	Single-payer
GDP per capita (PPP-corrected USD)	$60230
Health expenditure (% of GDP)	10%
Spending on prevention (% of health expenditure)	2.5%
Out-of-pocket spending on health (% of health expenditure)	14%

England's Public Health Act which was formed in 1848 is the main legislation covering public health policy and ensuring adequate protection from diseases [63]. The Public Health England 2020-2025 plan aims to protect and help people live longer in good health[23]. The overarching goals - to improve the wider determinants of health, health improvement, health protection, and healthcare and preventing premature mortality - have relevant indicators and monitoring in place clearly described in the Public Health Outcomes Framework[14] (Table 3). Each goal is taken forward nationally, regionally, and locally across relevant organizations. Up until 2021, the public health system was under one governing body (Public Health England) but is now divided over the UK Health and Security Agency whose main role is to protect from infectious diseases and health threats, the Office for Health Improvement and Disparities which aims to improve the nation's health so everyone can live in good health longer through health promotion activities, and the National Health Service (NHS)[64]. While these governing bodies are responsible for public health, multisectoral coordination is key in executing each goal specified in the Public Health Outcomes Framework[14]. The Department of Health and Social Care works with 25 agencies and public bodies as well as a variety of key stakeholders such as Health Education England, professional and representative public health organizations and the NHS England[65]. Voluntary, Community and Social Enterprise Health and Wellbeing Alliance serves to engage these stakeholders in co-producing public health guidelines and local health authorities in addressing health inequalities. Furthermore, there are mechanisms in place such as requirements to consult, online platforms to provide input and meetings with key professional groups. Patient data is collected in accordance with legal frameworks and data protection laws. There must always be a valid lawful basis for the collection and processing of data[66]. All data is available through public health profiles[14], a large public health data collection portal with information on key health indicators as well as their health system performance indicators.

England, United Kingdom

Land area	130279 km²
Population (millions)	56.6
Population ≥65 years	19%*
Governance system	Parliamentary constitutional monarchy; a Commonwealth realm
Life expectancy at birth	81 years*
Healthy life expectancy	70 years*
Type of health system	Single-payer
GDP per capita (PPP-corrected USD)	$46483
Health expenditure (% of GDP)	10%
Spending on prevention (% of health expenditure)	5%
Out-of-pocket spending on health (% of health expenditure)	17%

** Data for the whole of the United Kingdom*

The **Italian** constitution section 3.2 provides the right to health and health protection for each citizen and the community is the primary legislation applicable to public health. It emphasises population health is a fundamental value and the state must provide sufficient services to all in an equitable manner. In addition, the NHS, established in 1978, is a legal structure which covers universal access and non-discriminatory access to health services. The National Prevention Plan is the main policy and planning instrument regarding Italy's public health system[67]. The current plan (2020-2025) adopts a "one health" approach considering the relationships between environment- animals-humans in Public Health[67]. The plan is at the state level but leaves rooms for the regions to develop their own relevant goals in regional prevention plans, which are updated every 3-5 years. As such, the states and regions are held responsible for meeting the goals as there is no centralized authority structure. The National Prevention Plan has a systematic framework of performance indicators (Table 3) in place for adequate monitoring of the plans goals which is contextualized to each region/territory[68]. The plan is intersectoral in nature and includes collaboration with a wide range of ministries from agriculture to employment[60]. It also encourages participation from citizens/ communities, the private sector and NGO's which play an important role in the implementation of health and social health services[60]. Through regular discussion forums, diverse groups and ideas are involved in the decision-making process in collaboration with different leading authorities involved in the governance of the health. The Ministry of Health also creates national platforms to engage stakeholders in creating and implementing policies. All finalized public health decisions are made at the highest level in government and all involved ministries and institutions must act accordingly with the goals set. The New Health Information System which was created in collaboration with the states, regions, and provinces is a universal system of electronic records connecting all levels of care[60]. It also serves to monitor and evaluate the NHS at all levels by using a large set of indicators on six dimensions (population health, regional strategy compliance, quality measures, patient satisfaction and experience, staff satisfaction, efficacy, and financial performance) [63]. Some regions have developed electronic networks to facilitate communication between various health service providers[60].

Italy

Land area	297730 km²
Population (millions)	59.6
Population ≥65 years	23%
Governance system	Parliamentary republic
Life expectancy at birth	83 years
Healthy life expectancy	72 years
Type of health system	Single-payer
GDP per capita (PPP-corrected USD)	$41829
Health expenditure (% of GDP)	9%
Spending on prevention (% of health expenditure)	4.6%
Out-of-pocket spending on health (% of health expenditure)	23%

In **Latvia**, there is no single public health law, however their Epidemiological Safety Law and the Sexual Reproduction Law cover a wide range of public health issues such as disease prevention and health promotion activities. Additionally, there are various regulations for certain themes, including: addiction, infectious diseases, environmental health, and hygiene[69]. Public health is a centralized affair in Latvia; with the Ministry of Health in charge, although municipalities have certain responsibilities such as the provision of support for health promotion measures and organization of school health examinations. To support municipalities, Latvia's Network of Healthy Local Governments, an advisory board is in place which aims to promote good practices and support in solving various public health issues at the local level and to educate local governments in the field of public health[70]. The Centre for Disease Prevention and Control is responsible for informing the public on health prevention and promotion activities. Latvia has long-term Public Health Policy Guidelines (2021-2027) which support the development of Latvia's public health policy by building on previous public health policy and updating as needed and to ensure the continuous involvement of stakeholders. These guidelines lay the foundation for their public health vision, focusing on reducing inequities in health, reducing mortality from non-communicable diseases and external causes, and promoting a healthy work environment with clear results and performance indicators in 18 different policy areas, including the baseline and targets for 2024 and 2027 (Table 3)[13,71]. These guidelines then ensure the key objectives which are set out in the National Development Plan of Latvia (2012-2027) are indeed met. This national plan clearly indicates five multisectoral areas for action in their first priority for a health population: lifestyle, infections, integrated health care, human resources and sustainability. Multisectoral coordination is led by the Ministry of Health, which collaborates within a network such as the Ministries of Welfare, Food, Interior, Education, Economics, Finance, and Transport. In Latvia, public involvement such as including NGOs and the private sector, is mandated by law[72]. Universities, professional associations, and patient associations are involved at early stages of development of the Public Health Guidelines. Various health indicators are collected by the Centre for Disease Prevention and Control, the NHS, and the Central Statistical Bureau[73]. The Open Data

Latvia

Land area	62090 km²
Population (millions)	1.9
Population ≥65 years	21%
Governance system	Parliamentary republic
Life expectancy at birth	75 years
Healthy life expectancy	66 years
Type of health system	Universal public insurance
GDP per capita (PPP-corrected USD)	$31465
Health expenditure (% of GDP)	7%
Spending on prevention (% of health expenditure)	2.6%
Out-of-pocket spending on health (% of health expenditure)	36%

Portal provides an overview of all authorities performing public functions[74].The Open Data Portal provides an overview of all authorities performing public functions[74]

