Overview of foresight related activities

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Executive summary

The Population Health Information Research Infrastructure (PHIRI) on COVID-19 seeks to lay the foundation of a federated research infrastructure on population health to support research across Europe to underpin public health policy decisions in current and future pandemics or crises. Through Work Package 9 (WP9), PHIRI aims at gaining insights in possible future health impacts of the COVID-19 outbreak, by building capacity on foresight studies. A foresight study refers to a broad range of methodologies to describe possible futures.

This report presents a brief overview of the results from Task 9.1. "*Overview of current foresight activities in Europe and beyond*". This task was led by Universidade NOVA de Lisboa (DGS/UNL), in collaboration with other task Partners: National Institute for Public Health and the Environment in the Netherlands (RIVM), Austrian Public Health Institute (GÖG), and the Croatian Institute of Public Health (CIPH). This report aims to present a general mapping of foresight studies in Europe, but also includes international studies and studies from other non-European countries.

To develop this inventory of foresight studies and related activities, different methods were used:

- A survey exploring existing projects in European Member States (MS), current capacities and potential needs for foresight, and identifying foresight experts,
- A mapping through a desk research and a literature review of public health foresight studies

As a result, public health foresight projects and studies were identified and pooled into an inventory. This inventory includes studies from most MS, studies from international organizations and research consortiums, and studies and projects from other non-European countries. Most of these studies focused on the current pandemic, COVID -19. However, foresight studies have also been used in other public health areas, more commonly to address challenges posed by noncommunicable diseases.

Results of this report also show the foresight capacity in Europe. These results pinpoint that few countries have a more established capacity and the need to develop this same capacity across other MS, particularly in those where no foresight studies have been conducted or identified.

This report provides an overview of the inventory foresight studies in Europe. Although many foresight studies have been used to address the current pandemic, these methods are being increasingly recognized and used for other public health areas. Therefore, recommendations from this report focus on the development and strengthening of capacity building on public health foresight at the European level.

Key points

The key points of this report are the following:

1. The inventory of public health foresight activities and initiatives in the European MS identified a set of scenarios studies, using modelling, preparedness, and other methods. Some of these foresight studies address COVID-19.

2. Studies using foresight in healthcare since the 1990's were found, where:
   - Scenarios analysis is one of the most frequent methodology
   - Often, the role of foresight studies is to provide information for decision-making: healthcare services, technology, determinants, capacity building, and health spending.

3. There is a limited number of foresight studies; however, the number of studies is growing year after year.

4. While some MS seem to have a more developed foresight capacity, other MS need to strengthen the current capacity while other countries need to fully develop foresight capacity.

5. Establishing a Public Health Foresight Network will strengthen the current foresight capacity in Europe while promoting continuous capacity building and sharing of experiences.

Glossary

- **Backcasting** starts a desirable future and then works backwards to identify policies that will connect that specified future to the present.

- **Baseline/Reference** refers to one particular projection or scenario that is often used to indicate differences between scenarios, taking this baseline as a gauge.

- **Distributed Infrastructure on Population Health** (DIPoH) is a European Infrastructure for population health information, facilitating open, interconnected and data-oriented population health research across Europe.

- **Forecast/Prediction** is the most likely projection and is based on the most likely set of assumptions. A forecast usually covers a short- or medium-term period.

- **Foresight** is a systematic, participatory, future-intelligence-gathering and medium-to-long term vision-building process aimed at enabling present-day decisions and mobilizing joint actions.

- **Horizon Scanning** is systematic detection of early signs of potentially important developments. These can be weak (or early) signals, trends, wild cards or other developments, persistent problems, risks and threats.

- **Population Health Information Research Infrastructure** (PHIRI) is a roll-out of the research infrastructure on population health information to facilitate and generate the

best available evidence for research on health and well-being of populations as impacted by COVID-19.

- *Projection* refers to model-derived estimates of future trends, given a set of assumptions.

- *Research Network* is an active network of national and/or regional experts from several countries that perform comparative research in a specific health area (information domain).

- *Scenario* is a coherent, internally consistent, systematic and plausible description of a possible future state of the world, often including the path towards that future.

- *Variant* can be seen as a projection without any judgement of the likeliness of the assumptions. This can also be classified as a what-if projection.

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PHIRI D9.1: Overview of current foresight activities in Europe and beyond

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I.   Introduction

The Population Health Information Research Infrastructure (PHIRI) on COVID-19 seeks to support research across Europe to underpin public health policy decisions in the current pandemic and future crises. PHIRI offers a European mechanism for structured exchanges to facilitate and generate the best available evidence for research on health and well-being of populations. It is a roll-out of the sustainable infrastructure supporting population health research and policymaking, the federated research infrastructure on population health (DIPoH).

PHIRI's Work Package 9 (WP9) aims to gain insights in possible future health impacts of the COVID-19 outbreak, by building capacity on foresight studies, supporting EU MSs to develop scenarios, building a network of experts on foresight methodologies, and draw lessons for the EU on using foresight studies to inform policymaking.

Foresight is a systematic, participatory and vision-building process that explores the future to anticipate future trends and support present-day actions. A foresight study comprises a broad range of methodologies to describe possible futures, such as scenario building (including business-as-usual scenarios and policy scenarios), horizon scanning, trend impact analyses, driver analyses, etc. The working definition used here is: "*Foresight is a systematic, participatory, future-intelligence-gathering, and medium-to long term vision-building process aimed at enabling present-day decisions and mobilizing joint actions*" (1). Additionally, foresight can be described as "*a university human capacity which allows people to think ahead and consider, model, create and respond to future eventualities*" (2).

Public Health Foresight Studies (PHFS) are research tools that can provide a better understanding of possible future developments allowing policy makers to anticipate and possibly influence trends in public health and healthcare (3). Since foresight studies often address longer-term impacts, PHFS can show how such (public health) developments may evolve over the years if pursuing a 'business-as-usual' course and to give alternatives for dealing with possible 'future societal challenges' (4). Therefore, in light of the current COVID-19 crisis, PHFS can provide understanding of possible (health) impacts of the current pandemic, which include (but is not limited to) the impacts resulting from COVID-19 induced changes in regular healthcare services delivery, in lifestyle, and in socio-economic developments. PHFS are a useful support to translating insights into policy actions.

The current crisis indicates that PHFS might be more necessary than ever. Thus, it is important to gain insights in the current public health foresight activities and capacities in the European Region, who is or wants to be involved in these activities, and the needs that exist to level capacities.

II. Aims

Task 9.1 has three aims:

1. To provide a thorough overview of foresight studies conducted in Europe and beyond.

2. To provide an overview of current foresight capacities in EU MS and potential needs for enhancing capacities for applying foresight methodology.

3. To identify experts and academics in the field of foresight studies to build a European Public Health Foresight Network (PHFN).

III. Methods

To map and develop the inventory of PHFS, two main methods were used:

A. A desk research and a systematic literature review were conducted to identify public health foresight studies in Europe and beyond.

B. A survey was developed and applied, to collect complementary studies (not easily identified by desk research or from peer-reviewed literature, such as PHFS in the national language), as well as potential capacity needs and professionals with experience and/or interest in PHFS.

In this, public health foresight is the central aspect; both COVID-19 and non-COVID-19 related activities were eligible. The methodology is further explained below.

A. Desk Research and Systematic Literature Review

1. Desk Research

The main aim of the desk research was to identify existing projects using public health foresight methodology (including those related to COVID-19), the characteristics of the methods used, and the organizations across Europe and across the world responsible for those projects.

The desk search was conducted via Google search. The desk research was focused on generic health foresight projects, with the main purpose of identifying those related with COVID-19 non-pharmaceutical interventions. The chosen keywords for the Google search were "Public Health", "Health Foresight", and "Scenario", as well as looking for specific international organizations like 'WHO', 'ECDC' and 'European Joint Research Centre'.

2. Systematic Literature Review

A systematic literature review of public health foresight studies was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) Methodology (5), with the research question "*What public health exist, using predictive methods?*". The

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literature review focused on COVID-19 and other public health related topics (non-COVID-19 related). The databases searched were Scopus and Web of Science Core Collection (WoSCC). The literature screening was conducted throughout January 2021.

The search strategy (detailed in Appendix A) was based on four queries regarding four different concepts ("*scenario*", "*modelling*", "*foresight*" and "*preparedness*"). This method allowed the observation of the number of articles existing in both databases, considering the concept under study. The research conducted included the time range from 2019 to 2021 for the modelling and preparedness studies, but for the foresight and scenario studies the period 2015 - 2021 was taken, since it was also relevant to include pre-pandemic studies and preparation for these situations.

The inclusion and exclusion criteria were defined by the team and consisted of:

	Inclusion	**Exclusion**
Topic	COVID-19 related topics and public health topics (non-pharmaceutical approach or population health)	COVID-19 Clinical related topics
Geography	All countries and organizations	Non applicable
Type of Publication	Only journal articles	Grey's literature, Reviews, Conference papers, Posters, Reports, etc.
Timing	2019 – 2021 * Except for "Foresight" and "Scenario" that were between 2015-2021	Before 2015
Language	English	Non-English Studies

Inclusion Criteria: All the results had to be journal articles, published between 2019-2021 (except for "Foresight" and "Scenario" queries that were between 2015-2021) and written in English. The study was considered eligible for inclusion if the publication included these criteria:
1. COVID-19 related and other (non-Covid-19) public health topic (non-pharmaceutical approach or population health)
2. All countries and organizations, without geographical restrictions
3. For this study, the following definitions were considered:
   o "*Scenario building*" articles are papers describing specific scenarios and their potential outcomes, without using mathematical models;
   o "*Modelling*" articles are papers describing a mathematical model used for prevalence estimation, projecting trajectories and assessing effectiveness of non-pharmaceutical interventions, assessing effect of climate and meteorological conditions on COVID-19 transmission;
   o "*Preparedness*" papers are articles that study Public Health Emergency Preparedness (PHEP) plans, including prevention, mitigation, and recovery activities, as well as the ability to operationalize the planned tasks to enable responses to events;

o "*Foresight*" papers include studies that analyse the relevant past and envision it to define future states; create strategies to elaborate intended futures; and project possible outcomes of implemented measures.

Exclusion Criteria: Review papers and grey literature were excluded. All papers were filtered as per the database filtering options, filters applied excluded papers that investigated pharmaceutical and molecular therapies and approaches.

Study selection

The initial selection of papers was done using the title and abstract of the study. During later steps of the process full documents were analysed (see Figure 1). The process was performed by two researchers independently; disagreements were resolved by discussion.

Data extraction and synthesis

The data were managed and stored by Zotero and Microsoft Excel (version 16.46). These data were title, author, year, journal, aim, country of first author's affiliation, type of institution of first author's affiliation, and if the study is intended for national or subnational level. For data synthesis and analysis, a qualitative assessment was conducted based on the inclusion criteria presented above.

B. Foresight Capacity and Activities Survey

To complement the inventory of foresight activities with more specific information, a survey was developed (*"Foresight Capacity and Activities survey",* see Appendix B).

To facilitate distribution, participation and processing, the survey was developed in an online format, using Formdesk (Formdesk 4.1). The survey was first shared among colleagues and team members of the PHIRI project, i.e. more than 100 stakeholders from 28 Member States (MS). These colleagues were asked to share the survey amongst other colleagues whom they identified as (possible) experts in foresight studies (snowball method). Participants were given a period of 3 weeks to respond. The survey consisted of 8 questions divided in 4 sections covering the four aspects we aimed to collect information on: National Foresight Activities, Experts in the Field, Uptake in Policy Cycle, and Capacity Building Needs.

The survey allowed to collect information on: foresight studies conducted in MS, experts and/or professionals interested in public health foresight, and the capacity and capacity needs for public health foresight in MS.

IV. Results

A. Overview of public health foresight studies

Following the desk research, systematic literature review and the survey, we identified 410 studies, reports, and projects focusing on foresight studies and/or the different types of methods used in foresight (modelling, forecasting, scenario, preparedness).

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Through the desk research, a total of 21 studies were found: 13 foresight studies that have been conducted in Europe and European MS, and 8 foresight studies conducted by international organizations and other countries outside the EU).

The systematic literature search resulted in 1 577 documents. After removing the duplicates and first screening, 342 publications remained of full text screening. Of these, 331 publications were included (**Figure 1**) and their characteristics are represented in **Table 1**.

