

HEALTH EVIDENCE NETWORK SYNTHESIS REPORT 54

Evidence on mechanisms and tools for use of health information for decision-making

Victoria Blessing | Anoushka Davé | Peter Varnai



The Health Evidence Network

HEN – the Health Evidence Network – is an information service for public health decision-makers in the WHO European Region, in action since 2003 and initiated and coordinated by the WHO Regional Office for Europe under the umbrella of the European Health Information Initiative (a multipartner network coordinating all health information activities in the WHO European Region).

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Health Evidence Network synthesis report **54**

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Abstract

The World Health Assembly in 2005 urged Member States to establish or strengthen knowledge transfer mechanisms to support evidence-informed health policies and health care delivery. The European Health Information Initiative was set up to strengthen the use of evidence, information and research for policy-making in the WHO European Region. While good-quality health information is a key component for decision-making, it needs to be packaged and communicated in an effective way to policy-makers, the end-users. This report describes tools and mechanisms that can help to increase the use of health information in policy development. Packaging tools include synthesis methods, such as policy briefs, and visualization methods. Application tools include surveillance data and modelling/simulation to explore the behaviour and performance of processes and interventions. Dissemination and communication tools include health information-sharing platforms, newsletters and person-to-person communications. Finally, linkage and exchange tools such as knowledge networks facilitate the dissemination and refining of health information, thus increasing the chance of its translation into policy.

Keywords

HEALTH INFORMATION SYSTEMS, EVIDENCE-BASED PRACTICE, POLICY MAKING, HEALTH POLICY

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CONTENTS

▶ Abbreviations.....	iv
▶ Contributors.....	v
▶ Summary.....	vii
▶ 1. Introduction.....	1
▶ 1.1. Background.....	1
▶ 1.2. Methodology.....	5
▶ 2. Results.....	6
▶ 2.1. Health information packaging tools.....	10
▶ 2.2. Application tools.....	18
▶ 2.3. Dissemination and communication tools.....	22
▶ 2.4. Linkage and exchange tools.....	26
▶ 2.5. Linking tools to intended outcomes.....	28
▶ 3. Discussion.....	29
▶ 3.1. Strengths and limitations of the review.....	29
▶ 3.2. Additional considerations: health information quality.....	29
▶ 3.3. Tools and mechanisms to support the use of health information.....	31
▶ 3.4. Policy options and implications.....	34
▶ 4. Conclusions.....	36
▶ References.....	38
▶ Annex 1. Search strategy.....	47

ABBREVIATIONS

ART	artemisinin-based combination therapy
EVIPNet	Evidence-informed Policy Network
NGO	nongovernmental organization
SURE	Supporting Use of Research Evidence (project)



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SUMMARY

The issue

Evidence-informed policy-making is expected to contribute to stronger health systems because of the assumption that policy-makers will make better decisions if they are provided with higher-quality information. Health information includes data on population health status and mortality over time, causation of health problems, associations between health outcomes and risk or protective factors, and the effectiveness of public health interventions. However, the availability of health information does not inherently lead to its increased use in policy- and decision-making. Various tools and mechanisms can help to increase the use of health information in policy development by making policy-makers appreciate, understand and incorporate health information into policy decisions.

The synthesis question

This review examined methods to support the use of health information by public health and health system policy-makers, asking the question: “What is the evidence on mechanisms and tools for use of health information for decision-making?”

Types of evidence

The review draws from peer-reviewed publications indexed in the PubMed and Scopus databases as well as from grey literature and other health information-oriented databases. Publications were included if they were primary research articles or systematic reviews about tools and mechanisms that support the uptake of health information in policy-making.

Results

Knowledge translation mechanisms and tools that support the use of health information for policy decision-making may be grouped into four broad categories based on the way that health information is incorporated by policy-makers:

- packaging tools, including synthesis and visualization tools;
- application tools, including modelling and simulation;
- dissemination and communication tools such as electronic, automated and person-to-person dissemination methods; and
- linkage and exchange tools, including knowledge platforms and brokering.