The Public Health law (*"Wet publieke gezondheid"*) is the main legislation on public health in the **Netherlands** and describes public health as "the health protective and promotive measures for the population or specific groups, including preventing and early discovering disease". The law covers the organization of the public health system, measures to reduce the transmission of infectious diseases (including quarantines), and care for the youth and elderly. Other relevant laws for public health are the constitution, which states that the government should promote the health of all citizens, the law on security regions, which is used in emergency situations (such as pandemics), the law on municipalities, which outlines the municipal duty to protect health, and the law for social support, which includes the care for the homeless. In the still-to-be-applied environment law, municipalities must consider health in urban planning projects. Although occupational health is considered part of public health in many countries, this is considered a separate field in the Netherlands. The government has far-reaching authority to enforce rules on preventing the spread of infectious disease. Although there are various ambitions for public health in various domains, in some cases clear targets are absent[75], while in other cases a clear monitoring programme is set up[76]. Various stakeholders collaborate in the drafting and execution of public health policies, the different layers of government, professionals, scientists, the public and private organizations, but the level of collaboration varies between different plans. Although there are various ambitions for public health in various domains, in some cases clear targets are absent[75], while in other cases a clear monitoring programme is set up[76]. In general, the topic "health" is mainly contained within the Ministry of Health on the national level and the health and social policy areas on the local level. Various stakeholders collaborate in the drafting and execution of public health policies, the different layers of government, professionals, scientists, the public and private organizations, but the level of collaboration varies between different policy plans. This is known as the ÒpolderÓ model, where there is an active discussion between all stakeholders to reach consensus agreements that are then enacted by the

Netherlands

Land area	33670 km²
Population (millions)	17.4
Population ≥65 years	20%
Governance system	Parliamentary constitutional monarchy
Life expectancy at birth	82 years
Healthy life expectancy	71 years
Type of health system	Universal private insurance
GDP per capita (PPP-corrected USD)	$59268
Health expenditure (% of GDP)	10%
Spending on prevention (% of health expenditure)	3.2%
Out-of-pocket spending on health (% of health expenditure)	11%

government. There are various sources of data related to public health, such as the National Institute of Public Health and the Environment, the Statistics Netherlands and the municipal health services (GGD). Data is shared between the layers of government through national registration systems and health monitors, which provide various indicators collected on the local level by the municipal health services and shared nationally every four years. Data sharing among health providers is a problem, as various systems do not communicate properly.

There is no single law in **Australia** that defines the public health system. Within Australia's health system different parts have responsibilities for public health. The Australian health system itself is complex, with various levels of funding and responsibilities within the federal and state governments[77]. There are various public health acts on the state level who are each responsible for health promotion; as well as some programs run from the central (federal) government. A range of policies and strategies contain long-term targets for public health, including the National Obesity Strategy (still in consultation phase), the National Aboriginal and Torres Strait Islander Health plan, the National Action Plan for the Health of Children and Young People and the National Preventive Health Strategy. Usually, public consultations are an important aspect of new policies. Development of the National Preventive Health Strategy development was guided by a multi-sectoral expert steering committee with members from Commonwealth, state, academia and NGOs. Then, a draft consultation paper was developed and in an open consultation round a large number of responses was collected. The responsibility of change is shared among governmental layers, the healthcare sector, academia, the private sector, industry, communities and individuals. NGOs in the form of peak bodies are important organizations in the development and drafting of national strategies, these are organisations that are widely regarded as representatives of patients or professionals. Health-related data are primarily shared by the Australian Institute for Health and Welfare. The Australian Health Performance Framework supports system-wide reporting on the performance on the health sector. Health data sharing between providers of healthcare services is more dispersed and although there is a standard medical record, its use is not universal.

Australia

Land area	7692020 km²
Population (millions)	25.7
Population ≥65 years	16%
Governance system	Federal parliamentary democracy under a constitutional monarchy
Life expectancy at birth	83 years
Healthy life expectancy	71 years
Type of health system	Single-payer
GDP per capita (PPP-corrected USD)	$53330
Health expenditure (% of GDP)	10%
Spending on prevention (% of health expenditure)	2%
Out-of-pocket spending on health (% of health expenditure)	16%

Canada has three main levels of government; federal, provincial, and municipal, each with their own responsibilities[78]. The federal government is responsible for setting and administering the national standards of the health system whereas the provincial/territorial governments are responsible for managing, organizing, and delivering healthcare services for its residents. Thus, each province has its own unique health system in place which differs based on the needs of the population it serves[79]. In **British Columbia**, public health is governed through the Public Health Act (formerly known as the British Columbia health Act, 1893), a piece of legislation which serves to address current and emerging public health issues by providing public health authorities with certain tools and measures necessary to respond to public health emergencies[56]. This along with the Food Safety Act, Community Care and Assisted Living Act, Drinking water Protection Act, Tobacco Control Act, and School Act all work together to ensure public health standards are maintained[56]. British Columbia's Guiding Framework for Public Health highlights their vision and long-term measurable goals for promotion, protection, and prevention through four core domains in health improvement, prevention of disease, injury and illness, environmental health, and public health emergency management[51]. These guidelines are accompanied by strict indicators for each goal and updated every 10 years (Table 3). The ministry of health is responsible for ensuring that quality, appropriate, cost-effective health services are available to its citizens. It supports and funds the regions to execute their public health obligations[80]. There are 6 provincial health authorities responsible for service delivery with a sixth health authority responsible for the quality of services delivered[80]. While the responsibilities of public health are with the regional health authorities, the ways in which programs are shaped and delivered is a combined effort across all sectors and levels of government. Local communities, patient partners, NGO's, the private sector, and First Nations and Aboriginal groups are also key in creating health promoting and health protecting environments[51]. By inter-sectorial planning and coordination ÒtablesÓ these key stakeholders can be involved in the decision-making processes. For First Nations and Aboriginal people, the First Nations Health Authority works closely with the Public Health system to design and deliver public health programs that fit their needs

British Columbia, Canada

Land area	944735 km²
Population (millions)	5.2
Population ≥65 years	18%*
Governance system	Federal parliamentary democracy (Parliament of Canada) under a constitutional monarchy
Life expectancy at birth	82 years*
Healthy life expectancy	71 years*
Type of health system	Single-payer
GDP per capita (PPP-corrected USD)	$46611*
Health expenditure (% of GDP)	11%*
Spending on prevention (% of health expenditure)	6.2%*
Out-of-pocket spending on health (% of health expenditure)	15%*

** Provided data are for the whole of Canada*

and priorities[51]. The Public Health officer delivers reports to assess progress in achieving health targets, establishes standards of practice for and conducts reviews of medical health officers, as well as works with the British Columbia Centre for Disease Control to ensure their legislated mandates on disease control and health protection.