Figure 1 – *PRISMA Workflow Diagram*
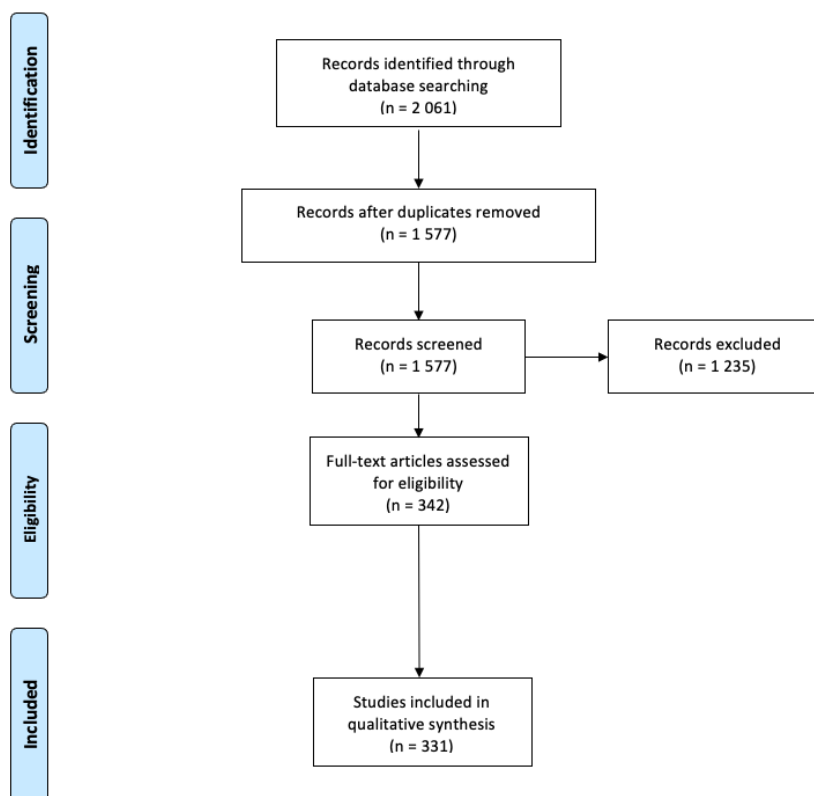
Table 1 – *Study Characteristics (N=342)*

Characteristics	N (%)
Region	
European Region	85 (25,1)
Americas Region	56 (16,5)
South-East Asia Region	32 (9,4)
African Region	27 (8)
Western Pacific Region	77 (22,7)
Eastern Mediterranean Region	62 (18,3)
Year (only for Foresight and Scenario, N=54)	
2015	4 (7,4)
2016	1 (1,9)
2017	6 (11,1)
2018	8 (14,8)
2019	25 (46,3)
2020	10 (18,5)

Stakeholders' involvement	
Universities	286 (70,3)
Governments	37 (9,1)
Research Institutes	51 (12,5)
Others	31 (7,6)
Unknown	2 (0,5)
Level of Action	
Local	23 (6,8)
Regional	63 (18,7)
National	202 (59,9)
International (more than 1 country)	11 (3,3)
Continental	10 (3,0)
Global	16 (4,7)
Other	12 (3,6)

Regarding the survey, 58 studies and/or reports were identified. The survey received responses from 27 participants from 21 MS (**Figure 2**): Albania, Austria, Belgium, Bosnia and Herzegovina, Croatia, Czech Republic, Estonia, Finland, Germany, Ireland, Lithuania, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Spain, Sweden, and the United Kingdom (UK). The affiliations and job descriptions of participants were diverse. Participants were mainly affiliated to public health institutions, ministries of health, universities, and public health agencies. They held positions as researchers and research managers, statisticians, data analysts, medics, foreign affairs managers, professors, scientists, policy makers, senior advisers, vice-rectors, health officers, heads of unit, and public health specialists.

Of the studies identified through the survey, 21 foresight studies regarded COVID-19 and related topics. The other 37 studies related to other public health areas. Common topics addressed in foresight studies were on other health conditions such as non-communicable diseases (NCDs), influenza, etc.; other public health issues such as human resources in healthcare, health care payments and drug pricing, impact of legislation changes, health technologies, health capacity, primary care services, integrated hospital services, security challenges, and aging populations (12 studies); and health care expenditures.

Figure 2 – Participating Countries in the Survey
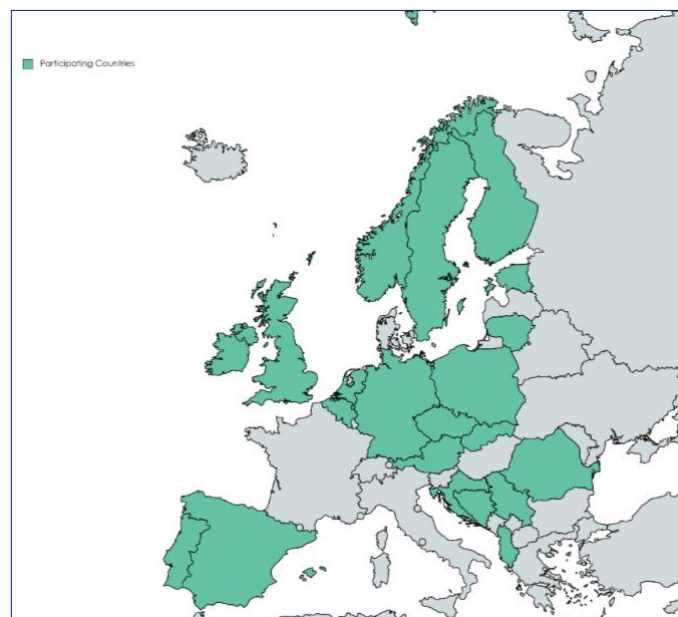
B. Examples of foresight activities and initiatives

A collection of PHFS and projects were identified from several countries, European projects, Non-Governmental Organizations (NGO), and International Organizations. This section presents a selection of studies as examples of interesting PHFS (**Table 2**) and provides a brief summary and overview of each study.

Table 2 – Organization of the selected examples according to theme

	Study / Project		
COVID Related FS in Europe	*Preparedness for COVID-19* ECDC	*Dutch Public Health Foresight Study, in the light of COVID-19* RIVM (The Netherlands)	*Spain After COVID-19: From resilience to reimagination* McKinsey & Company (Spain)
Non-COVID Related FS in Europe	*FRESHER Project* H2020 Project	*Healthcare in Europe: Scenarios and implications for digestive and liver diseases (2040)* United European Gastroenterology	*A scenario-planning approach to human resources for health: the case of community pharmacists in Portugal* ePharmacare Project (Portugal)
COVID Related FS Outside Europe	*Future Scenarios for Food & Health Systems: Post-pandemic recovery and transition to a more resilient, sustainable, and equitable health care system in Canada* NOURISH Project		*How to build scenarios in preparation for or during humanitarian crises* Assessment Capacities Project
COVID Related FS in Europe	*Healthcare Scenarios in a Trump World – The Future of the Affordable Care Act and Its Impact on Business Strategy* FULD + Company		*The Sustainability of Health Care Spending in Canada (2017)* Fraser Institute

1. COVID-19 related Foresight Studies in Europe

ECDC – Preparedness for COVID-19

This project focused on the preparedness for COVID-19. It was developed by ECDC with the following purpose: "*Preparedness planning is essential in order to respond effectively to outbreaks and epidemics. Sharing and aligning activities at European and international level in public health emergency preparedness adds value to the efforts of single countries to strengthen their capacities and ensure coordinated and effective support when faced with cross-border health threats.*" (6).

The ECDC issued a report suggesting that healthcare facilities, including long-term care facilities, and regarding the preparedness for COVID-19, should apply several types of measures to minimize the risk of transmission of COVID-19 (7). The report (described in **Table 3**) further develops these measures as a way to better respond to the COVID-19 risks.

Table 3 – Description of "Infection prevention and control and preparedness for COVID-19 in healthcare settings"

Name of study/report	Preparedness for COVID-19

Objective/Aim of study	COVID-19 resilience and guidelines for better preparedness
Scenarios used	A set of public health scenarios related with COVID-19
Methods, Tools and instruments	Preparedness guidelines and recommendations

RIVM – Dutch Public Health Foresight Study, in the light of COVID-19

The Dutch Public Health Foresight study in the light of COVID-19 (c-PHSF) is a special edition (8) done by the Rijksinstituut voor Volksgezondheid en Milieu (RIVM). RIVM reports in this edition on future developments in the field of public health and care, considering the COVID-19 pandemic (**Table 4**). In addition to the direct consequences such as COVID-19, indirect consequences of the COVID-19 crisis were analyzed. These consequences are diverse, from health effects due to changing lifestyles and lower levels of provided regular care to the longer-term effects of socio-economic developments.

The future health impacts are analysed by applying a Trend or Business-as-usual scenario, which covers most important driving forces of the DESTEP categorization (**D**emography, **E**conomy, **S**ocial-cultural, **T**echnology, **E**nvironmental, **P**olitical-institutional). These DESTEP trends are combined with three COVID-19 scenarios. Both the short term (00-5 years) and the long-term impacts (5-20 years) are covered

This study reported that COVID-19 can be a leading cause of death in 2020 in the Netherlands. It also highlights the importance of the implementation of coronavirus measures in the burden of disease caused by COVID-19. Moreover, the report acknowledges that the long-term effects for former COVID-19 patients are still unknown and considers the significance of indirect effects of COVID-19 in the (temporary) limited access to regular healthcare, changes in lifestyles and social life due to coronavirus measures.

Table 4 – Summary of the RIVM c-PHFS Scenario Study

Dimension	**RIVM c-PHFS Scenario Study**
Scope / Issue	Future Population health, including COVID-19
Conceptual model	Lalonde-based
Disciplines	Multi (i.e., epidemiology, demography, health economy, virology, mathematics, communication)
Context	DESTEP
Time horizon	0-5 and 5-20 years
Indicators	ECHI+
Scenario	Business-as-Usual (BaU) + COVID-19 scenarios
Data sources	National
Uncertainties	Qualitative

Tools	Expert panels, focus groups, simulation models
Participatory	Stakeholder meetings with groups (elderly, youth), health care providers, health insurance providers
Modelling	Population Health modelling; Demographic + epidemiological projections, attribution to a wide set of more than 30 determinants using Population Attributable fractions (PAF), health care expenditure
Effects & Impacts	(excess) mortality, morbidity, Burden of Disease, perceived health, lifestyle, life expectancy, health expectancy, health care expenditure, health inequalities

McKinsey & Company – Spain After COVID-19: From resilience to reimagination

This is an example of a very elementary approach to foresight, based on surveying a set of stakeholders and inquiring them about the future (an unstructured Delphi study) (9).

In this study, the implications of the COVID-19 pandemic on Spain's economic well-being were examined through five elements: 1) the starting point of the Spanish economy before the pandemic; 2) the impact the crisis could have on different sectors; 3) the government's response to date; 4) the accelerating trends that could shape the new economic reality; and 5) the need for public and private sector measures to accelerate recovery.

As such, this study has allowed us to conclude that to accelerate recovery and facilitate the transition to the new economic reality in Spain will require an effort from three horizons: "*short-term survival (resilience), return to a certain normality and partial recovery of value and employment (return) and design and adaptation to a new economic reality (reinvention)*" (10).

The main results from this simple studies are aimed at both policy makers and the consultancy company clients. As an example (9):

- COVID-19 is expected to bring about permanent changes in the behavior of society and economic agents: **83% of the respondents are less optimistic** than Europeans about the country's economic recovery and still very concerned about health and safety issues.
- Sectors should also work collaboratively to boost demand by **ensuring client confidence through hygiene and health protocols** and implementing campaigns to promote local demand (particularly in the tourism sector).
- The public sector is expected to be vital in this phase, too, through potential policies that support the recovery of traditional growth engines and the evolution of newer growth sectors, **ensuring an adequate regulatory framework and a resilient healthcare system.**

2. Non COVID-19 related Foresight Studies in Europe

ePharmacare Project – A scenario-planning approach to human resources for health: the case of community pharmacists in Portugal

This was a study focusing on using foresight tools to address human for health planning, in the case of the community of pharmacists, with links with both primary healthcare and public health (3). For many years, the community pharmacies have supported both vaccination and other public health interventions like healthcare surveys.

The study applied scenario planning to analyse the future evolution of community pharmacist needs, and the impact of digitalization, aiming at 2020 (from 2010). One can see a summary at the **Table 5**, bellow.

Table 5 – Summary of the ePharmacare Scenario Study

Dimension	ePharmacare Scenario Study
Scope / Issue	Future community pharmacist
Conceptual model	Yes - National Health Service
Disciplines	Pharmacy, Management, Technologies
Context	External factors driving change
Time horizon	10 years
Indicators	Human Resources and Economics
Scenario	Critical uncertainty-based (3 scenarios)
Data sources	INFARMED
Uncertainties	Innovation & Policymaking/regulations
Tools	Scenario Planning
Participatory	Workshops with Stakeholders
Assumptions	Evolution follows actual trends
Outcomes	Demand evolution of new pharmacists
Effects & Impacts	University places in commentary pharmacy Community pharmacist job market dynamics
Challenges	Improve community pharmacist communication, marketing and digital competencies

H2020 Project – FRESHER Project

FRESHER was a H2020 European Project that focused on developing a set of scenarios for the future of Health in Europe. Furthermore, as mentioned on the website "*Building the FRESHER Scenarios was a systematic and creative process, the focus being on how structural changes in governance, economy and society overall may influence citizens' behaviours and consequently their health status and NDCs incidence*" (11).

The study addresses "*which are the main drivers of change that could reshape the socio-economic and political context and have a high impact in creating a healthy future*" (11), as a research question.

The methodology used consisted of:

1st: a **"Horizon Scanning"** was conducted, to select the most important short-, medium- and long-term trends and identify drivers related to health and non-communicable diseases

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(NCD). To complement it, a literature review was done on well-researched risk factors. Three workshops (Vienna, Brussels, and Lisbon) were organized in 2015 to elicit stakeholders' observations about possible changes, wider correlations and potentially emerging issues.

The results of these workshops were included in the FRESHER report 3.1 "*Horizon Scanning*" (12).

2nd: The project team aggregated and fine-tuned the identified drivers in eight key trends and launched a survey in June 2016 to collect stakeholders' informed opinions on the importance of the trends in reducing the incidence of NCDs and on their uncertainty by 2050. The survey results can be found in the FRESHER report 4.1 "*Health Stories*" (13).

3rd: After a refinement of the key trends, and based on comments in the survey, review of foresight literature and discussion within the team, four FRESHER Health Scenarios were built (**Figure 3Figure 3** – Four Health Scenarios from the FRESHER Project) (14).