All these tools can have one or more modalities and outcomes when used by policy-makers. However, evidence about successes and challenges in the use of health information for evidence-informed policy-making is still emerging.

Policy considerations


Health information systems include all relevant actors from the health information producers through brokers and networks and on to the intended end-users of health information, the policy-makers. Use of health information can be generated by:

- **push methods**, where information producers on their own initiative use research data and health information to create products such as academic publications or evidence briefs;
- **pull methods**, where policy-makers commission an evidence brief based on exact specifications;
- **exchange methods**, where information analysts and policy-makers work in partnership, often facilitated by knowledge brokers, to collect evidence and organize the necessary steps together from agenda setting to implementation; and
- **integrated methods**, where a knowledge translation platform is institutionalized in an organization or in the broader health system with key stakeholders represented, clear objectives for action, regular assessment of the relevance of its efforts and incorporation of elements of push, pull or exchange efforts.

The specific applicability of each of the tools and mechanisms highlighted in this review will depend on its intended purpose and the context and environment within which it will be deployed, but all are capable of being used in resource-scarce settings to support decision-making. Examples are given in the review of how multiple tools can be used together or sequentially to achieve maximum effect. Based on the findings of the review, the following options can be suggested for three key stakeholder groups.

Health information producers might consider:

- ensuring that the health information produced meets the needs of, and is relevant to, the end-users by engaging with them on a continuous basis;
- establishing personal contact with brokers and end-users to build trust because trusted partnerships increase the prospects of health information being considered reliable and then used;

- 
- fostering the use of packaging tools in conjunction with dissemination and communication tools to achieve the highest benefit from health information; importantly, the better the coordination between the tools, the greater the benefit is likely to be; and
 - adding value to health information packaging by using application tools such as models and simulations to fill gaps and present scenarios.

Knowledge brokers might consider:

- establishing relationships with and acting as an active link between producers and users of health information to build a value chain and bring health information into immediate practical use;
- presenting suitably packaged health information, both on their own initiative as well as when prompted by end-users; and
- advocating a key role for knowledge brokers in increasing the capacity of policy-makers to use health information for decision-making.

Health information users might consider:

- ensuring effective strategic oversight over information integration and production;
- establishing personal contacts with health information providers to learn about available health information and its potential uses, and deepen personal understanding;
- informing health information providers about health information needs and working with them to identify and fill remaining information gaps; and
- institutionalizing links with health information providers to ensure an adequate supply of health information in terms of coverage and timeliness.

The most effective use of health information is when all stakeholders interact and communicate to ensure the best available evidence is used to support choice of policy options.





1. INTRODUCTION

1.1. Background

Evidence-informed policy-making is rapidly becoming a cornerstone of modern public health policy worldwide. At the World Health Assembly in 2005, WHO Member States were urged to establish or strengthen knowledge transfer mechanisms in order to support evidence-informed public health and health care delivery systems as well as evidence-informed health policies (1). This commitment was reiterated in 2016 with the Action Plan to Strengthen the Use of Evidence, Information and Research for Policy-making in the WHO European Region (2), which was presented at the 66th session of the WHO Regional Committee for Europe and is implemented under the European Health Information Initiative (a multipartner network coordinating all health information activities in the WHO European Region). Policies informed by evidence are expected to contribute to stronger health systems based on the assumption that higher-quality evidence will help policy-makers to make better decisions (2–4). Importantly, incorporating evidence into policy requires not only a comprehensive understanding of the policy-making process but also awareness of how to source, use and implement evidence in a timely manner (2,5). As such, in practice, there is room for improvement in using evidence more and in better ways to influence policy development. This can often be achieved through efficient knowledge translation mechanisms.