In **Chile**, public health is mainly a responsibility of the 15 regional health authorities (Secretaria Regional Ministerial de Salud) that ensure compliance with health norms, plans and programmes. Municipalities are responsible for education and social services. The law *"Sistema Elige Vivir Sano"*, or the healthy living system, promotes healthy living, sport, self-care and family development[81]. Under this law, all state institutions should incorporate policies related to health promotion and prevention. This includes national, regional, and local collaboration. An interministerial committee with ministers from many relevant ministries, such as health, education, social security, urbanism and sport, ensures collaboration on public health themes[81]. Stakeholders collaborate in the governance on public health, including patients, NGOs and industry, although the use of public consultations varies between various topics as they are not mandatory. There is a "healthy parliament of children" where children discuss health-related topics. The *"Consejos de Desarrollo Local y Consejos Consultivos"* are local advisory councils that discuss health priorities within the community. Additionally, there are various organizations that are dedicated to promoting specific public health themes, such as the movement coalition, founded by the Chilean medical societies and the National Federation of Independent Street Markets, which promotes healthy diets. Chile's National Health Strategy (Estrategia Nacional de Salud) (2021-2030) has recently been drafted after extensive consultation with scientific and academic organizations, professional associations, representatives of civil society, and patient groups[82]. Four health objectives have been identified: improve the health and well-being of the population; reduce health inequalities; ensure the quality of health care; and more towards building healthy communities and environments[13]. Indicators for set goals are still being finalized[13]. Data on health-related indicators are collected through several surveys, such as the national socioeconomic characterization survey and epidemiolocal surveillance, which is carried out every seven

Chile

Land area	743532 km²
Population (millions)	19.1
Population ≥65 years	12%
Governance system	Presidential republic
Life expectancy at birth	80 years
Healthy life expectancy	70 years
Type of health system	Universal public-private insurance
GDP per capita (PPP-corrected USD)	$25110
Health expenditure (% of GDP)	9%
Spending on prevention (% of health expenditure)	Unknown
Out-of-pocket spending on health (% of health expenditure)	33%

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years. The Department of Health Information and Statistics of the Ministry of Health provides health-related data on utilization of services and health facility reporting.

In **Singapore** the responsibility for public health mainly lies within the Ministry of Health and the Health Promotion Board[83]. In addition to these organizations, other involved governmental organizations are the National Environment Agency and the Urban Redevelopment Authority. Singapore has a Healthy Living Master Plan, which was drafted using feedback from a wide range of community members and professionals to ensure that the perspectives and needs of citizens were at the forefront. This plan was completed in 2014 with a vision for 2030[84]. This plan emphasises health that is natural, effortless, and accessible to all Singaporeans through creating healthy environments, communities, and increasing the affordability for healthy living options. Various organizations collaborate on public health, such as schools, employers, religious organizations, community centres and grassroot organizations. For some issues there are public consultations. Singapore does not have one universal Public Health legislation but several, such as the Infectious Diseases Act[85], the Environmental Public Health Act, Sale of Food Act[57] and the Health Promotion Board Act[86]. They also have many laws governing unhealthy behaviours such as an anti-smoking law, alcohol consumption law, and misuse of drugs laws. The responsibility to enforce these laws is with the National Environment Agency, Tobacco Regulation Branch, Health Science Authority, and Central Narcotics Bureau. The Ministry of Health and Health Promotion Board periodically conduct national surveys to gain insights in the health status and lifestyle of Singaporeans and are responsible for sharing data to appropriate stakeholders and service providers.

Singapore

Land area	709 km²
Population (millions)	5.7
Population ≥65 years	13%
Governance system	Parliamentary republic
Life expectancy at birth	83 years
Healthy life expectancy	74 years
Type of health system	Universal public insurance
GDP per capita (PPP-corrected USD)	$98520
Health expenditure (% of GDP)	0%
Spending on prevention (% of health expenditure)	Unknown
Out-of-pocket spending on health (% of health expenditure)	30%

The Aletta Jacobs School of Public Health is a joint partnership of the University of Groningen, UMCG, the Hanze University of Applied Sciences and NHL Stenden University of Applied Sciences

4.5.2 Resource generation

The second building block is resource generation, which mainly covers the health workforce and availability of products necessary for the delivery of healthcare services. Table 6 provides an overview of the different professionals working in public health for the included countries, categorized following British Columbia's framework into consultants/ specialists, frontline workers, managers/supervisors and medical health officers. Consultants/ Specialists are those with advanced education and training in a particular domain in public health and provide expert advice and support to the other public health professionals[87]. Frontline workers are defined as individuals with post-secondary education in public health and work directly with patients and communities to execute public health care functions[87]. Managers/ supervisors are often responsible for oversight of major public health programs or functions and often have staff reporting to them[87]. Medical Health officers are trained physicians with a legislative responsibility for monitoring, preventing, and controlling communicable and chronic diseases and thus play a leading role in the public health system[87].

Table 6 overview of professionals working in public health and public health training institutes

	Consultants/specialists	Frontline workers	Managers/ supervisors	Medical health officers	Public health Institutes & Programmes
Denmark	Regional councils	Nurses, health visitors, doctors, dentists, psychologists, dieticians, physiotherapist, and occupational therapists	Managers in municipalities	Staff in Danish Health Authority	University of Copenhagen – School of Global Health & Public Health University of Southern Denmark- Public Health Aarhus University- Public Health Danish National Institute of Public Health- PhD Public Health training
England	PH intelligence analyst, epidemiologists, PH consultants, PH research analysis/ assistants, PH specialists, PH specialist registrars, Dental PH consultants	Registered nurses, school nurses, PH nutritionists, PH practitioners, GPs, Health Visitors	Directors of public health, regional directors of public health	Deputy chief medical officer and Chief medical officer	Various universities, such as the London School of Hygiene and Tropical Medicine Health Education England

	Consultants/specialists	Frontline workers	Managers/ supervisors	Medical health officers	Public health Institutes & Programmes
Italy	National institution of Health, medical doctors, health scientists, epidemiologists, and technicians	GP's, psychologists, nurses, health care assistants, technicians, and administrative personnel, social workers, educators, occupational therapists, and rehabilitation workers	States and regions governing bodies	Local health units	University of Milan- Public Health University of Verona-Diagnostic and Public Health Catholic University of the Sacred Heart- School of Public Health University of Bologna- School of Health Policies
Latvia	Epidemiologist, public health specialist, data analysts, health economists, environmental specialists, and lawyers	GP, nurses, psychologists, nutritionists, social workers	Coordinators of health promotion	State operational medical comity (OECD,2022)	Rīgas Stradiņa University- Institute of Public Health
Netherlands	Epidemiologists, , medical environmentalists medical technical staff, toxicologists, quality officers, health scientists, policy analysts	Public Health physicians, paediatricians, public health nurses, speech therapists, psychologists, dental preventive staff, occupational therapists, social nurses, psychiatric nurses, social workers, prevention workers, switchboard operators, Central Post Ambulance	Minister, alderman, Director of public health (of municipal health service, GGD)	N/A	No public health programmes

	Consultants/specialists	Frontline workers	Managers/ supervisors	Medical health officers	Public health Institutes & Programmes
Australia	Policy analysts and officers (including public health trained specialist, (health) economists, epidemiologist, medical officers.	GPs, nurses, Aboriginal health workers, mental health workers, social workers, psychologists, allied health workers (dental hygienists, physiotherapists)	Administrators	Chief Medical Officers; Chief Health Officers	University of Sydney- School of Public Health University of Queensland - School of Public Health University of Technology Sydney- School of Public Health University of Adelaide- School of Public Health University of New South Wales- School of Population Health University of Melbourne- School of population and Global Health University of Western Australia- School of Population and Global Health University of Newcastle- School of Medicine and Public Health Monash University – School of Public Health and Preventative Medicine Royal Australasian College of Physicians- Australasian Faculty of Public Health Medicine