*Figure 3 – Four Health Scenarios from the FRESHER Project (14)*
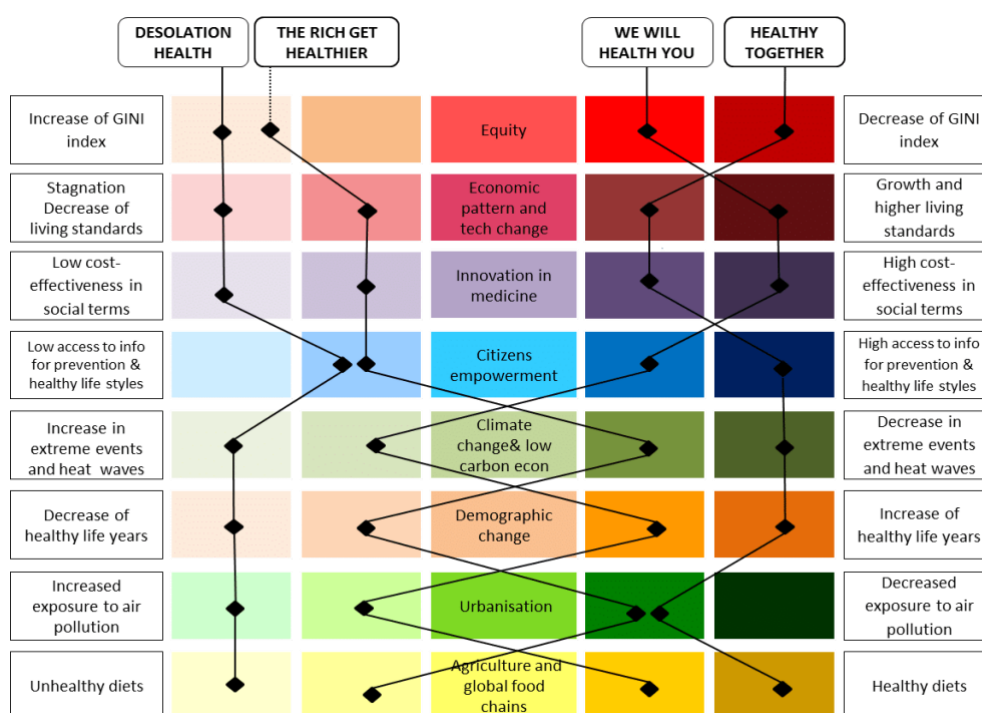
United European Gastroenterology – Healthcare in Europe: Scenarios and implications for digestive and liver diseases (2040)

This study was developed by a European medical association on gastroenterology to improve the information regarding the future of digestive and liver diseases in Europe (15).

In a certain part of the text, they say very eloquently that: "*Of course, it is impossible to predict how Europe will look in 2040 from a political, societal or healthcare perspective. But while we may not be able to foretell the future, as a society and as clinical specialists, we can create plausible future scenarios for healthcare in Europe, enabling us to focus our thinking, sharpen our strategies and inform our decision-making.*" (15)

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They used a typical scenario-based approach, looking at key uncertainties and main driving forces to design three different and complementary scenarios (**Figure 4**). They provided a set of quality images to support the process and the translation.

Figure 4 – GI Healthcare Delivery Key Uncertainties (15)
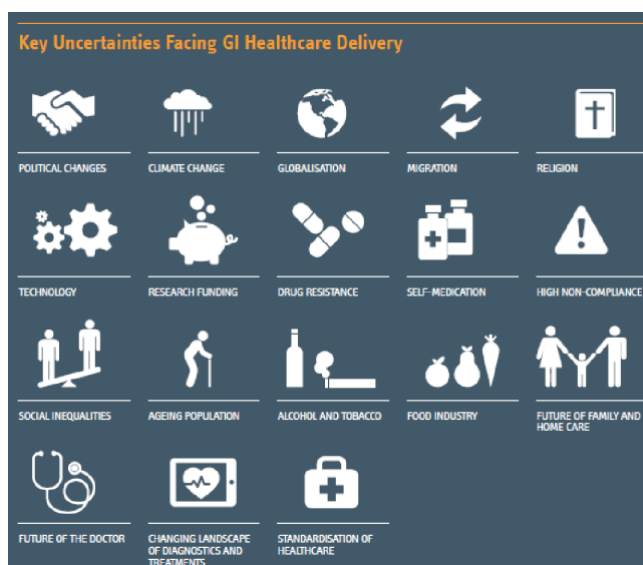
With collaboration with expert scenario planners to develop a set of plausible, relevant, and challenging scenarios that could impact GI healthcare delivery in the future, this study arrived at 3 possible scenarios (**Figure 5**):

Figure 5 – Scenarios of Healthcare in Europe 2040 (15)
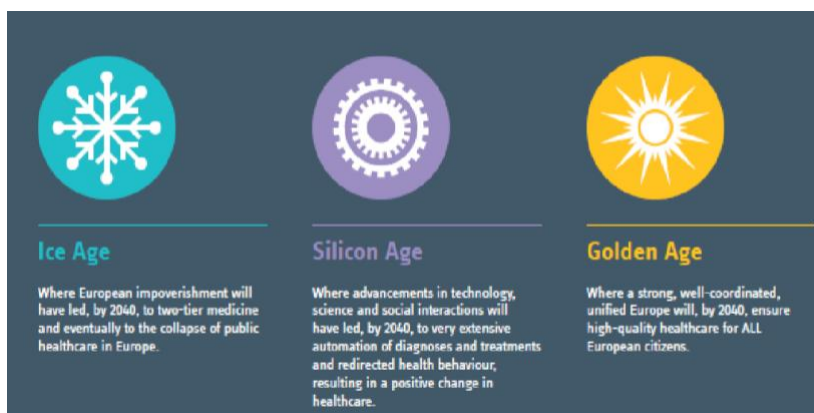
3. COVID-19 related Foresight Studies outside Europe

NOURISH – Future Scenarios for Food & Health Systems: Post-pandemic recovery and transition to a more resilient, sustainable, and equitable health care system in Canada

Canada has a long tradition on foresight, since the Lalonde Report in 1975. This study explores four possible futures for the Canadian healthcare and food systems post-COVID-19. It explores some of the implications for short-term strategies and long-term vision of Nourish (16). **Figure 6** illustrates the four scenarios designed, looking at the impact of funding, the role of communities and of technologies for future provision of care.

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Figure 6 – Four Post-COVID-19 Scenarios for Food & Health Systems (16)

Figure 6 – Four Post-COVID-19 Scenarios for Food & Health Systems (16)
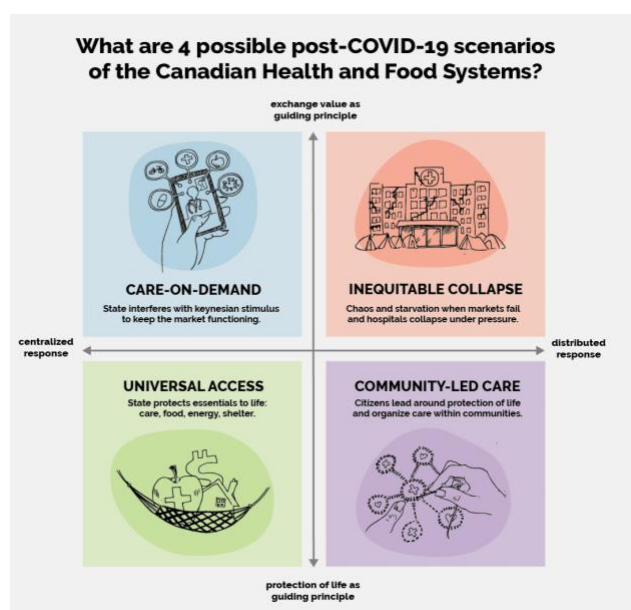
Assessment Capacities Project – Scenario Building: How to build scenarios in preparation for or during humanitarian crises

This very interesting project focuses on humanitarian crises, where it presents two approaches to examine possible futures (17):

- **Back casting approach** - most common within humanitarian crises, where it starts by analyzing one outcome and then identifies the chain of events leading to this outcome. The identification of best/most likely/most serious scenarios. While this approach may be faster and lighter, it has the disadvantage that it is very likely to focus on extreme futures and neglects alternative futures that are not currently imagined.

- **Plausibility chain approach** - is a more comprehensive scenario building approach for humanitarian contexts and starts with identifying variables that are likely to trigger a chain of events resulting in a humanitarian impact. Informed assumptions are then made about the most important variables and the direction of these variables, and then potential humanitarian outcomes are determined.

The report provides a step-by-step approach (plausibility chain approach) on how to build scenarios, and this methodology can be applied to a range of scenarios and timeframes, from a long-lasting conflict to a sudden onset disaster (**Figure 7**).

Figure 7 – Step-by-Step explanation of the Chain Plausibility Approach (17)

Throughout this study, it was perceived that the humanitarian community is often unprepared for sudden events or humanitarian developments. Examples provided include the 2010 cholera outbreak (in Haiti) and the sudden spread of Islamic State control areas in 2013 (in Syria). In addition, scenario building is an essential part of humanitarian operations as it allows to inform contingency plans and preparedness measures for possible developments.

4. Non COVID-19 related Foresight Studies outside Europe

FULD + Company – Healthcare Scenarios in a Trump World: The Future of the Affordable Care Act and Its Impact on Business Strategy

This is an interesting study focusing on the health system in United States, from the perspective of the Affordable Care Act, and the healthcare strategy very much dependent of political approaches by the two main parties in USA (18).

They say very clearly that "*Without a clear sense of future conditions, how can healthcare organizations plan strategically?*" (18).

To address the unprecedented degree of uncertainty faced in the wake of Donald Trump's election, four scenarios looking ahead to the year 2020 have been developed. In developing these scenarios there has been a careful choice of driving factors to ensure that these scenarios capture a range of plausible future conditions in which health care and health insurance companies may find themselves.

A structured brainstorming and divergent-convergent thinking session was conducted to identify about 50 driver variables (representing the industry's volatility points) and which were grouped into three categories:

- **Political dynamics** - can tend toward gridlock or harmony
- **U.S. economic conditions** - may tend toward recession or robustness
- **Healthcare industry structure** - may tend toward consolidation or fragmentation

As a result, 8 possible scenarios were developed. **Figure 8** illustrates all possible combinations of dimensional behavior, however it emphasizes the 4 scenarios for future development that are believed to be mutually exclusive but collectively exhaustive.

Figure 8 – Scenario Selection table from "Healthcare Scenarios in a Trump World" (18)

Scenario	Political Dynamic		U.S. Economy		Industry Structure	
	Gridlock	Harmony	Recessionary	Robust	Fragmented	Consolidated
Hunger Games	x		x		x	
All Bets Off	x		x			x
Tech Saves Healthcare	x			x	x	
Adam Smith's Invisible Hand	x			x		x
Well, At Least We Tried		x	x		x	
Winter of our Discontent		x	x			x
Party Like It's 1999		x		x	x	
Eisenhower Returns		x		x		x

Figure 1: Fuld + Company's healthcare and health insurance industry scenario matrix. The highlighted scenarios were selected as the best collective representation of the future of the industry.

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This study was conducted in Canada because of the vital need to determine whether health care spending is sustainable (19). To do this, it is important to routinely assess historical, current, and expected trends in health care spending.

2 scenarios were developed based on a projection model of future health expenditures based on 3 factors: demographic (population growth and aging), inflation (general and health-specific inflation), and other factors (government policy, income elasticity, technology evolution, etc.):

- **Long-term trend model** - is based on reasonable expectations of the factors analyzed based on observed trends over the 15-year period (2001 to 2016).
- **Short-term trend model** - the assumptions regarding the analyzed factors are changed to reflect only trends between a shorter and more recent 5-year period (2011 to 2016).

As can be seen from **Figure 9**, the difference in the period of trend analysis (between the two models) is reflected in the predicted results.

Figure 9 – Healthcare Spending projection in Canada between 2016 to 2031 (19)
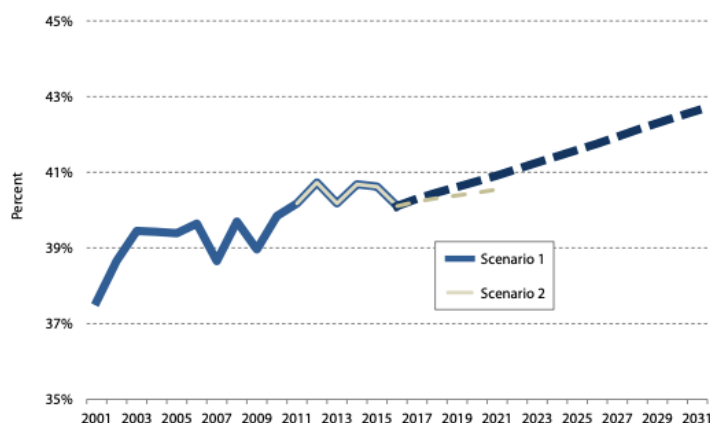
C. Current capacity and potential demands for applying foresight methodology

One aim of the PHIRI project is to address health inequities by mitigating the health capacity needs and bring all MS to the same level of knowledge and capacity.

The desk research found that most health foresight projects were developed with practical aims involving several types of stakeholders (from researchers, experts to policy makers). Most projects comprised components of capacity building, as the teams engaged benefit from the experience, including using foresight integrated with planning or decision-making. As for the results from the literature review, these results were mostly research outcomes developed by research teams, which means that there are capacities in health foresight studies available in the Universities that can be leveraged.

The survey gathered input and information regarding the current capacity and needs of MS to develop or improve the foresight capacity in their country. Participants were asked if they had information or knowledge about foresight studies that had been conducted in their countries since 2015 (**Figure 10**). 81% of the participants reported being aware of foresight studies being conducted in their countries. The survey shows that in 18 MS, foresight studies have been conducted and that these MS have some capacity in public health foresight.
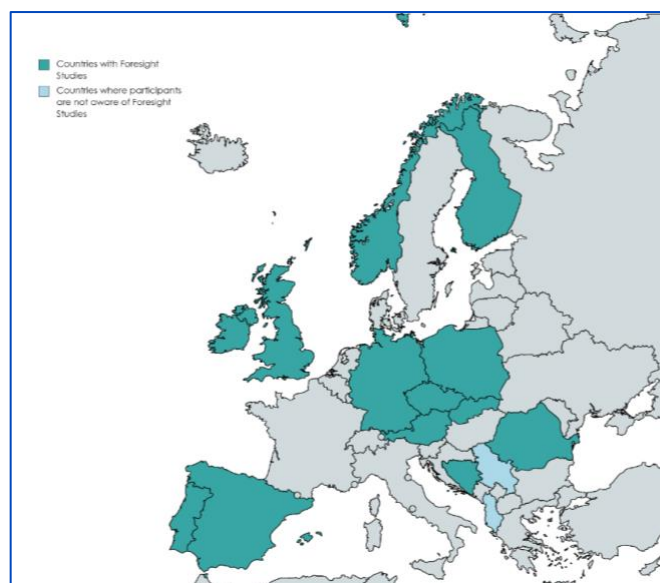
Figure 10 – Countries with Foresight Studies

Figure 10 – Countries with Foresight Studies

Figure 11 shows that, of those participants that had knowledge of foresight studies conducted in their countries, they reported that most of the foresight studies have been about COVID-19 and related topics (81%). Other common topics addressed in foresight studies were on other health conditions such as non-communicable diseases (NCDs), influenza, etc. (57%); other public health issues such as human resources in healthcare, health care payments and drug pricing, impact of legislation changes, health technologies, health capacity, primary care services, integrated hospital services, security challenges, and aging populations (57%); and health care expenditures (48%). Less common areas addressed in foresight studies included determinants of health (29%), environmental health (24%), and health inequalities (24%).