	Consultants/specialists	Frontline workers	Managers/ supervisors	Medical health officers	Public health Institutes & Programmes
British Columbia, Canada	Epidemiologists, environmental health scientists, evaluators, nurse, health inspectors, practitioners, and advanced practice nurses	GP, PH nurses, PH/ environmental health officers, PH dietitians, dental hygienists, nutritionist, public health dentists, social workers, and health promoters	PH administrators and population health directors	Chief medical officers	University of British Columbia- School of Population and Public health University of Northern British Columbia- Community Health University of Victoria – School of Public Health & Social Policy Simon Fraser University- Population and Public Health
Chile	Epidemiologist	GP, registered nurses, dietitians, psychologists, dentists, physiotherapists, social workers, speech therapists, pharmacists and midwives	Local health care service administrator, Health services coordinator	Vice-Minister for Public Health, (OECD,2019)	University of Chile - School of Public Health
Singapore	Epidemiologists, statisticians	GP, nurses, dentists, physiotherapists, pharmacists	Programme administrators in Ministry of Health and Health Promotion Board	Director of medical services, Director-General Public Health	National University of Singapore- Saw Swee Hock School of public health

In **Denmark**, the regional councils function as advisors to the municipal councils to ensure they are able to fulfil their public health obligations[88]. The municipal council serves as a supervisor role and is responsible for establishing preventative and health promoting services for the populations they serve[88]. Nurses, health visitors, doctors, dentists, psychologists, dieticians, physiotherapists, and occupational therapists make up the frontline professionals involved in the Danish public health system. These professionals are trained regarding vulnerable populations and have access to continuing professional development.

England's public health consultants/specialists are public health intelligence analysists, research analysists/assistants, epidemiologists and public health consultants. Their frontline workers include GPs, registered nurses, school nurses, public health nutritionists, and public health practitioners. Directors of public health and regional directors of public health have a supervisory role on the public health system. Their deputy chief medical officer and chief medical officer are responsible for managing the overall public health system regarding monitoring and prevention of diseases and are the most senior government advisors on all health matters. Public health professionals receive training on vulnerable populations and have access to continuing professional development including through UK's public health registry offering more than 100 programmes. All registered public health consultants must demonstrate annual continuous professional development to be in good standing with the Faculty of Public Health, a membership organization for all public health professionals across the UK and around the world[89].

The NHS in **Italy** consults the National Institution of Health, medical doctors, health scientists, epidemiologists, and technicians. Frontline workers such as GPs, psychologists, nurses, health care assistants, technicians, and administrative personnel make up the local health units. In some cases social workers, educators, occupational therapists, and rehabilitation workers may be involved as in cases for mental health promotion and care. The states and regions act as managers for the public health system as they are responsible for public health and the local health units can be regarded as the medical officers providing guidance and oversight. Both training for vulnerable populations and continuing professional development programmes are available. The National Continuing Education commission (ECM) is legislation for obligatory continuing education for health professionals to meet national goals and to be up to date on the needs of the patient, needs of the health services, and their own professional development.

In **Latvia** epidemiologist, public health specialist, data analysts, health economists, environmental specialists, and lawyers serve as consultants or specialists. Healthcare providers such as family doctors, specialist doctors, nurses, psychologists and nutritionists make up their core frontline workforce. Coordinators of health promotion oversee public health programs and the state operational medical committee which ensures appropriate health measures are in place to prevent and control the spread of disease and management of chronic diseases[90]. No continuing professional development programmes are available and although there is attention to working with vulnerable groups in vocational training, this is not something public health specialists are trained for specifically.

There are various health professionals working in public health in the **Netherlands**. On the policy side, there are consultants/specialists such as epidemiologists, researchers, policy advisors. Key frontline workers include paediatricians, (paediatric) nurses, and public health doctors. There are systems available for continuing professional development, which is mandatory for medical professionals, which also includes training regarding vulnerable populations. On the national level, various organizations are involved with public health, such as the National Institute for Public Health and the Environment, the Council for Health and Society and the Trimbos institute. On the regional level, there are 25 municipal health services which execute many public health tasks that have to be carried out by the 352 municipalities. These services employ both health professionals that see patients, and employees with roles

in research and policymaking.

In **Australia**, policy analysts and officers function as consultants in the public health system and may have a range of different qualifications including epidemiologists, (health) economists, medical officers, sociologist and biostatisticians. They have the responsibility to draft health promotion programmes. Doctors, nurses, mental health workers, social workers, and Aboriginal health workers make up some of the core frontline workers. Administrators take on a supervisor role in public health ensuring policies and programmes are implemented. The Chief Medical Officer is the principal advisor to the government responsible for health protection of citizens and this role is replicated in each of the states under the title of Chief (Public) Health Officer. Public health workers do receive continuing training, but this varies depending on the profession, including dedicated training regarding vulnerable populations.

In **British Columbia**, consultants are epidemiologists, environmental health scientists, evaluators, nurses, practitioners, and advanced practice nurses. Frontline workers are GPs, public health nurses, public health/ environmental health officers, public health dietitians, dental hygienists, social workers, and health promoters. Managers and supervisors are public health administrators and population health directors. Medical health officers have the most senior position in public health and are responsible for monitoring the health of the population and providing independent advice to the ministers and public officials on public health issues. Public health professionals receive training regarding vulnerable populations such as cultural safety training and must also engage in continuing professional development as required by employers or licencing authorities. Institutions such as the British Columbia Centre for Disease Control is a leading information body to provincial and national health authorities by providing surveillance, detection, treatment, and consultation services. The population-public-health surveillance team collects, analyses, interprets, and disseminates data about the population's health (i.e., health status, risk factors, and socioeconomic status).

Professionals working in public health in **Chile** are in the health districts, where epidemiologists are employed; on the municipal level, where community prevention plans are drafted; and within primary health centres, where epidemiology liaisons are employed in addition to primary healthcare providers who offer health services for individuals. GPs, registered nurses, dietitians, psychologists, dentists, physiotherapists, social workers, speech therapists, pharmacists and midwives make up the essential frontline workers[91]. Local health care service administrator, and health services coordinator supervise public health programmes and functions. The vice-minister for public health functions as their chief medical officer[81]. There are systems for continuing professional development, but for the most part they are self-funded. The main motivation for state-funded continuing professional development programmes is for health professionals to further specialize and gain residency as a specialist healthcare provider. The training regarding vulnerable population is heterogenous across the country.

In **Singapore**, epidemiologists and statisticians have a consultancy role whereas doctors, nurses, pharmacists, and physiotherapists are essential frontline workers in public health. The director of medical services can be regarded as the chief medical officers in Singapore. For health professionals continuing professional education is mandatory to renew their licenses, and they receive training regarding vulnerable populations.

4.5.3 Financing

The third building block concerns the financing of the public health system. In paragraph 4.2 we already provided an overview of the expenditure on preventative care for most of the countries we included. In this part, we dive deeper in how these funds are raised and how they are spent in each of the countries.

The **Danish** public health system is funded through national and local taxes at the level of municipality. Municipalities raise their own taxes and receive funds from the national level but can also apply for additional, earmarked funding from national sources (*SATS pulje*). Hospitals receive a fixed budget which is adjusted for population characteristics as well as payments for specific services such as diagnosis related groups. General practitioners receive capitation fees and fee-for-service payments for services such as vaccinations. National government, regions, and municipalities complete yearly budget agreements which are driven by the health targets outlined by the Health Promotion Packages[58].

Public health in **England** is funded by general taxation and users do not have to pay out of pocket for public health services. The department of Health & Social care allocates these funds to the NHS for public health spending. Local authorities may receive funding for public health through a Public Health Ring Fenced Grant based on the populations needs to ensure they can provide the mandated services. In addition, local authorities produce Joint Strategic Needs Assessments to assess the current and future health, care, and well-being needs of the local community to inform local decision making.