Figure 11 – Health related topics addressed in Foresight Studies conducted in MS
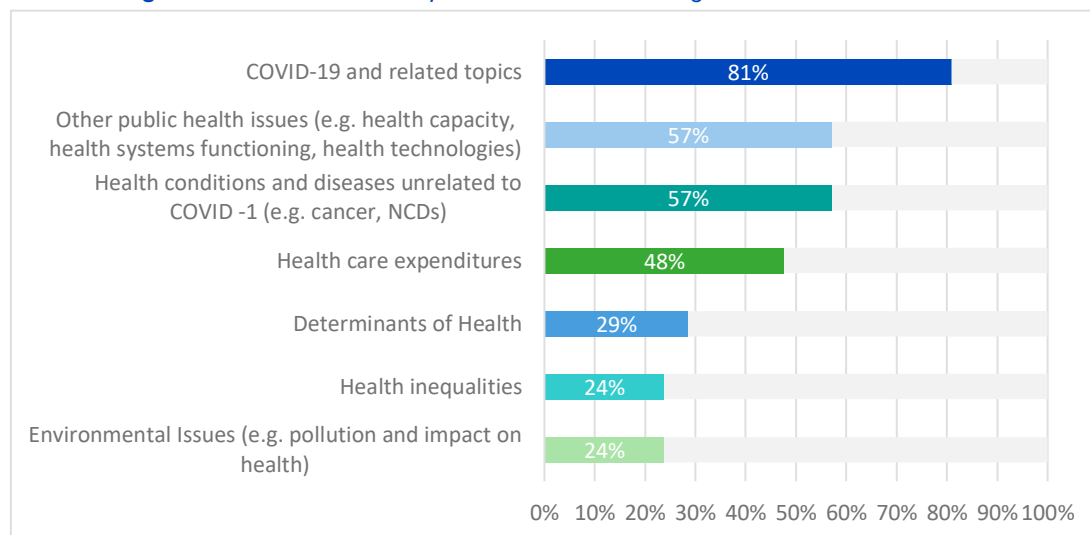
We found that 19 MS had carried out foresight studies, thus these countries have some level of capacity in foresight. However, participants reported the need to further develop and strengthen capacity in foresight in their countries. The results of this survey will be used to fine tune the foresight capacity building task (Task 9.2).

As seen in **Figure 12**, 17 participants provided their input and informed what their needs are in order to develop foresight capacity and skills. According to participants, the main areas to develop are understanding foresight studies (94%) and the use of methodologies (88%). Other areas that require attention include how to carry out foresight studies (76%), access to relevant data to conduct foresight studies (71%), advocating foresight (53%), and resources and capacity (47%). 2 participants (12%) reported on 'other', mentioning that all areas require comprehensive training with practical examples since developing foresight skills is an ongoing process.

Figure 12 – Foresight Capacity Needs
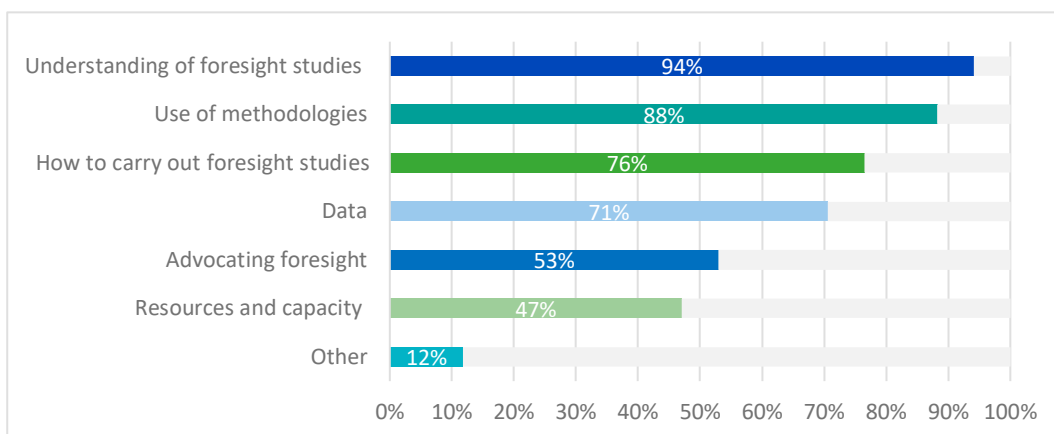
Regarding 'Understanding of Foresight Studies' (**Table 6Error! Reference source not found.**): participants have indicated that they need a deeper understanding and knowledge on what foresight entails and its methodologies, how to select the methods according to certain scope and purpose and understanding the degree of automation and integration. Participants also want to learn about proper implementation of foresight studies particularly when communicating to policy makers, but also on how to train other individuals on foresight. Participants want to learn and understand about the full use of the foresight cycle, getting advanced knowledge on its use, in positive and negative events and developments, and its implementation.

Table 6 - Comments and answers from participants regarding "Understanding of Foresight Studies"

Understanding of Foresight Studies
There is no clear view about foresight for policymakers
Although different foresight techniques are used for public health, only rarely more advanced concepts are used. Hardly ever a full forecast methodology cycle is used.
How to choose the foresight method that is fit for purpose (quantitative, qualitative, mixed, etc.) 1. **Purpose**: from providing independent advice as an input to a policy process through legitimizing existing policy decisions; 2. **Scope**: from providing an overview of an uncharacterized field through exploring a predefined field; 3. **Degree of automation**—from an automated process through an expert-driven exercise; 4. **Duration**: from an on-demand activity through an ongoing process; and 5. **Integration**—from being a stand-alone activity through being part of a broader policy-making process.
Learn about how to implement the results of foresight studies
We do not have a tradition of modelling, so we need to develop this skills and methods

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Basic concepts and methodologies used in foresight
More in-dept knowledge of the methodologies used in foresight
To my knowledge foresight studies are not widely used in Germany, up to now. I am aware of foresight studies to inform potentially negative events in the future. I think there is a potential to show potentially positive developments as well.
Improvements in the use of foresight studies with more emphasis on training individuals on how to carry out such studies and why they are important.
Advanced knowledge on foresight studies, the methods and applications
There are already a few experts addressing health forecasting in Portugal, but they are not enough. A critical mass of expertise is important to properly cope with the demands in healthcare. The main areas to be developed should be: - Advanced understanding about foresight studies; - Integration of foresight studies with policy-making; - Practical foresight studies tools (e.g. data collection and workshops' organizing).
Training, bibliography available to guide the development of foresight studies
To understand foresight studies. I would like to gain specific knowledge of foresight and future studies, especially regarding the methods.
Advanced applications of foresight studies

Regarding 'Use of Methodologies' (**Table 7**): some participants mentioned specific methods such as scenario building and forecasting. Participants want to learn about the complete methodology steps on foresight studies: from data collection, how to choose methods and appropriate combination of methods (including interviews to stakeholders and involving different partners), to the synthesis of results and reporting. They want to learn more advanced methods and concepts in foresight and the use of the full methodology cycle.

Table 7 – Comments and answers from participants regarding "Use of Methodologies"

Use of Methodologies
Use of modern approaches
Although different foresight techniques are used for public health, only rarely more advanced concepts are used. As far as I know, hardly ever a full forecasting methodology cycle is used. • For the synthesis/reporting: recommendations on combining qualitative and quantitative aspects and data • Which are the tried and tested methods for conducting stakeholder workshops/interviews as part of a foresight study • Useful software's for data collection and analysis
Consistent and harmonized methodologies that can allow data comparisons. Improving the use and application of methodologies
There are many methods that are being used, and we are just finishing the first validation analysis for prediction in our data
Forecasting methods
How to extensively involve different partners
Permanent functions are being planned and considered

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• Foresight data collection methods;   • Foresight studies reporting and presenting;   • Stakeholder selection and management;
Scenario building and forecasting methods
Complete methodology steps from data collection and analysis to results according to scenarios. How to choose methods and appropriate combination of methods.
Any advanced methodology

Regarding 'How to Carry Out Foresight Studies' (**Table 8**): participants informed that they want to learn on the different aspects of planning and carrying out foresight studies: time needed, essential elements before setting up the study, level of integration with the policy process, implementation, evaluation, etc. These aspects also include protocols, guidelines, and tools that can be used and how to incorporate the available information into the models.

Table 8 - Comments and answers from participants regarding "How to Carry Out Foresight Studies"

How to Carry out Foresight Studies
Although different foresight techniques are used for public health, only rarely more advanced concepts are used. As far as I know, hardly ever a full forecasting methodology cycle is used.
• Time needed and other consideration and planning aspects   • What are the essential elements to put in place before setting up the foresight study (including regulatory)?   • Level of integration needed in the policy process?   • What are the next steps once the foresight study is completed? Implementation? Evaluation?
The use of common methodologies that can allow the comparison of results with other country
Mechanics of the modelling, especially refining the model
All aspects related and considerations necessary to carry out foresight studies
Process of the foresight studies, how to incorporate all the available information to the models.
How have in place guides/ tools/templates/case studies on a central webpage.
• Develop more specific foresight studies;   • Leverage the development of more specific and focused foresight studies;   • How to create a foresight team;   • How to engage the stakeholders;
Protocols and methodologies to carry out studies
Step by step methodology with examples.
Interested to learn about software applications used for foresight studies
Best implementation practices in the context of federal countries

Regarding 'Data' (**Table 9**): participants informed that in the countries there are data gaps, and that data can be limited; therefore, participants are interested in learning more about which specific data are necessary to conduct foresight studies, on data collection, data sources, and data analysis. They have also mentioned the importance of data harmonization, generation of evidence, and the use and automation of databases.

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Data
More information and training on how to carry out data collection
Health care system in Austria is very federal oriented. And so it is with data. Some information (e.g. diagnosis data for outpatient health care) is not available at all. How to manage these challenges?
Public available data are extremely limited in Belgium • What types of data (linkages) have been helpful in the context of generating evidence for foresight studies? • How have routine population health databases and non-health administrative databases been used? • What is the level of automation needed?
Data collection and analysis
There are no harmonization efforts across institutions. How to manage this issue regarding the collection and use of data?
Specific data for scenario building
There are a number of national data gaps. How to handle this issue?
The set of data collected for the National health Plan should be expanded to include foresight-type data; • Methods to collect and present data to strengthen the quality of the foresight exercises; • How to create routines for data collection and reporting;
Data sources and analysis methods
How to abstract relevant data. Data analysis, especially in the area of human resources for health.

Regarding 'Advocating for Foresight' (**Table 10**): participants acknowledge that it is important for all the different stakeholders (policy makers, clinicians, patient groups, general public, etc.) to understand and appreciate the utility of scientific foresight studies into policy making. They want to learn about how to properly advocate and promote foresight studies, including the use of guidelines for such purpose and knowledge translation.

Table 10 – Comments and answers from participants regarding "Advocating for Foresight"

Advocating for Foresight
There is a bad understanding of the utility of scientific foresight studies from policy makers and the general population. Information on developing the dissemination strategy for a foresight study and key elements for policy, clinicians, patient group, general public, etc.
There are still problems related to perception of foresight results in the general and professional audience
Knowledge translation
How to sale the product to relevant stakeholders
This is currently being considered through the OPS2030 Project
Foresting studies need more discussion and dissemination (stakeholders and population in general). Foresight studies should be integrating in the training of public health professionals.
Use of guidelines for advocating foresight
How to advocate and how to promote studies.

Regarding 'Resources and Capacity' (**Table 11**): participants want to learn about the human and infrastructure capacity necessary to carry out foresight studies. This includes having available literature resources, data, the time requirements, manpower and expertise, and the training of specialists in this field.

Resources and Capacity
There is a lack of human and infrastructure capacity
A "middle" tear, moderating the foresight process with expert/research knowledge and stakeholders similar to the Netherlands is missing.
Necessary considerations: • FTE's • Duration of the whole study
We need more manpower for this activity
What type of expertise would be required to carry out foresight studies?
We can identify a shortage of foresight experts; There is also a lack of a serious culture of planning and forecasting; The importance of promoting also research on health foresight.
Training of specialists, online literature access
How to obtain relevant data, and how to carry out foresight studies on future capacities.

The survey has provided relevant information to prepare capacity building workshops (WP9, Task 9.2) that will address the concerns expressed by participants and bring MS into the same level of foresight capacity. The information from the survey will also serve as a good basis to guide the development of scenarios in the next phase of the PHIRI project (WP9, Task 9.3).

D. Experts and Academics Network

These professionals were authors reporting on foresight studies and experts that have shared their reports and experiences through the survey. These experts and professionals will be invited to become members of the Public Health Foresight Network (PHFN).

Figure 13 shows the countries where professionals in foresight studies were identified from the survey. These professionals will be invited to become members of the Public Health Foresight Network.

Figure 13 - Countries with identified professional on Foresight Studies
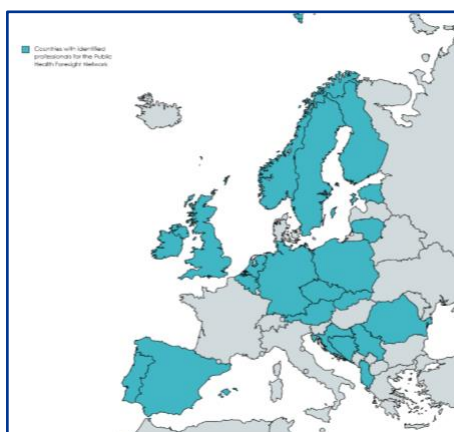
V. Discussion, Implications and Limitations

The combination of methods and the inventory presented in this report enabled us to improve our understanding about the activities in public health foresight within Europe. The results allow for recommendations for the development of specific training in Public Health Foresight.