Italy's public health system is primarily financed through corporate tax which is pooled nationally but allocated to each region. A fixed proportion of national value added tax revenue collected by the central government can also be redistributed to regions who have inadequate funds to provide essential level of care. Regions are also allowed to generate their own additional revenue. Annually, the Standing Conference on Relations between the states, regions, and autonomous provinces set criteria for allocation of funding to regions. Italy's "budget law" communicates to parliament about public expenditure and the revenue foreseen for the following year according to the laws in force and this helps guide the public health financing. Italy's current health expenditure reflects the national health needs. The level of health needs is determined through regulatory interventions and agreements between the states and regions. In 2013, the standard cost methodology was implemented in legislation and aimed to improve the allocation of resources, analysis of situations of inefficiency or inadequacy (compare between regions) and provide elements for evaluating programmes.

The **Latvian** healthcare sector is funded publicly through general taxation for about 61%, while out-of-pocket funding is used to cover over a third of health expenses. GPs are paid using a mix of a per-capita allocation and quality bonuses, which include health prevention. No specific funding is allocated to preventive care and health promotion. For some programmes, such as influenza vaccinations, specific target audiences have been identified that are offered the intervention free of charge. For other programmes, NGO's deliver public health programmes in the domains of mental health, diabetes, oncology, and HIV for example.

The **Dutch** national government finances public health through funds for the municipal fund, which is then distributed to the municipalities. Municipalities also have limited options to tax their inhabitants. The national government also funds specific policy programmes that can be carried out by the municipalities or other organizations. The municipalities decide on the funding of the municipal public health services. Municipalities with an older or less healthy population, receive more money from the municipal fund. As municipalities have very tight budgets, this is a risk for the stable allocation of funding to public health services. The National Institute for Public Health and the Environment is funded through the Ministry of Health. Public health services are free for everyone who is considered the target audience, but some services are paid out-of-pocket, such as traveller's vaccinations.

Various levels of funding are available for public health in **Australia**, including national, state, local, private, and charitable funding. Funding is allocated through a mix of evidence, policy windows, political preferences, and public demand and fixed at a department level. Vaccination and screening services are provided free of charge, as well as all services provided by public hospitals. Out-of-pocket spending in Australia is rather high, especially for specialized medical services that are provided by private practitioners. Health spending from public means is drawn mostly from progressive income taxes. Contracts with local health networks are based on local demographics.

Most of the public health system in **British Columbia** is financed through provincial taxation. A portion of the health sector funding also comes from a transfer to provinces from the federal government (Canada Health Transfer). The provincial government can distribute this funding for health care through the Ministry of Health with the approval of the members of the provincial democratic institutions. Out of pocket funds are not requested for public health services. The revenue collection is through progressive income taxes and consumption taxes. The funds are allocated to public health providers through regional health authorities and the Provincial Health Service Authority with program-based funding from the provincial government. For services such as immunizations, physicians are paid in three different ways; fee-for-service, Ministry of Health's alternative payment programme, and rural programs. While funding for public health services varies amongst the regional authorities their funding is sufficient and stable. These funds are delivered by the ministry which uses the previous year's funding as a base, then assesses where the government must support each health authorities regarding its commitments such as funding for new facilities or wage increases. The unallocated funding is then allocated using a population needs-based funding tool. This assess the health needs based on factors such as population size, age structure, and health status, where services are delivered, and cost adjustment factors.

Healthcare in **Chile** is funded through both a public health fund and private coverage schemes, through contributions from employed persons. About half of overall healthcare expenditure is paid out-of-pocket. Certain public health services, such as vaccinations, are fully covered by the government.

In **Singapore**, the public health system is mainly financed through general taxation. Vaccinations for children and some screenings are provided free of charge, such as tuberculosis screening. Other screening programmes are also funded through co-payments, including chronic diseases and cancer. Except for private providers, public health providers are salaried government employees.

4.5.4 Service delivery

The final building block concerns the delivery of public health services. Here, we make a distinction between the delivery on the individual level, e.g., a consult between a doctor and a civilian, and policy level interventions with the aim of reaching many civilians simultaneously. The latter are often specific programmes, for example to promote a healthy lifestyle. An overview of providers delivering public health services for the included countries is displayed in Table 7.

Table 7 providers of public health services at the individual and the policy levels

	Individual-level	Policy level
Denmark	GPs, hospitals, school nursing services, public health centres, community mental health services (*socialpsykriatrien*), health visiting services	Municipality medical services
England	GP practices, schools, families own home, primary care centres, secondary care centres, local health authorities, voluntary organizations, health visiting services, dental practices	Governmental institutions, NHS England, Academic public health institutions
Latvia	GP practices, vaccination centres.	Governmental institutions, specialized institutes, laboratories.
Italy	GP practices, public hospitals, local health unit, private hospitals affiliates with the Public Health System	Governmental institutions (Ministry of Health, regional governments)
Netherlands	Child health clinics, STD clinics, municipal health service office, schools, GPs	Municipal health services (GGD), National Institute for Public Health and the Environment (RIVM)
Australia	GPs, hospitals, schools, community health clinics	States, local governments, Communicable Diseases Network Australia
British Columbia	Community/public health units, community health centres, primary care homes, schools, street clinics, youth centres, nursing outposts, GP offices, certain pharmacies.	British Columbia centre for disease control, population-public-health surveillance team
Chile	Primary health centres, rural clinics, schools, Therapeutic Diagnostic Centers, Health Reference Centers, hospitals	
Singapore	Schools, workplaces, primary care facilities, GP clinics and community care clinics	Health Promotion Board, National Environment Agency, Urban Redevelopment Authority

In **Denmark** the responsibility of public health delivery is with the GPs, hospitals, and municipalities. GPs provide services such as screening programmes and vaccinations, while hospitals provide disease-specific prevention as well. General prevention and health promotion is the responsibility of the municipality, services are delivered in schools, public health centres, and the community setting, e.g., through community-based mental health services. The integration of the public health system is relatively high with the overall healthcare system. To ensure quality, the Danish Quality Model has been designed to integrate and systematize existing quality initiatives. This serves to create standards in hospitals and patient treatment but can also be applied to private practitioners and municipal health services. The Danish Institute for Quality and Accreditation in Healthcare holds the standards and indicators for quality service delivery by health professionals. Data generated through the Danish Model is available for sharing

amongst health professionals and the public. This Model serves to make information readily available for those who need it.

In **England**, public health services are delivered in a range of settings such as schools, families own homes, local community or primary care settings, and secondary care settings. The UK Health and Security Agency is responsible for prevention, detection, and leading response in health protection. The Chief Medical Office leads the national efforts in health promotion and prevention and is responsible for data and monitoring of policy. NHS England is responsible for various public health services such as immunization and screening. Local authorities are responsible for improving the health of their local population by providing them with adequate public health services. All public health service providers are required to register with the Care Quality Commission. All diagnostic laboratories must be accredited by the UK Accreditation Service to ensure they meet several mandatory internal standards.