A. Inventory of foresight activities and initiatives

The inventory presented here shows that there is a growing interest in the use of prospective studies in public health and health care. The two methods used (desk research and literature review) allowed us to identify a comprehensive set of prospective studies and to arrive at some interesting observations about the results achieved.

Something important to note is that in the desk research, the main methodology used in the studies was scenario methodology. However, the results of the literature review show that there was a lack of scenario studies. We can infer that scenario analysis is more complex (and costly) than other methodologies; some MS may not have been able to define and develop scenarios using mathematical models on possible COVID-19 trends, for example.For those studies using scenario analysis, scenario analysis enabled most health stakeholders to explore future alternatives with digital services, in order to improve planning and decision-making. These studies often worked as a capacity building activity, training both experts and stakeholders to be better aware about the future threats and opportunities.

It was also possible to observe that there are already a high number of studies conducted to study the COVID-19 pandemic using predictive methodologies. This large number of studies shows a response to the need for governments and agencies to visualize possible scenarios and implement interventions to mitigate the effects of the pandemic and achieve possible positive scenarios and outcomes.

These studies reveal that the main focus is on analyzing how prepared countries are with respect to the pandemic and what direction the COVID-19 pandemic will take through mathematical modeling methods (e.g., in the short term). Modeling papers account for 50% of all papers, and only 14% address forecasting or scenario building (e.g., long-term). This may be due to time constraints, the need to respond quickly to COVID-19, and the fact that they are simpler to implement. The results also show that prospective studies have also been used to address other areas of public health, albeit on a smaller scale. Another common area addressed by prospective studies was that of NCDs. This focus could relate to the need for interventions that promote healthy lifestyles to prevent and control NCDs due to their current high disease burden in European countries.

Although we have found a diverse set of studies related to health prediction, these are still very few compared to other types of public health research methods and studies. It seems that both the NHS and the RIVM have more maturity in developing foresight studies.

For the studies using scenario analysis, scenario analysis has allowed most health stakeholders to explore future alternatives with digital services in order to improve planning and decision making. These studies often functioned as an empowerment activity, training both experts and stakeholders to be more aware of future threats and opportunities. Academic, health-related government institutions, and private organizations are using foresight to support their planning and decision making.

It is notable that 70% of the literature is focused at the national or international level and only 25% at the sub-regional and local level. This is probably the result of centralized planning and a lack of

professionals. This is a drawback, as there could be a problem with reducing the scale of consequential interventions. Also, notably, most of the foresight literature is in the domain of universities and research institutes (almost 85%), and less than 10% in the domain of governments, which could mean that all foresight activities are seen as "scientific" rather than "practical".

This could explain why foresight studies are not systematically used in the countries. The use of foresight methods is often found only in internal documents. For example, modeling is now commonly used by some MoHs and governments when deciding on new constraint methods for COVID-19. However, none of these are published as peer review documents, whereas they are limited to a calculation provided to governments to support decision making.

However, through our results, we also learned that there are prospective studies conducted in MS that have been used in the policy cycle - either through sharing and informing policy makers or through recommendations implemented from these studies on policy changes. This provides a positive view on the actual use of foresight studies, which may indicate that some stakeholders are aware of the usefulness and relevance of foresight studies in the policy cycle when considering policy changes and their impact on the future. However, the usability and implementation of foresight studies need to be further addressed. Stakeholder engagement and capacity building in this field are needed to advocate for a comprehensive implementation of PHFS in policy making.

B. Current capacity and potential demands for applying foresight methodology

The findings presented in this report indicate that there is a certain level of capacity already available on foresight across European MS and in other countries across the globe. However, both participants' feedback from the survey and the results from the literature review indicate the need to further develop and strengthen this capacity, particularly in those countries where no studies were found (e.g. Albania, Serbia). Learning about the experiences of participants and the aspects of foresight studies that they want to learn will allow the WP9 team to develop workshops to address these capacity needs. The capacity building process needs to consider a comprehensive approach from engaging a generic group of public health experts in the topic to creating a network of specialized professionals able to support MS in developing regular (and comparable) health foresight studies.

C. Health foresight experts and academics Network

Through the survey we identified professionals with (some) knowledge on foresight studies. They were able to share with us information and perspectives on foresight studies that have been conducted in their countries. These identified professionals will be invited to become members of the PHFN.

The PHFN should be developed and nurtured throughout the PHIRI project. This network will enable a larger base of discussion and promotion of the foresight field in public health among MS. This network of experts will have the possibility to establish a European Conference and leverage the participation of MS in European Health-related projects.

D. Implications

Although relevant foresight activities have been conducted in the European MS, they are still limited and, therefore, broader efforts are necessary. PHIRI represents an opportunity to promote public health foresight into becoming a more mature field.

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1. Overview of current foresight activities and initiatives in the European MS

The inventory points to the existing knowledge on PHFS, which have been conducted in many different areas of public health and have engaged different sorts of organizations and stakeholders. However, as one could see from COVID-19 responses globally, there is a clear need to further develop this field of research to make it more standardized and harmonious. The development of more PHFS will require a larger expert base and capacity across countries.

2. Current capacity and potential demands for applying foresight methodology

The current mapping of PHFS has shown there is significant health foresight capacity in universities, research centres, and some governmental offices. However, the number of publications is still small and focuses mostly on mathematical methods other than scenario/foresight methods. Thus, there is a great opportunity to improve the production of research in this field. The maturity of the research field will depend largely on the existence of experts. Therefore, the importance of improving the capacity building and reach-out of training in the European MS is paramount.

Although there is already some capacity available in many MS, it is very limited and unbalanced, implying the need for developing more comprehensive capacity building programs across Europe. PHIRI aims at balancing the capacity across MS, therefore the information gathered in this report will support the development of foresight capacity workshops in PHIRI's Task 9.2 to bring all MS to the same level of capacity in foresight.

3. Health foresight experts and academics Network

The creation of a "Health foresight experts and academics Network" has clear implications for the future of the field of public health foresight as a mechanism to further promote discussion, develop the field, and advance new studies, besides the direct engagement of European MS.

4. Implications for knowledge translation

An important outcome of PHFS is their use in the policy cycle. Through the survey, we also collected information on the use of foresight studies into the policy cycle. 87% of the participants reported that foresight studies have been used to inform policy making (results not shown). Some participants reported that these studies have been shared with policy makers and government agencies, but do not know if the results of these studies have been in fact implemented or had an influence in the policy cycle; some participants have reported that, in fact, these reports have had an outcome and influenced policy. While some countries have an institution with the capacity to perform these studies upon request by the MoH (e.g. Belgium, Netherlands), other countries have reported only sharing results and report to policy makers and the government, without much acknowledgement of the impact and use of the studies by these. Some of these studies have focused on COVID-19 to respond to need to control the current crisis.

The usability and importance of foresight to inform policy and the possible outcomes of interventions needs to be further developed – more advocacy on the use and importance of foresight in public health is necessary. Foresight studies can assist in better and more informed decision making of current and new interventions towards more desirable futures.

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E. Limitations

The most significant limitation of this study is that the development of this inventory mainly involved the members of PHIRI. We expect that the development of the following tasks of WP9 will provide additional information to improve the results presented here.

Some of the tools and methods used in this report also presented some limitations. The desk research had the limitations associated with a search on Google (with limited set of key words).

The literature review had as main limitation that only two databases were reviewed. Moreover, we conducted four separate reviews: scenario, modelling, foresight, and preparedness with different keywords and search limitations. Another main limitation of the literature review is that grey literature was not included. This limitation is of importance since results of research projects are presented in reports prepared within organizations and may or may not be published in peer-reviewed journals. However, this limitation may have been addressed by the information collected via the survey and the inventory desk research.

The survey collected information from only 21 MS, meaning that the information from some MS was still lacking. Some participants provided thorough information, while others were scant. The survey can be biased since it was only shared among colleagues participating in the PHIRI project – we do not know if stakeholders not involved in PHIRI were able to access this survey in order to respond to it.

VI. Conclusions and Final Recommendations

A. Conclusion

The combination of different approaches to collect data enabled us to create the present report which also provides an overview of the capacity and use of PHFS in Europe. This report also includes an overview of other foresight studies conducted outside Europe.

There is a growing interest in developing foresight studies. Particularly, COVID-19 seems to bring new impetus to the field and its importance. Combining several foresight methods (e.g. scenario planning), instead of relying solely on mathematical models and utilizing them in a systematic way, can lead to better preparedness by countries' health systems for unexpected crises.

Public health foresight studies are growing, but it still is very limited and more countries need to tackle the public health foresight competences. Many MS have a certain level of capacity in foresight but need further development and implementation so that foresight studies can be properly conducted to inform policy.

Furthermore, establishing a Public Health Foresight Network is relevant in developing public health foresight and increasing capacity in the MS across Europe.

B. Final Recommendations

The present report shows a clear need to develop both generic and expert capacity building programs on public health foresight. Although there is a growing concern about public health foresight there is still a lack of basic knowledge on this field in addition to a shortage of professionals and organized teams in most MS.

MS need to develop and improve their foresight capacity. Recommendations include the establishment of foresight offices and increasing capacity through continuous training to academics and public health professionals. Comprehensive foresight capacity can enable the development of relevant arguments and skills to communicate results and implications to policy makers that can result in desirable policy change.

Regarding the network of public health foresight experts, it should be nurtured with the development of a set of meetings to discuss case studies, methodologies, experiences, and other relevant topics on public health foresight. Links with the EUPHA Public Health Section will be welcomed. These experts should also be engaged as much as possible to participate in the activities of the PHIRI project, namely during task 9.4 (Developing guidance in identifying promising policy strategies (translating the information into knowledge).

References

1. Conway M. An Overview of Foresight Methodologies. 2006;10.

2. Cuhls K. From forecasting to foresight processes—new participative foresight activities in Germany. J Forecast. 2003 Mar 1;22(2–3):93–111.

3. Gregório J, Cavaco A, Velez Lapão L. A scenario-planning approach to human resources for health: the case of community pharmacists in Portugal. Hum Resour Health. 2014 Oct 13;12:58.

4. Verschuuren M, Hilderink HBM, Vonk RAA. The Dutch Public Health Foresight Study 2018: an example of a comprehensive foresight exercise. Eur J Public Health. 2020 Feb 1;30(1):30–5.

5. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. BMJ. 2009 Jul 21;339:b2535.

6. European Centre for Disease Prevention and Control. Preparedness for COVID-19 [Internet]. European Centre for Disease Prevention and Control. [cited 2021 Jul 28]. Available from: https://www.ecdc.europa.eu/en/covid-19/preparedness-and-response

7. European Centre for Disease Prevention and Control. Infection prevention and control and preparedness for COVID-19 in healthcare settings - Sixth update [Internet]. Stockholm: ECDC; 2021 Feb. Available from: https://www.ecdc.europa.eu/sites/default/files/documents/Infection-prevention-and-control-in-healthcare-settings-COVID-19_6th_update_9_Feb_2021.pdf

8. Rijksinstituut voor Volksgezondheid en Milieu. Corona-inclusive Public Health Foresight Study [Internet]. Looking beyond COVID-19, about the future of our health. 2020 [cited 2021 Jul 28]. Available from: https://www.volksgezondheidtoekomstverkenning.nl/english/magazine

9. Martínez M del M, Fernandez S, Francés D, Marcos I. Spain after COVID-19: From resilience to reimagination. McKinsey & Company [Internet]. 2020 Jun 4; Available from: https://www.mckinsey.com/business-functions/risk/our-insights/spain-after-covid-19-from-resilience-to-reimagination

10. Martínez M del M, Fernandez S, Francés D, Marcos I. España post COVID-19: de la resiliencia a la reinvención. McKinsey Co. 2020 Jun;12.

11. FRESHER Project. Scenario Building Process [Internet]. Foresight Fresher. [cited 2021 Jul 28]. Available from: https://www.foresight-fresher.eu/fresher-project-results/scenario-building-process

12. Giesecke S, Guiffrè G, Hörlesberger M, Lai T, Mattioli B, Quaranta MG, et al. Drivers and Trends of Future Developments of Non-communicable Diseases. FRESHER Project; 2016 Mar.

13. Ricci A, Guiffrè G, Lai T, Üksik L, Zembala M, Halik R, et al. Health Scenario Stories. FRESHER Project; 2016 Jun.

14. FRESHER Project. The four FRESHER Scenarios [Internet]. Foresight Fresher. [cited 2021 Jul 28]. Available from: https://www.foresight-fresher.eu/fresher-project-results/four-fresher-scenarios

15. United European Gastroenterology. Healthcare in Europe 2040: Scenarios and implications for digestive and liver diseases [Internet]. United European Gastroenterology Research; Available from: https://ueg.eu/files/776/8c6744c9d42ec2cb9e8885b54ff744d0.pdf

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16. Lapalme H, Reynolds J, Hsu C. Future Scenarios for Food and Health Systems: Post-pandemic recovery and transition [Internet]. Nourish Health. [cited 2021 Jul 28]. Available from: https://www.nourishhealthcare.ca/blog/2020/4/27/future-scenarios-for-food-amp-health-systems-post-pandemic-recovery-and-transition-to-a-more-resilient-sustainable-and-equitable-health-care-system-in-canada

17. ACAPS. Scenario Building: How to build scenarios in preparation for or during humanitarian crises [Internet]. 2016 Aug [cited 2021 Jul 28]. Available from: https://reliefweb.int/sites/reliefweb.int/files/resources/acaps_technical_brief_scenario_building_august_2016.pdf

18. Sawka K, Mehra T. Healthcare Scenarios in a Trump World: The Future of the Affordable Care Act and Its Impact on Business Strategy. Boston, MA: Fuld + Company; 2017 p. 25 pages.

19. Barua B, Palacios M, Emes J. The Sustainability of Health Care Spending in Canada 2017 [Internet]. Canadá: FRASER Institute; 2017 Mar p. 44 pages. Available from: https://www.fraserinstitute.org/sites/default/files/sustainability-of-health-care-spending-in-canada-2017.pdf

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Appendices

A. Literature Search Strategy

	Query
Query 1 **"Scenario"**	TITLE-ABS-KEY ("Public Health" OR "Healthcare" OR "Health Systems") AND TITLE-ABS-KEY ("COVID-19") AND TITLE-ABS-KEY ("scenario") AND (LIMIT TO (LANGUAGE, "English") AND (LIMIT TO (PUBYEAR, 2021) OR LIMIT TO (PUBYEAR, 2020) OR LIMIT TO (PUBYEAR, 2019) OR LIMIT TO (PUBYEAR, 2018) OR LIMIT TO (PUBYEAR, 2017) OR LIMIT TO (PUBYEAR, 2016) OR LIMIT TO (PUBYEAR, 2015)
Query 2 **"Modelling"**	(TITLE-ABS-KEY ("Public Health" OR "Healthcare" OR "Health Systems") AND TITLE-ABS-KEY ("COVID-19") AND TITLE-ABS-KEY ("Modelling") AND (LIMIT TO (LANGUAGE, "English") AND (LIMIT TO (PUBYEAR, 2021) OR LIMIT TO (PUBYEAR, 2020) OR LIMIT TO (PUBYEAR, 2019)
Query 3 **"Preparedness"**	(TITLE-ABS-KEY ("Public Health" OR "Healthcare" OR "Health Systems") AND TITLE-ABS-KEY ("COVID-19") AND TITLE-ABS-KEY ("Preparedness") AND (LIMIT TO (LANGUAGE, "English") AND (LIMIT TO (PUBYEAR, 2021) OR LIMIT TO (PUBYEAR, 2020) OR LIMIT TO (PUBYEAR, 2019)
Query 4 **"Foresight"**	TITLE-ABS-KEY ("Public Health" OR "Healthcare" OR "Health Systems") AND TITLE-ABS-KEY ("COVID-19") AND TITLE-ABS-KEY ("foresight") AND (LIMIT TO (LANGUAGE, "English") AND (LIMIT TO (PUBYEAR, 2021) OR LIMIT TO (PUBYEAR, 2020) OR LIMIT TO (PUBYEAR, 2019) OR LIMIT TO (PUBYEAR, 2018) OR LIMIT TO (PUBYEAR, 2017) OR LIMIT TO (PUBYEAR, 2016) OR LIMIT TO (PUBYEAR, 2015)

B. Survey: Foresight Capacity and Activities

Introduction to this Survey

This survey is set up within the context of the PHIRI project. **PHIRI** aims to set up and lay the foundation of **a federated research infrastructure** on population health to facilitate and generate the best available evidence for research on health and well-being of populations. PHIRI's purpose is to **support research** across Europe to underpin (public health) policy decisions in current and future epidemics or crises. PHIRI's initial focus is the impact of COVID-19.

This project is composed by nine work packages. Particularly, Work Package 9 (**WP9**) aims to **gain insights in possible future health impacts of the COVID-19** outbreak, by **building capacity on foresight studies**, supporting countries to **develop scenarios**, building a network, and draw lessons for the EU.

The team members of WP9 of the PHIRI project invite you to participate in this survey. We **aim to collect information** to get an overview of how European countries have been **using foresight studies and methodologies** regarding COVID-19 and other public health areas, to **get insight on the needs** of European countries to develop capacity on foresight, and to **identify persons** for each country who wish to be part of our **public health foresight network.**

The survey consists of 8 questions within 4 sections covering: National Foresight Activities, Experts in the Field, Uptake in Policy Cycle, and Capacity Building Needs. It takes approximately 15 to 20 minutes to fill in this survey. You can pause and return to the survey if you need to; you can also go back and change answers if necessary. You **can respond** to this survey until **February 19th, 2021**.

If you have any questions about this survey, please contact PHIRI.NL@rivm.nl.

Scope of the Survey

Clarification of terminology

Foresight refers to a **broad range of methodologies to describe possible futures**. It comprises methodologies such as scenario building (including business-as-usual scenarios and policy scenarios), horizon scanning, trend impact analyses, driver analyses, etc. The working definition that we use is: "**Foresight is a systematic, participatory, future-intelligence-gathering, and medium-to long term *vision-building process* aimed at enabling present-day decisions and mobilizing joint actions**." (OECD, 2020)

Objectives of this survey:

1. To collect **information on current and recent foresight studies**, including (but not limited to) scenario building, preparedness, and modelling related to COVID-19 (and other health related aspects).
2. To **collect information on the existing capacities regarding foresight** studies and needs to expand these capacities.

3. To gain insights **in how foresights studies are being used in the policy making process** (policy uptake).

This survey considers:

- Information and **experiences on health-related foresight studies** in the European countries, particularly the EU/EFTA, as of **2015.** These include, but are not limited to: scenario building, preparedness studies, focus groups, and modelling.
- **Information on foresight capacity** of the member states (MS) in the EU/EFTA (existent or not, needs for capacity building) and/or organizations (e.g. academic and other research organizations) conducting research to inform policy makers. This information includes all experiences with foresight methodologies, the outcomes of research, and related publications **focused on public health related topics and COVID-19.**
- **Information on gaps and needs for foresight capacity from MS**. Information should include, but is not limited to: awareness on the use of foresight studies, the extent on which these methods have or have not been used, etc.

This survey does not consider:

- Foresight studies on non-public health related topics (e.g. social and economic studies, use of technologies, etc.)
- Specific health technologies (pharmaceutical products and medical devices)
- Studies before 2015

Target group(s):
This survey is directed to EU/EFTA based **policy makers and researchers in public health** organizations/institutions, ministries of health, academic (Universities), and non-academic research institutions with an interest in public health issues and foresight studies.

This survey does not consider MS outside EU/EUFTA and research and policy makers not involved in public health issues and foresight studies

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Questions:

Background

☐ I agree to my personal data being stored and used for the purpose of this survey, according to the GDPR and AVG regulations

Country: _____
Respondent:
- Name:
- Affiliation:
- Position (e.g. researcher, policy maker, etc.):
- Email:

Please provide us with your email address; you will receive a confirmation email with a PDF with your answers to this survey.

National foresight activities

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2. Are you aware of any foresight studies and/or activities performed in your country since 2015?*
   - Yes
   - No

If you answered 'No', you can continue with the last question (question number 8), so we can learn about foresight capacity needs.

3. Within these foresight studies, which health related topics or issues have been addressed?
   - Health conditions and diseases unrelated to COVID 19 (e.g. cancer, NCDs)
   - COVID 19 and related topics
   - Other public health issues (e.g. health capacity, health systems functioning, health technologies)
   - Health care expenditures
   - Determinants of health
   - Environmental issues (e.g. pollution and impact on health)
   - Other, please specify:____

Please specify your choice of 'Health conditions': _____
Please specify your choice of 'Other public health issues': _____
Please specify your choice of 'Determinants of health': _____
Please specify your choice of 'Environmental issues': _____

4. If these studies are **about COVID-19**, please provide as much information as possible (links to projects, reports, references, etc.)*
   Please provide information (links to projects, reports, references, etc.) of each example in a different text field (provided below)

5. For topics **other than COVID 19**, please list reports and projects on foresight studies in your country **with related links and references**? (or please include a brief description of the project if you have no links or references)*

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Experts in the field

6. Do you know who has carried/is carrying out health foresight studies/applied foresight methodologies/building scenarios in your country?*
   - Myself
   - Someone else. Could you please provide the contact details of experts in foresight in (public) health? (please provide name, affiliation, any other information): *_____

7. Did you/they have any partnership when carrying out foresight studies?
   - No.
   - Yes (Please provide information on countries, institutions, and/or researchers involved):*_____

Uptake in the policy cycle

8. Have the results of health foresight studies/activities been used by/to inform policy makers?*
   - No
   - Yes. How? (please share links, information, etc.)_____

Capacity building needs

We want to learn which are your needs on developing foresight skills in order to carry out foresight studies. Please indicate (with as much details as possible) what you would like to further develop and learn.

9. Do you think that your country needs additional public health foresight capacity?*
   o No
   o Understanding of foresight studies (e.g. basic concepts, methodologies, advanced applications, etc.)
   o Use of methodologies (e.g. scenario building, forecasting, etc.)
   o How to carry out foresight studies
   o Data (e.g. availability, analysis, etc.)
   o Resources and capacity (e.g. in governmental institutions)
   o Advocating foresight (e.g. knowledge translation, link to policy process, etc.)
   o Other, please specify_____

Please specify your choice of 'Understanding foresight studies': _____
Please specify your choice of 'Use of methodologies': _____
Please specify your choice of 'How to carry out foresight studies': _____
Please specify your choice of 'Data': _____
Please specify your choice of 'Resources and capacity': _____
Please specify your choice of 'Advocating foresight': _____

C. References from Survey

Member State	References to Foresight Studies on COVID
Austria	Bicher et al. Supporting Austria through the COVID-19 Epidemics with a Forecast-Based Early Warning System. MedRxiv, 2020. DOI: https://doi.org/10.1101/2020.10.18.20214767 Josef Baumgartner & Serguei Kaniovski & Jürgen Bierbaumer-Polly & Christian Glocker & Ulrike Huemer & Simon Loretz & Helmut Mahringer & Hans Pitlik, 2020. ""Die Wirtschaftsentwicklung in Österreich im Zeichen der COVID-19-Pandemie. Mittelfristige Prognose 2020 bis 2024"[Economic development in Austria under the sign of the COVID-19 pandemic]. Medium-term forecast 2020 to 2024 ," WIFO Monthly reports , WIFO, 2020; 93 (4), pages 239-265. Bundesministerium. Der Österreichische Strukturplan Gesundheit – ÖSG 2017 [The Austrian Health Structure Plan – ÖSG 2017]. 2017. Accessed 10 March 2021. Available at: https://www.sozialministerium.at/Themen/Gesundheit/Gesundheitssystem/Gesundheitssystem-und-Qualitaetssicherung/Planung-und-spezielle-Versorgungsbereiche/Der-%C3%96sterreichische-Strukturplan-Gesundheit-%E2%80%93-%C3%96SG-2017.html Reiter, D, FülOp, G, Pochobradsky, E, Röthlin, F, Stoppacher, A. Rehabilitationsplan 2020 [Rehabilitation Plan 2020]. Gusundheit Österreich, 2020. Accessed 11 March 2021. Available at: https://www.sozialversicherung.at/cdscontent/load?contentid=10008.742311&version=1611835415
Belgium	COVID en Wetenschap. RESTORE. 2020. Accessed 10 March 2021. Available at: https://covid-en-wetenschap.github.io/restore Franco, N. Covid-19 Belgium: Extended SEIR-QD model with nursing homes and long-term scenarios-based forecasts. MedRxiv, 2020. DOI: https://www.medrxiv.org/content/10.1101/2020.09.07.20190108v2 CORDIS. FRESHER Project - FoResight and Modelling for European HEalth Policy and Regulation. 2017. Accessed 11 March 2021. Available at: FoResight and Modelling for European HEalth Policy and Regulation	FRESHER Project	H2020	CORDIS	European Commission (europa.eu) KCE - Belgian Health Care Knowledge Centre. 2021. Accessed 11 March 2021. Available at: https://kce.fgov.be/en Van den Broeck, P, Raeumakers, P, et al. Future scenarios about drug development and drug pricing. KCE Report 271, 2016. Accessed 11 March 2021. Available at: https://kce.fgov.be/sites/default/files/atoms/files/KCE_271_Drug__Pricing_Report.pdf

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	Benahmed, N, Lefèvre, M, Vinck, I, Stordeur, S. Alternative scenarios for the forecasting of the midwifery workforce: horizon scanning and quantification model. KCE Report 312c, 2019. Accessed 11 March 2021. Available at: https://kce.fgov.be/en/alternative-scenarios-for-the-forecasting-of-the-midwifery-workforce-horizon-scanning-and
Bosnia and Herzegovina	UNDP. Jačanje DOTS strategije i unapređenje Programa borbe protiv tuberkuloze, uključujući i kontrolu pojave sojeva rezistentnih na više lijekova i kontrolu širenja infekcije u Bosni i Hercegoviniv [Strengthening the DOTS strategy and improving the Tuberculosis Control Program, including controlling the emergence of multidrug-resistant strains and controlling the spread of infection in Bosnia and Herzegovina]. 2016. Accessed 10 March 2021. Available at: https://www.ba.undp.org/content/bosnia_and_herzegovina/bs/home/operations/projects/democratic_governance/strengthening-the-dots-strategy-and-improving-the-national-tuber.html Federalno Ministarstvo Zdravstva. Strateške osnove za usvajanje i implementaciju Projekta jačanja zdravstvenog sektora [Strategic bases for the adoption and implementation of the Health Sector Strengthening Project]. Accessed 10 March 2021. Available at: https://www.fmoh.gov.ba/index.php/projekt-jacanja-zdravstvenog-sektora
Czech Republic	Dokumentaceprediktivnich modelu [Documentation of predictive models]. 2021. Accessed 10 March 2021. Available at: https://share.uzis.cz/s/cmFHjc4jbqPBAER
Estonia	Fischer, K and Kadastik, M. COVID-19 Prognoosid 22.12.2020 [COVID-19 prognosis 22.12.2020]. University of Tartu, 2020. Accessed 10 March 2021. Available at: https://www.kriis.ee/sites/default/files/eriolukord/covid19_progrnoosid_krista_fischer_ja_mario_kadastik.pdf Lukka, K and Habicht, T. Ravikindlustuse pikaajalise prognoosimudeli uuendamine ning uute poliitikastsenaariumite analüüs [Updating the long - term forecast model of health insurance and introducing new ones for the analysis of policy scenarios]. 2016. Accessed 11 March 2021. Available at: https://www.sm.ee/sites/default/files/content-editors/Ministeerium_kontaktid/Uuringu_ja_analuusid/ravikindlustuse_prognoos_2060.pdf
Finland	Tervola, J, Mukkila, S, Ilmarinen, K, Kapiainen, S. The effect of health care payment legislation on poverty – a simulation study. 2018. Accessed 11 March 2021. Available at: https://www.slideshare.net/THLfi/jussi-tervola-susanna-mukkila-katja-ilmarinen-ja-satu-kapiainen-the-effect-of-health-care-payment-legislation-on-poverty-a-simulation-study Honkatukia, J. Social and health care cost projections - the CHESS model. 2018. Accessed 11 March 2021. Available at: https://www.slideshare.net/THLfi/juha-honkatukia-social-and-health-care-cost-projections-the-chess-model Terveyden ha Hyvinvoinnin Laitos. WHO:n tavoite kansantautikuolleisuuden vähentämiseksi Suomessa realistinen – mutta ei itsestään selvä [The WHO goal