Public health services are delivered in the local health authorities' health units in **Italy**. These autonomous bodies organize and plan the health care system for specific areas for the population they serve. Vaccinations or screenings are carried out in health units, but GPs also carry out public health activities in their own offices. Italy's Ministry of Health is the central governing body of the NHS which is responsible for the functions of the states and regions in their execution of public health measures. The NHS covers all citizens, legal foreign residents, and undocumented immigrants for urgent and essential services. The aim of health protection is a goal of the social systems in both the public and private sectors. The National Health Plan requires collaboration with many professionals working in the public health system which is seen through integrated networks. These integrate the various levels of prevention and care to ensure appropriate coordination and continuity of health care and social services. The National Health Plan indicators allow for proper monitoring of health services to ensure goals are being met and services are delivered equitably.

In **Latvia**, the organizations delivering public health services are quite broad: from the Ministry of Health on the national level, to local governments, NGOs and private enterprises. The level of collaboration between the various organizations depends on the specific issue and seems to be best established for infectious diseases. Public health services are delivered for individuals at GP practices, vaccination centres and private centres. On the population level, there are governmental institutions and specialized institutes and laboratories.

In the **Netherlands**, the municipal health services deliver most public health-oriented services. The most prevalent patient-oriented public health centre is the child health clinic, which is mainly focussed on children (e.g., vaccination and screening programmes). In most regions, there is a child health clinic within a 10-20 km radius. Although everyone can receive public health services free of charge, there are groups that are more difficult to reach, such as elderly with a migration background. There are quality systems for the municipal health service, registrations for health professionals and guidelines for care processes.

On the policy level, the states are mainly responsible for the delivery of public health services in **Australia**; with many programs delivered by local health authorities that have contractual agreements with state governments to deliver those services. Examples include early childhood and community health clinics. Local governments monitor sanitation and hygiene, food safety and water quality. Patient-level health services are delivered mainly through the standard health system, usually through GPs. During the pandemic, there were specialized public health services, such as mass vaccination hubs. Certain services, such as childhood screenings, may occur in schools.

British Columbia's public health system is integrated and complementary to the overall healthcare system with a population health, health promotion and disease prevention lens. Public health services can be delivered in a wide range of settings such as community/public health units, community health centres, or primary care homes (in some areas of British Columbia), schools, street clinics, youth centres, nursing outposts, GP offices, and approved pharmacies depending on the service. The Ministry of Health ensures overall quality and that appropriate, cost-effective, and timely health services are available for its citizens. The ministry's Population and Public Health division is key for the provincially coordinated and regionally delivered public health system which in turn are responsible for health service delivery. However, the First Nations Health Authority is only responsible for service delivery and improvement of health outcomes for First Nations peoples in British Columbia and have their own goals and indicators. Regarding quality assurance of public health delivery, the Provincial Health Officer is responsible for monitoring the population's health and advises the ministry and public health officials of emerging issues.

In **Chile**, Regional Ministerial Secretaries (SEREMIS) and the primary healthcare networks are responsible for delivering public health services. The main entry point for these services is through primary health centres. Vaccinations are delivered through schools within the School Vaccination Programme. Although the primary care network is integrated with secondary and tertiary levels of care, the coordination with the public health services is often not clearly defined.

In **Singapore**, service delivery is monitored through the submission of indicators, e.g., on mortality and re-admissions. The public health system is integrated with the regular healthcare system, while the Health Promotion Board offers education and training resources. Public health services are usually delivered within schools and workplaces, in collaboration with primary care facilities and within the community. While quality assurance measures are well established for healthcare providers, they are less established for health promotion activities.

4.6 Limitations and tensions related to public health

With respect to any system, there are always points for improvement. There is agreement amongst all country agents that more effective governance and funding for public health is required. Regardless of a centralized or decentralized health system within the compared countries, there seems to be a common lack of organizational clarity. This comment directly relates to the building block of governance and as previously mentioned, this is key to the success of all subsequent blocks. Some countries express there is lack of organizational leadership and dialogue between various actors in governance for public health. That may be between different ministries such as education or finance, or even within the same ministry. Similarly in our results, it is not often clear who is responsible or accountable for the public health goals. This can then lead to confusion of responsibilities and may impact the performance of the public health system directly. Another issue which emerged was related to data collection, sharing and utilization. As we are well into the 21st century, there have been major rapid advancements to be able to collect and utilize data for health system performance and for the health status of the population it serves. While many countries have advanced systems in place, there are still gaps which remain regarding sharing the data with key actors as well as utilizing it to drive policy.

Funding for public health is relatively low in all countries and this fact is acknowledged as a weakness in all health systems by country agents. The low public funding available makes it so some countries have to charge for basic public health services such as cancer screenings. Others have structures which favours certain socioeconomic groups over others which may increase health inequities. Investment in prevention and early detection is deemed important by all country agents to better optimize population health outcomes and reduce health inequities.

4.7 The role of public health in the overall health system

4.7.1 Health data sharing

In **Denmark** electronic medical records are available to all individuals and health professionals. Additionally, a unified health data portal is available for researchers and policy makers. The data infrastructure is regarded as having played an important role in dealing with the COVID-19 pandemic[92]. In **England** there is a legal framework covering how patient data is handled and processed. This requires the data collection and processing to be transparent, fair, and lawful, that is there must be a lawful basis for obtaining and using the data. In England patient data entails information on tests results and information for various healthcare providers to discuss appropriate treatment options with patients and carers[93]. In **Italy**, the New Health Information System is a universal system of electronic records connecting all levels of care. It also serves to monitor and evaluate the NHS. Some regions have developed electronic networks to facilitate communication between various health service providers to improve continuity of care. Few regions have developed personal health records for patients to access their medical information (i.e., prescriptions, hospital discharge instructions). In **Latvia**, there are regulations on a unified electronic information system within the health sector[94], but in practice, the data exchange between various healthcare providers is limited to mostly electronic prescriptions for drugs, sick leave certificates and GP referrals. In Latvia, there are regulations on a unified electronic information system within the health sector[94], but in practice, the data exchange between various healthcare providers is limited to mostly electronic prescriptions for drugs, sick leave certificates, and GP referrals. In the **Netherlands**, every four years the 25 municipal health services collect local, regional, and national data on population health, social status, and lifestyle. This data is shared amongst key decision makers to drive policy. For health care providers there is a computer system (*"Landelijk Schakelpunt"*) which is used to share patient data between providers of healthcare. **Australia** has system wide reporting on population health and health care performance across all states and territories. Patient data is often stored at the GPs office but is slowly being integrated into a single standard medical record. Local hospital networks also store data providing data sharing opportunities for local public hospital districts, primary care providers, schools, and private hospitals. The National Health Agreement facilitates data sharing amongst states and the federal government. In **British Columbia**, health data is available for all health system partners such as health organizations, public bodies, or researchers. Their Health Data Platform provides anonymized data on a single platform supporting the flow between research and analysis between the health sector and academia. All data is governed by legislation and governing policies. In **Chile**, health data sharing is not formally established across health institutions, however, there are some specific examples such as a COVID-19 pass. Public health providers in Chile are integrated in the health care network, but no national framework is available to share data across health providers. In some health districts common IT services do facilitate the sharing of information. An exception is the Immunization Registry, which is an integrated system that provides data on vaccinations for the whole Chilean population. In **Singapore**, public health data is readily available on the Ministry of Health's webpage. Here there is information on various health system indicators as well as resources for the public and healthcare professionals. Patients can also log-in to view their personal health and appointments.

4.7.2 Role of GPs in the public health system

In **Denmark**, GPs are responsible for screenings and vaccinations. For example, new-born screening, and HPV or influenza vaccinations can all be done by GP in their office. In **England**, the GPs serve to facilitate screenings (i.e., cervical cancer screening) as patients registered to a GP will receive regular reminders for when they are required to have a screening. GPs also serve to diagnose and test for diseases and illnesses as well as provide vaccinations if needed. In **Italy**, GPs working at the local health units or in their own practice can administer vaccinations and

screenings. In **Latvia**, GPs have an important role regarding screenings and receive €2 per screening for patients aged below 65 or €1 for those over 65 years old[95].In Latvia, GPs have an important role regarding screenings and receive €2 per screening for patients aged below 65 or €1 for those over 65 years old[95]. In the **Netherlands**, the public and primary health systems are quite separate, although there seems to be a trend to increase integration of public health with curative health. GPs provide vaccinations for the elderly and are paid per vaccination. In **Australia**, GPs are a main entry point to the public health system, also for preventive services such as screenings. For example, a GP may refer a female patient to a breast screening service. In **British Columbia**, GPs can screen and vaccinate individuals for a variety of conditions. In **Chile**, preventive screenings ("*Examen de Medicina Preventiva*") and some vaccinations are delivered through primary care centres and rural health clinics. In **Singapore**, the Ministry of Health works closely with GPs particularly for screenings and vaccinations which are often delivered in their offices.

4.7.3 Embedding of public health in the mental health system

The **Danish Health** Authority focuses on the treatment of mental illness and early interventions. The "*socialpsykiatrien*" organizes community based mental health interventions. In **England**, mental health is an integrated part of the goals defined by Public Health England: promoting good mental health, preventing mental illness and suicides[23]. The Prevention Concordat for Better Mental Health is a programme that is facilitating local and national action around mental health promotion[96].The Prevention Concordat for Better Mental Health is a programme that is facilitating local and national action around mental health promotion[96]. **Italy** has a Mental Health Services Network which is under the Department of Mental Health, a set of structures responsible for the care, assistance, and protection of mental health within each defined local health authority[97]. Mental Health Centres are known to be the first reference point for citizens as they coordinate all interventions related to prevention, treatment, and rehabilitation. The National Prevention Plan also includes promotion of mental well-being for all citizens throughout all stages of life[98]. There is also an explicit Mental Health Plan (2022-2027) which outlines mental health promotion and prevention activities[99]. **Latvia's** mental health system is integrated into all levels of health care. Primary care focuses on prevention, early diagnosis and treatment. The Plan for Improving of Availability Mental Health Care also focuses on promotion and prevention of mental health. Since 2021, Latvians have an opportunity to receive state-funded psychological and psychotherapeutic assistance to overcome the increased burden of mental illness since the COVID-19 pandemic. Additionally, resources are available for GPs to learn how to identify and support patients with mental illness[100]. In the **Netherlands**, youth health care professionals are working to prevent mental health problems in children and have a role in the early detection of problems. The public mental health care, which focusses on patients that cannot be reached by the regular mental health system, often is part of the municipal public health services[101]. In the Netherlands, youth health care professionals are working to prevent mental health problems in children and have a role in the early detection of problems. The public mental health care, which focusses on patients that cannot be reached by the regular mental health system, often is part of the municipal public health services[101]. In **Australia**, mental health inpatient and outpatient services are most often provided through public hospitals. There is a dedicated mental health commissioner with a formal position to guide policy on mental health issues. Policy is implemented through several programmes and services. A main strategy is the National Mental Health and Suicide Prevention Plan. **British Columbia's** guiding public health framework includes mental health promotion and prevention as well as prevention of harms associated with substances. The Healthy Minds, Healthy People plan addresses mental health and substance use in British Columbia with a focus on lifelong mental wellbeing. This plan involves partnership across all sectors and communities. Namely the Ministry of Health's efforts for harm reduction, mental health promotion and integrated primary and community care[102]. In **Chile** the first National Mental Health and Psychiatry Plan was introduced in 1993 and served to integrate mental health care in primary healthcare. The current National Mental Health Plan (2017-2025) emphasises a community-based approach to mental health care and to adhere to

standard human rights principles[103]. Mental health is also incorporated to broader public health policies such as "*Chile Crece Contigo*" or "Chile Grows with you", which is an integrated system of social interventions that fit the needs of a child, family or community[104]. In Chile the first National Mental Health and Psychiatry Plan was introduced in 1993 and served to integrate mental health care in primary healthcare. The current National Mental Health Plan (2017-2025) emphasises a community-based approach to mental health care and to adhere to standard human rights principles[103]. In **Singapore**, the Institute of Mental Health is the designated mental health hospital which also serves to provide guidelines and support for the community. In 2006, the National Mental Health Blueprint was created with a focuses on promotion, prevention, early detection and treatment of mental health[105]. The Community Mental Health Masterplan was created to complement the existing plan but focus more on mental health care in the community, care close to home. These plans shifted the focus from institutionalized care to community care[106].

5. Discussion

This is an up-to-date review on public health policies and practices based on nine countries around the world. Previous work is dated, limited to Europe, focuses on health only, and/or lacks information sources[107–109]. We provide a conclusive comparison with high levels of detail and insight into the themes and focus of public health in each country. We highlight the similarities and differences amongst each of the countries and current areas which need attention. From a previous public health system comparison (2012) performed by the WHO European Observatory, information was not as accessible and was a major obstacle in understanding how each country views public health and the policies and practices in place[109]. Over the last decade since information has been digitized and more transparent, we were able to leverage on both scientific and grey literature to gain insight into the public health structure in all country. We also used country agents, experts in public health policy, to provide context and validate our findings for each country. This allowed us to identify even more relevant and up to date policies and visions which were being drafted since the COVID-19 pandemic.

This research is not without limitations. First it is important to clarify this is a comparison of public health policy only. While we take note of each country's public health vision, governance structure, workforce, and service delivery, we do not assess if indicators are reached nor the actual overall performance of their public health system. Similarly, we do not assess if mechanisms are in place such as forums for citizen participation on policy development or laws mandating private sectoral participation are indeed utilized. However, understanding the underlying health system structure in each country is a necessary to move forward with any such performance reviews. By identifying these building blocks in place, we give space to discuss what aspects are lacking and where improvements can be made on the policy level. For example, while it is clear all countries have a vision and goals, there is no clear indication on who is accountable for achieving these goals. Thus, future work can be directed towards filling the gaps that exist on the policy level, which will ultimately impact the citizen level.

Next, we would like to mention the use of the WHO health system framework to assess the public health of each country[9]. As this framework was originally intended to assess complete health systems, we found it may not fully capture the scope of public health. Not all countries have a defined public health system but rather it is an extension of their health system, and primary care and prevention often overlap. Also, the building blocks are mainly dealing with issues related to the health system, while they are not necessarily designed to capture information on health from the full societal level, including other policy domains.

While this is an international comparison, only nine countries are present and are not a conclusive representation of the different public health systems that may exist. These countries were selected on expert opinions rather than performance indicators themselves. As the countries were both culturally and geographically distinct and have varying governance and health systems, we believe this research provided lessons that are quite generalizable to many public health systems in developed countries. Of course, within developing countries the relevant health-related issues are quite different from developed countries; this could be a topic for a follow-up research project.