	of reducing mortality in Finland is realistic - but not self-evident]. 2015. Tutkimuksesta Tiiviisti 8. Accessed 11 March 2021. Available at: https://www.julkari.fi/bitstream/handle/10024/125823/URN_ISBN_978-952-302-458-8.pdf?sequence=1
Germany	RKI. Modellierung von Beispielszenarien der SARS-CoV-2-Epidemie 2020 in Deutschland [Modeling of example scenarios of the SARS-CoV-2 epidemic 2020 in Germany]. 2020. Accessed 10 March 2021. Available at: https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Modellierung_Deutschland.html Deutscher Bundestag. Unterrichtung durch die Bundesregierung. Bericht zur Risikoanalyse im Bevölkerungsschutz 2012 [Report on risk analysis in civil protection 2012]. 2013. Accessed 11 March 2021. Available at: https://dipbt.bundestag.de/dip21/btd/17/120/1712051.pdf
Ireland	Department of Health. Irish Epidemiological Modelling Advisory Group to NPHET. 2021. Accessed 10 March 2021. Available at: https://www.gov.ie/en/publication/dc5711-irish-epidemiology-modelling-advisory-group-to-nphet-technical-notes/ Brick A, Walsh B, Keegan C and Lyons S. COVID-19 and emergency department attendances in Irish public hospitals. ESRI Quarterly Economic Commentary, Special Article. 2020. Accessed 10 March 2021. Available at: https://www.esri.ie/publications/covid-19-and-emergency-department-attendances-in-irish-public-hospitals Keegan, C, Brick, A, Bergin, A, Wren, M-A, E, Henry, E. and Whyte, R. Projections of expenditure for public hospitals in Ireland, 2018–2035, based on the Hippocrates Model. ESRI Research Series Report 117. 2020. Accessed 10 March 2021. Available at: https://doi.org/10.26504/rs117 Brick, A, Keegan, C. Paying more to wait less: Estimating the cost of reducing Ireland's public hospital waiting lists. ESRI Working Paper 688. 2020. Accessed 10 March 2021. Available at: https://www.esri.ie/system/files/publications/WP688_0.pdf Wren MA, Keegan C, Walsh B, Bergin A, Eighan J, Brick A, Connolly S, Watson D, Banks J. 2017. Projections of Demand for Healthcare in Ireland, 2015-2030: First Report from the Hippocrates Model. Research Series Report 67. Dublin: ESRI. Accessed 11 March 2021. Available at: https://www.esri.ie/system/files/publications/RS67.pdf Keegan, C, Brick, A, Walsh, B, Bergin, A, Eighan, J, Wren MA, 2018, How many beds? Capacity implications of hospital care demand projections in the Irish hospital system, 2015-2030. The International Journal of Health Planning and Management, 2018, pp. 1-14. DOI: https://doi.org/10.1002/hpm.2673 Connolly S, Nolan A, Walsh B and Wren MA. 2018. Universal GP care in Ireland: Potential cost implications. Economic and Social Review 2018; 49(1): 93-109. Accessed 11 March 2021. Available at: https://www.esri.ie/system/files/media/file-uploads/2018-05/RB201813.pdf

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	Nolan, A. 2019. Reforming the delivery of public dental services in Ireland: potential cost implications. ESRI Research Series Report No. 80. DOI: https://doi.org/10.26504/rs80 Trinity College Dublin. The Irish Longitudinal Study on Ageing (TILDA). 2020. Accessed 11 March 2021. Available at: https://tilda.tcd.ie/about/ Doherty, E, Walsh, B, O'Neil, C. Decomposing socioeconomic inequality in child vaccination: Results from Ireland. Vaccine, 2014. 32 (17); pg 3438-3444. DOI: https://doi.org/10.1016/j.vaccine.2014.03.084
Netherlands	RIVM. 2020: New Dutch Public Health Foresight study in the light of COVID-19. 2020. Accessed 10 March 2021. Available at: https://www.rivm.nl/en/foresight-studies RIVM. PHFS-2018: A healthy prospect. 2018. Accessed 11 March 2021. Available at: https://www.rivm.nl/en/foresight-studies
Poland	ICM. ICM Epidemiological Model. 2020. Accessed 10 March 2021. Available at: https://covid-19.icm.edu.pl/en/ F. Rakowski, M. Gruziel, L. Bieniasz-Krzywiec, J. Radomski. Influenza epidemic spread simulation for Poland - a large scale, individual based model study. Physica A 389(16); pg 3149-3165. DOI: https://doi.org/10.1016/j.physa.2010.04.029
Portugal	Auditores Nacionais do Curso de Promoção a Oficial General. Desafios estratégicos para portugal no pós-COVID-19. Centro de Investigação e Desenvolvimento (CIDIUM). 2020. Available at: https://www.ium.pt/s/wp-content/uploads/CIDIUM/Cadernos%20do%20IESM-IUM/Cadernos%20do%20IUM%20N.%C2%BA43%20-%20Desafios%20Estrat%C3%A9gicos%20para%20Portugal%20no%20P%C3%B3s-Covid-19.pdf Valadares Tavares, L. Engineering and Technology for the Development of Portugal: Technology Foresigh, 2000-2020. Synthesis. Accessed 12 March 2021. Available at: https://docplayer.com.br/10306708-Engineering-and-technology-for-the-development-of-portugal-technology-foresight-2000-2020-synthesis-l-valadares-tavares.html DGS. Plano Nacional de Saúde - Revisão e Extensão a 2020 [National Health Plan - Revision and Extension to 2020]. Plano Nacional de Saúde, 2015. Accessed 12 March 2021. Available at: https://pns.dgs.pt/nhp-in-english-2/ FRESHER Project. Accessed 12 March 2021. Available at: https://www.foresight-fresher.eu/ Gregório, J., Cavaco, A. & Velez Lapão, L. A scenario-planning approach to human resources for health: the case of community pharmacists in Portugal. *Hum Resour Health* **12,** 58 (2014). DOI: https://doi.org/10.1186/1478-4491-12-58

	DGS. COVID-19. 2021. Accessed 12 March 2021. Available at: https://covid19.min-saude.pt/ Carmo Gomes, M, Nunes, A, Nogueira, J, Rebelo, C, Viana, J, Rozhnova, G. Previsões sobre o Futuro da Pandemia: O Papel dos Modelos Matemáticos [Forecasting the Pandemic: The Role of Mathematical Models]. Acta Med Port, 2020. 33(11): 713-715. DOI: 10.20344/amp.15049
Romania	Sistemul informatic integrat IASO [Integrated computer system – IASO]. 2020. Accessed 10 March 2021. Available at: https://www.spacescience.ro/projects/iaso/
Spain	Instituto de Salud Carlos III. Estudio Nacional de sero-Epidemiología de la infección por SARS-CoV-2 en España (ENECOVID) [National sero-Epidemiological study of the infection by SARS-CoV-2 in Spain (ENECOVID)] Accessed 10 March 2021. Available at: https://portalcne.isciii.es/enecovid19/ Instituto de Salud Carlos III. Monitorización del comportamiento y las actitudes de la población relacionadas con la COVID-19 en España (COSMO-SPAIN): Estudio OMS [Monitoring the behavior and attitudes of the population related to COVID-19 in Spain (COSMO-SPAIN): WHO Study]. Accessed 10 March 2021. Available at: chttps://portalcne.isciii.es/cosmo-spain/ Instituto de Salud Carlos III. Factores de difusión COVID-19 en España [COVID-19 spread factors in Spain]. Accessed 10 March 2021. Available at: https://coviddifusion.isciii.es/fdd/ Other sources on COVID-19: https://www.isciii.es/QueHacemos/Servicios/VigilanciaSaludPublicaRENAVE/EnfermedadesTransmisibles/MoMo/Paginas/MoMo.aspx https://www.isciii.es/QueHacemos/Servicios/VigilanciaSaludPublicaRENAVE/EnfermedadesTransmisibles/MoMo/Paginas/MoMo.aspx

D. Literature Review: Table with some studies

Concept	Title	Year	Author	Conclusions
Scenario	COVID-19 pandemic, dengue epidemic, and climate change vulnerability in Bangladesh: Scenario assessment for strategic management and policy implications	2021	Rahman, Md Mostafizur; Bodrud-Doza, Md; Shammi, Mashura; Islam, Abu Reza Md Towfiqul; Khan, Abu Sadat Moniruzzaman	Assess the potential impact of a simultaneous strike of climatic hazards and infectious disease outbreaks and their possible strategic management in Bangladesh under 3 different scenarios (cyclon or flood plus covid; denge or malaria plus covid; all together)
	Simulation and Improvement of Patients' Workflow in Heart Clinics during COVID-19 Pandemic Using Timed Coloured Petri Nets	2020	Zeinalnezhad, Masoomeh; Chofreh, Abdoulmohammad Gholamzadeh; Goni, Feybi Ariani; Klemes, Jiri Jaromir; Sari, Emelia	This is one of the few studies that show how hospitals can use workflow modelling using timed coloured Petri nets to manage healthcare systems in practice.
	Routine childhood immunisation during the COVID-19 pandemic in Africa: a benefit-risk analysis of health benefits versus excess risk of SARS-CoV-2 infection	2020	Abbas, Kaja; Procter, Simon R.; van Zandvoort, Kevin; Clark, Andrew; Funk, Sebastian; Mengistu, Tewodaj; Hogan, Dan; Dansereau, Emily; Jit, Mark; Flasche, Stefan	High-impact scenario and a low-impact scenario for approximating the effects of sustaining routine childhood immunisation during the COVID-19 pandemic.
	Deficit and occupancy of beds in the adult intensive care unit of the Unified Health System in the state of Piaui from the perspective of COVID-19	2020	dos Santos Silva, Pedro Henrique; Vieira Cirilo, Sara Sabrina; Soares, Lorena Sousa; Fernandes Silva, Franciele Basso	Scenarios for the dissemination of the new coronavirus were proposed, and mathematical calculations were used to estimate the deficit and occupancy of the adult SUS ICU beds, for each health macroregion in the state
	Living in a Multi-Risk Chaotic Condition: Pandemic, Natural Hazards and Complex Emergencies	2020	Hariri-Ardebili, Mohammad Amin	5 scenarios - pandemic only, pandemic plus natural hazard, pandemic plus political conflict or protests, all 3 together. The final scenario is an intense version of any of the previous four scenarios. One major conclusion out of this paper is that a multi-hazard situation combining any three hazard sources of pandemic, natural hazard, and complex emergency might have a cascading effect. Since various dimensions of this problem is still unknown (i.e., we do not have a quantitative metric to evaluate the risk, and we clearly are not prepared to face it), the authors implore governments to allocate additional financial

				resources to multi-hazard risk research, paving the way for a safer, less uncertain future.
	Assessing the hospital surge capacity of the Kenyan health system in the face of the COVID-19 pandemic	2020	Barasa, Edwine W.; Ouma, Paul O.; Okiro, Emelda A.	Assessing the hospital surge capacity of the Kenyan health system, 3 scenarios depending on the level of transmission of covid
	Economic evaluation of border closure for a generic severe pandemic threat using New Zealand Treasury methods	2018	Boyd, Matt; Mansoor, Osman D.; Baker, Michael G.; Wilson, Nick	Border closure scenarios due to pandemics or bioweapon
	Alternatives for saving lives in slums during the pandemic: the contribution of dynamic systems	2020	Diniz Chaves, Gisele Lorena; de Oliveira, Igor Czermainski; Rodrigues, Vinicius Picanco; Viegas, Claudia Viviane; de Carvalho Aquino, Ellen Larissa	Brazil, slums, scenarios for covid fight
	Egypt beyond covid 19, the best and the worst-case scenarios	2020	Rezk, M.R.A.; Piccinetti, L.; Radwan, A.; Salem, N.M.; Sakr, M.M.; Khasawneh, A.	Egypt, 2 scenarios for economy after covid
	Built environment of Britain in 2040: Scenarios and strategies	2021	Gürdür Broo, D.; Lamb, K.; Ehwi, R.J.; Pärn, E.; Koronaki, A.; Makri, C.; Zomer, T.	Great Britain, 3 scenarios for green environment in 2040
Modelling	Real-time measurement of the uncertain epidemiological appearances of COVID-19 infections	2021	Gupta, M.; Jain, R.; Taneja, S.; Chaudhary, G.; Khari, M.; Verdú, E.	Deep learning prediction model of confirmed and death cases of COVID-19 in following 30 days based on previous 260 days, India.
	Coronavirus disease model to inform transmission reducing measures and health system preparedness, Australia	2020	Moss, R.; Wood, J.; Brown, D.; Shearer, F.M.; Black, A.J.; Glass, K.; Cheng, A.C.; McCaw, J.M.; McVernon, J.	SEIR modelling study that concludes an unmitigated COVID-19 epidemic would dramatically exceed the capacity of the health system of Australia over a prolonged period. Not for general and further use but a model that justifies flatten the curve strategy. Not for public use, no detailed descriptions of model, just results.
	Estimation and Monitoring of COVID-19's Transmissibility From Publicly Available Data	2020	Silveira, A.; Pereira, Jr., A.	In this work, data from the number of susceptibilities, infections, recoveries, deaths, and individual parameters of three coupled differential equations were combined.
	Impact of social distancing measures on coronavirus disease healthcare	2020	Wang, X.; Pasco, R.F.; Du, Z.; Petty, M.; Fox, S.J.; Galvani, A.P.; Pignone, M.;	A mathematical model of COVID-19 transmission that incorporates age-stratified risks

	demand, central Texas, USA		Claiborne Johnston, S.; Meyers, L.A.	and contact patterns and projects numbers of hospitalizations, patients in intensive care units, ventilator needs, and deaths within US cities.
	Pandemic responses in vulnerable communities: A simulation-oriented approach	2020	Rodrigues, V.P.; de Oliveira, I.C.; Chaves, G.L.D.; Aquino, E.L.C.; Viegas, C.V.	Simulation model with policy recommendation-
	A novel heuristic algorithm for the modeling and risk assessment of the covid-19 pandemic phenomenon		Asteris, P.G.; Douvika, M.G.; Karamani, C.A.; Skentou, A.D.; Chlichlia, K.; Cavaleri, L.; Daras, T.; Armaghani, D.J.; Zaoutis, T.E.	The time evolution of COVID-19 is investigated for six different countries/states, namely New York, California, USA, Iran, Sweden and UK based on a recent heuristic algorithm proposed by the authors.
	Investigating the trajectory of the covid-19 outbreak in Milwaukee county and projected effects of relaxed distancing	2020	Bemanian, A.; Ahn, K.W.; O'brien, M.; Rausch, D.J.; Weston, B.; Beyer, K.M.M.	Compartmental models were used to estimate the number of hospitalizations and critically ill patients in Milwaukee County if distancing policies were removed
	Real-time neural network-based predictor for cov19 virus spread	2020	Wieczorek, Michal; Silka, Jakub; Polap, Dawid; Wozniak, Marcin; Damasevicius, Robertas	real-time predictor to help in estimation of COVID-19 spread. This prediction model is developed using Artificial Neural Networks (ANN) to estimate the future situation by the use of geo-location and numerical data from past 2 weeks
	The impact of lockdown strategies targeting age groups on the burden of COVID-19 in France	2020	Roche, Benjamin; Garchitorena, Andres; Roiz, David	Model aiming at seeing which age group should be under lockdown - the answer is young people, and not (only) elderly. France
	A network model of Italy shows that intermittent regional strategies can alleviate the COVID-19 epidemic	2020	Della Rossa, Fabio; Salzano, Davide; Di Meglio, Anna; De Lellis, Francesco; Coraggio, Marco; Calabrese, Carmela; Guarino, Agostino; Cardona-Rivera, Ricardo; De Lellis, Pietro; Liuzza, Davide; Lo Iudice, Francesco; Russo, Giovanni; di Bernardo, Mario	A network model that sees Italy regions as nodes and says national lockdown can be avoided
Foresight	Four normative perspectives on public health policy-making and their preferences for bodies of evidence	2020	Schoemaker, C.G.; Van Loon, J.; Achterberg, P.W.; Den Hertog, F.R.J.; Hilderink, H.; Melse, J.; Vonk, R.A.A.; Van Oers, H.	In this paper, we illustrate how policy frames may favour the use of specific bodies of evidence.

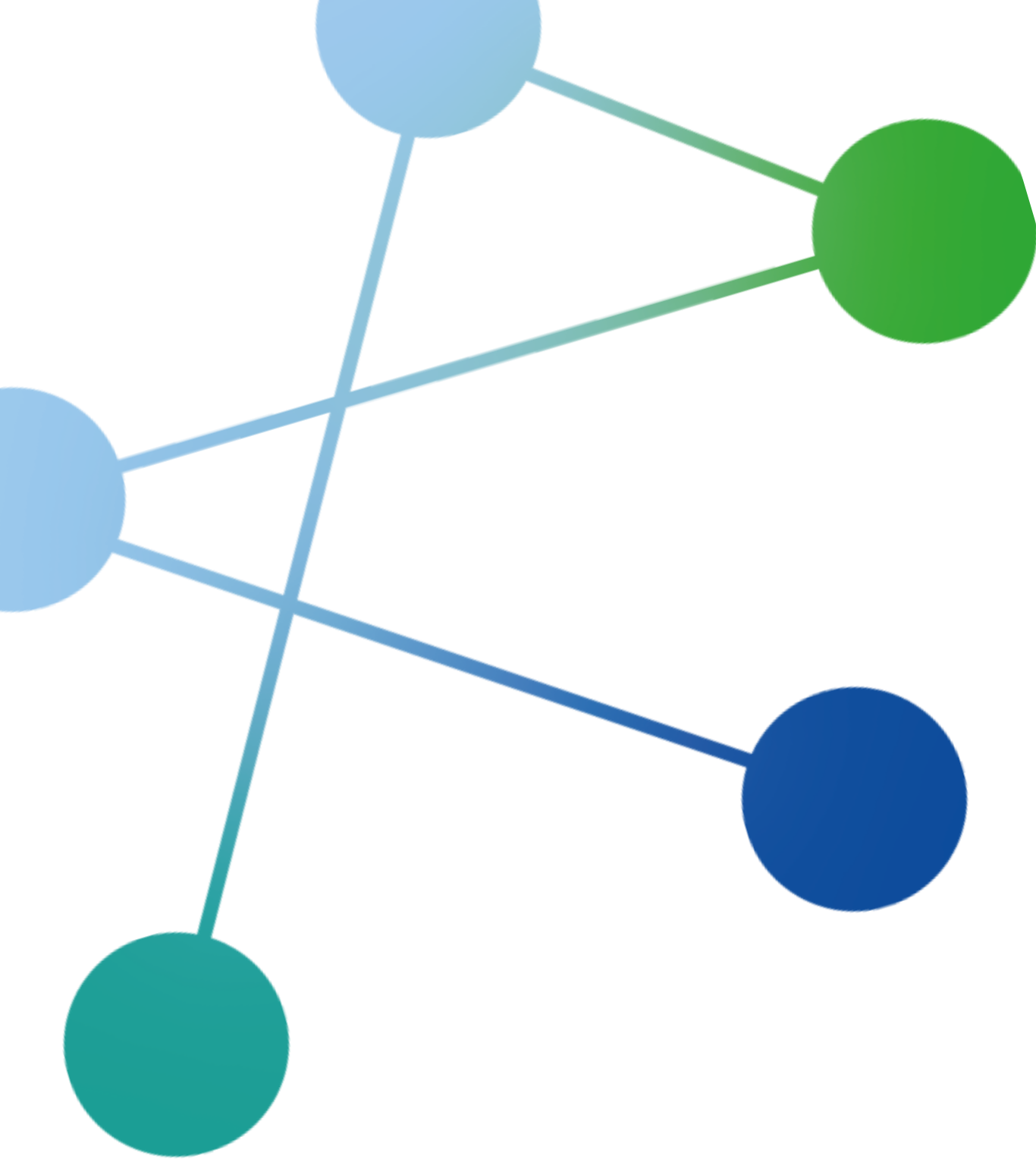|	Title	Year	Authors	Description
	Strategic foresight, leadership, and the future of rural healthcare staffing in the United States	2018	Reimers-Hild, C.	This article uses a strategic foresight tool, megatrends, to examine forces influencing long-term healthcare staffing in the rural United States.
	Health information technologies in Iran: Opportunities for development	2019	Hemmat, M.; Ayatollahi, H.; Maleki, M.; Saghafi, F.	This study aimed to investigate the key and non-key health information technologies which could be considered for the future strategy development in Iran.
	A qualitative study of the current situation of elderly care in Iran: what can we do for the future?	2016	Goharinezhad, S.; Maleki, M.; Baradaran, H.R.; Ravaghi, H.	This study was conducted to identify the challenges of elderly care in Iran and to help policymakers develop roadmaps for the future through providing a clearer image of the current state of affairs in this area of healthcare.
	Enhancing optimization planning models for health human resources management with foresight	2020	Amorim-Lopes, M.; Oliveira, M.; Raposo, M.; Cardoso-Grilo, T.; Alvarenga, A.; Barbas, M.; Alves, M.; Vieira, A.; Barbosa-Póvoa, A.	This study proposes a new socio-technical methodology to factor in uncertainty over the future within mathematical programming modelling. The methodological approach makes use of foresight and scenario planning concepts to build tailor-made scenarios and scenario fit input parameters, which are then used within mathematical programming models
	Outbreak Column 20: are outbreaks man-made disasters that display intertwined errors of human judgement and behaviour?	2017	Curran, E.T.	The purpose of this reflective exercise was to turn hindsight into foresight and determine the intertwined levels of safety behaviour needed to prevent any future pathogen emerging to produce healthcare disasters.
	A multi-stakeholder perspective on sustainable healthcare: From 2030 onwards	2020	Pereno, Amina; Eriksson, Daniel	This study aimed to address the topic of the possible futures of sustainable healthcare from a multi-stakeholder perspective, in order to define a long-term scenario and the key strategies to enhance this transition.
	The Dutch Public Health Foresight Study 2018: an example of a comprehensive foresight exercise	2020	Verschuuren, Marieke; Hilderink, Henk B. M.; Vonk, Robert A. A.	This paper gives a general overview of the Dutch Public Health Foresight Study (PHFS) 2018, providing insight into what performing a broad scenario exercise in the field of public health entails and its societal impacts.

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	Wiring up multiple layers of innovation ecosystems: Contemplations from Personal Health Systems Foresight	2017	Pombo-Juarez, Laura; Konnola, Totti; Miles, Ian; Saritas, Ozcan; Schartinger, Doris; Amanatidou, Effie; Giesecke, Susanne	This paper develops further the concept of `multi-layered foresight' by addressing multiple layers of innovation ecosystems in foresight design and management.
	Foresight of Promising Technologies for Healthcare-IoT Convergence Service by Patent Analysis	2019	Lee, Sangjic; Choi, Jinwoo; Sawng, Yeong-wha	This study aims to offer a foresight of promising technologies for the ICT-based healthcare by employing two technology forecasting methods.
Preparedness	Assessing COVID-19 through the lens of health systems' preparedness: time for a change	2020	El Bcheraoui, Charbel; Weishaar, Heide; Pozo-Martin, Francisco; Hanefeld, Johanna	a new model of development assistance for health, one that is focused on stronger and more resilient health systems, should be the world's top priority.
	Responses to COVID-19 in five Latin American countries	2020	Alejandra Benitez, Maria; Velasco, Carolina; Sequeira, Ana Rita; Henriquez, Josefa; Menezes, Flavio M.; Paolucci, Francesco	This paper focuses on the first months of the pandemic in five Latin American countries: Brazil, Chile, Colombia, Ecuador and Peru. It analyses how the pre-pandemic context, and the government's responses to contain and mitigate the spread together with economic measures have affected the COVID-19 health outcomes.
	Projected health-care resource needs for an effective response to COVID-19 in 73 low-income and middle-income countries: a modelling study	2020	Edejer, Tessa Tan-Torres; Hanssen, Odd; Mirelman, Andrew; Verboom, Paul; Lolong, Glenn; Watson, Oliver John; Boulanger, Lucy Linda; Soucat, Agnes	This study aimed to identify what the additional health-care costs of a strategic preparedness and response plan (SPRP) would be if current transmission levels are maintained in a status quo scenario, or under scenarios where transmission is increased or decreased by 50%.
	Disease burden and clinical severity of the first pandemic wave of COVID-19 in Wuhan, China	2020	Yang, Juan; Chen, Xinhua; Deng, Xiaowei; Chen, Zhiyuan; Gong, Hui; Yan, Han; Wu, Qianhui; Shi, Huilin; Lai, Shengjie; Ajelli, Marco; Viboud, Cecile; Yu, Hongjie	Here the authors analyze disease burden and clinical severity of COVID-19 during the first wave in Wuhan, China in comparison to past influenza virus pandemics and COVID-19 in the US and Canada. These estimates of symptomatic cases, medical consultations, hospitalizations and deaths

				should guide preparedness for this disease.
	Preparedness of the Healthcare Personnel Against the Coronavirus Disease 2019 (COVID-19) Outbreak: An Audit Cycle	2020	Zafar, Nowera; Jamal, Zohaib; Khan, Muhammad Mujeeb	This study is focused on assessing the preparedness of healthcare personnel and the effectiveness of an educational intervention to improve this preparedness in those dealing with the COVID-19 infection.
	Strategies for Post-COVID Cities: An Insight to Paris En Commun and Milano 2020	2020	Pisano, Carlo	This study aims to introduce a series of factors that should be taken into consideration in building a working framework to define and evaluate strategies for post-COVID cities.
	Public governance mechanism in the prevention and control of the COVID-19: information, decision-making and execution	2020	Xiang, Gao; Jianxing, Yu	In the context of coordinating multiple stakeholders, the role of the local government can be defined as `meta-governance'. It shall provide rules to facilitate collective action and co-produce quality public services. However, the case of Wuhan suggests that some local governments still rely on the traditional administrative system, which hampers them in terms of issuing a sufficient response to the COVID-19 outbreak.
	COVID-19 preparedness among Emergency Departments: A cross-sectional study in France.	2020	Casalino, E.; Bouzid, D.; Ben Hammouda, A.; Wargon, M.; Curac, S.; Hellmann, R.; Choquet, C.; Ghazali, D.A.	To evaluate hospital and Emergency Department (ED) preparedness in France facing the Coronavirus disease 2019 (Covid-19) rapid growth epidemic-phase, and to determine the link between preparedness and responsiveness.
	Assessing healthcare Workers' knowledge, emotions and perceived institutional preparedness about COVID-19 pandemic at Saudi hospitals in the early phase of the pandemic	2020	Alreshidi, N.M.; Haridi, H.K.; Alaseeri, R.; Garcia, M.; Gaspar, F.; Alrashidi, L.	This study aimed to assess HCWs knowledge, emotions and perception of preparedness of their institutions towards COVID-19 pandemic.
	Preparedness of African Palliative Care Services to Respond to the COVID-19 Pandemic: A Rapid Assessment	2020	Boufkhed, S.; Namisango, E.; Luyirika, E.; Sleeman, K.E.; Costantini, M.; Peruselli, C.; Normand, C.; Higginson, I.J.; Harding, R.	To evaluate the preparedness and capacity of African palliative care services to respond to the COVID-19 pandemic.

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