With the aforementioned points in mind, we highlight strengths and limitations of this study. While we highlight the policies in place and areas for improvement, we showcase how these countries while different contextually have many overlapping practices in place. Thus, this research can pave the road for future developments in the field of public health policy assessments.

6. Conclusion

Using the WHO Health System Performance Assessment (HSPA) framework[9], we compared the public health systems of nine countries. An important lesson from this comparison is that a strong public health system has the potential to strengthen society as a whole, as health becomes an integral part of the whole government. This approach differs from medicine on a fundamental level, in that it is not focussed on curing patients, but preventing citizens from becoming patients in the first place. The introduction of clear health-related goals is fundamental in having health through all policies, as it can be used to align all actors within a health system. Focussing on outcomes, rather than outputs, and ensuring that decision makers are accountable for reaching the goals, are important aspects in improving the health of citizens.

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Appendix I

Questionnaire 'Public health system comparison'

Public health system comparison

Country expert form

Thank you for agreeing to participate in this comparison between public health systems. Below are questions on five different themes: **governance**, **resource generation**, **financing**, **service delivery** and **final questions**. We ask you to fill in the various questions to the best of your ability, **if possible, please provide references**.

This form is a fillable PDF, meaning you can input your replies in the text boxes below the questions. We recommend using Adobe Acrobat software for this, the free Acrobat reader can be downloaded here.

After you filled in the form, replies can be sent to Simon van der Pol - s.van.der.pol@umcg.nl. **Any questions** you may have can also be sent to this address.

Definition of public health

For this research project, we use the definition of public health from the World Health Organization:

"The science and art of promoting health, preventing disease and prolonging life through the organized efforts of society".

Country / state

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Theme 1: governance

1. Is there a national health sector policy / strategy / plan with goals and targets?

- ○ Yes
- ○ No
- ○ _____

2. What is the public health vision, including long-term measurable goals?

3. Does the public health policy / strategy / plan clearly mention indicators allowing for regular monitoring and evaluation? If yes, which indicators?

E.g. increase healthy life years by a certain amount?

4. Does the public health policy / strategy / plan include multisectoral coordination? If yes, how?

Deliberate collaboration amongs stakeholders to reach the goals set forth in the health policy

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5. Do key stakeholders participate during the preparation of new public health policies / strategies / plans and the review? If yes, which stakeholders are involved?

E.g. national/local governments, patients groups, medical professionals

6. Can you provide one great example of collaboration between the various stakeholders on a public health topic?

7. To what extent are communities, non-governmental organizations and the private sector involved?

8. Which mechanisms and dialogue platforms are in place to ensure involvement of key stakeholders in the health decision-making process?

E.g. legal procedures, online platforms to provide input

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9. Are relevant data collection databases available, such as health surveys, birth and death registration, census, health facility reporting, health system resource tracking?

- ○ Yes
- ○ No
- ○ _____

10. Can you provide a website where these data are publicly available?

11. How is data sharing arranged between various layers of government?

E.g. sharing of effects of policies that are recorded in national databases with local governments

12. How is data sharing arranged between various providers of public health services?

E.g. patient data

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13. Which legislation is applicable to the public health system?

E.g. applicable articles in the constitution, specific public health acts

14. Are existing public health laws aligned with the government's public health policies and plans?

- ○ Yes
- ○ No
- ○ _____

15. To what extent are measures taken to effectively implement and enforce public health legislation?

16. Regarding the governance, are there specific differences to the input above for urban planning?

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17. Regarding the governance, are there specific differerences to the input above for particulate matter?

18. Regarding the governance, are there specific differences to the input above for HPV vaccination and screening?

19. Regarding the governance, are there specific differences to the input above for annual and pandemic influenza?

20. Regarding the governance, are there specific differerences to the input above for mental health in the public health sector?

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21. Regarding the governance, are there specific differerences to the input above for the screening of diseases within children?

Theme 2: resource generation

22. Which professionals are involved in the public health system?

E.g. school doctors, psychologists, nurses, dentists, epidemiologists

23. Do public health professionals receive training regarding vulnerable populations?

- ○ Yes
- ○ No
- ○ _____

24. Are there systems for continuing professional development available for public health professionals?

- ○ Yes
- ○ No
- ○ _____

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25. If the previous answer was yes, please explain which professional development is available.

26. Which organizations are involved with public health?

E.g. specific public health centres, schools, municipalities

27. Where are public health services delivered usually?

E.g. specific publc health centres, the GP office, schools

28. What is the density of public health facilities?

Depending on the answer to the previous question, how many individuals do these facilities serve?

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29. Are pharmaceutical and other consumables available where and when needed?

- ○ Yes
- ○ No
- ○ _____

30. Regarding the resource generation, are there specific differences to the input above for urban planning?

31. Regarding the resource generation, are there specific differences to the input above for particulate matter?

32. Regarding the resource generation, are there specific differences to the input above for HPV vaccination and screening?

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33. Regarding the resource generation, are there specific differences to the input above for annual and pandemic influenza?

34. Regarding the resource generation, are there specific differences to the input above for mental health in the public health sector?

35. Regarding the resource generation, are there specific differences to the input above for the screening of diseases within children?

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Theme 3: financing

36. How is the public health system financed?

E.g. national funding, local funding

37. To what extend are out-of-pocket funds requested?

38. How are the funds allocated to the public health providers?

E.g. based on the population they serve

39. Are funds sufficient and stable?

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40. Is revenue collection and pooling equitable?

41. To what extent is the payment of providers driven by information on the health needs of the population they serve?

42. Regarding the financing, are there specific differences to the input above for urban planning?

43. Regarding the financing, are there specific differences to the input above for particulate matter?

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44. Regarding the financing, are there specific differences to the input above for HPV vaccination and screening?

45. Regarding the financing, are there specific differences to the input above for annual and pandemic influenza?

46. Regarding the financing, are there specific differences to the input above for mental health in the public health sector?

47. Regarding the financing, are there specific differences to the input above for the screening of diseases within children?

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Theme 4: service delivery

48. Which organization is mainly responsible for delivering public health services.

E.g. a dedicated public health organization

49. How is the public health system integrated within the overall health system?

E.g. referrals to primary care or specialized care

50. How do the professionals working in the public health system collaborate with other health providers (e.g. school doctors, general practitioners)

51. Which quality assurance measures are in place in regarding the delivery of public health services?

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52. Are the services delivered in an equitable manner?

Are all populations served?

53. Regarding the service delivery, are there specific differences to the input above for urban planning?

54. Regarding the service delivery, are there specific differences to the input above for particulate matter?

55. Regarding the service delivery, are there specific differences to the input above for HPV vaccination and screening?

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56. Regarding the service delivery, are there specific differences to the input above for annual and pandemic influenza?

57. Regarding the service delivery, are there specific differences to the input above for mental health in the public health sector?

58. Regarding the service delivery, are there specific differences to the input above for the screening of diseases within children?

Theme 5: final questions

59. What are you most proud of considering the public health system in your country?

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60. If there is one thing you could change in the public health system, what would that be?

61. Do you have any final comments relevant for this study?

Thank you for filling in the form. **The filled-in form can be sent** to Simon van der Pol - s.van.der.pol@umcg.nl. Any questions you may have can also be sent to this address.

Below is a submit button, which is used for internal reasons, you do not have to use this.

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