WHO defines knowledge translation as “the synthesis, exchange and application of knowledge by relevant stakeholders to accelerate the benefits of global and local innovation in strengthening health systems and improving people’s health” (6). While health researchers, especially in clinical medicine, often consider explicit clinical research to constitute evidence, policy-makers take a broader view. Policy-makers consider evidence to arise from several other sources beyond clinical and observational health research, as long as these sources are valid and relevant to the population (7). Such sources may include health information, expert opinion and experiences, and the prevailing historical and political context.

1.1.1. Health information

Health information is a subset of evidence that encompasses data and indicators related to socioeconomic determinants of health; health status/mortality of individuals and populations; risk factors; service coverage; and health system

inputs, outputs and outcomes (8,9). It is collected, processed, stored, reported and used with the aim of influencing policy- and decision-making, programme action and efficient resource allocation, ultimately for improving health outcomes (8). Health information systems provide the underpinnings for decision-making and have four key functions: data generation; data compilation; analysis and synthesis; and communication and use. The health information system collects data from the health sector and other relevant sectors, analyses the data and ensures their overall quality, relevance and timeliness, and finally converts the data into information for health-related decision-making (10). The health information system is heavily biased towards quantitative (longitudinal) data, which can be disaggregated by sex, age and socioeconomic characteristics (8). These data may be used by researchers, data analysts, public health managers or policy-makers to:

- describe the scope and magnitude of health conditions and their geographical and demographical distribution;
- explore the associations between health outcomes and risk or protective factors; and
- assess the effectiveness of public health interventions.

Some of the common sources of health information for policy are census data, birth and death records, public health and behavioural surveillance data, service-generated data from public health facilities, national health accounts and household surveys (8). A health observatory is an institutional mechanism that can help to incorporate health information into policy-making and can undertake public health monitoring by producing, assembling and analysing information on health outcomes and their determinants (11). Observatories can be governmental, nongovernmental or academic entities that monitor health trends, identify gaps in health information, provide guidance on the appropriate methods to be used and integrate population-based (e.g. vital statistics, censuses and sociodemographic surveys) and institution-based data from both within and outside the health sector. Emerging models show that decision-makers can also be active and contributing coproducers of new information for public health decision-making (12). Such collaboration in a functioning health information system can enhance the richness, relevance and real-world applicability of health information.

1.1.2. The use of health information in policy-making

Policy development is an extended, iterative process, and, therefore, health information can influence policy at multiple points in this process (13,14). Typically, policy-makers use health information to identify the need for policy action,



to formulate a policy, to implement it in a feasible way (e.g. by using health information to create awareness and mobilize communities) and finally to determine how effective a policy is in terms of addressing the problem in question (14). Importantly, health information can be used at the early agenda-setting stage to frame the magnitude of the health problem and also at midterm and ex-post policy evaluation stages to assess various aspects of the implemented policy, such as change in burden or cost-effectiveness of the new intervention. The outcome of the evaluation, in turn, may lead to setting new policy agendas or adjusting the existing policy (14). A functioning health information system, therefore, involves policy-makers who request health information and who can evaluate its relevance, interpret it and use it for feedback into policy.

However, the availability of good-quality health information does not inherently lead to an increased uptake by policy-makers. In order for such uptake to occur, interventions in the technical, behavioural and organizational domains are necessary (15). The technical domain includes systems or processes to collect and review health information and to ensure the quality of such information (e.g. in terms of its interpretability, timeliness, completeness, accuracy, validity and relevance). The behavioural domain relates to the attitudes and capacity of information producers and end-users when using data to solve problems and improve programmes. Finally, the organizational domain concerns the structure and processes of the organizations that use the data.

1.1.3. Modalities

Mechanisms and tools to support evidence-informed policy-making may take different forms and may be driven by different stakeholder groups. Additionally, they may have different modalities. Tools may be used in response to push activities by producers of research data and health information or pull actions from data users to establish links between evidence and action (16). For example, an evidence brief may be created by information producers on their own initiative on topics of their choice (push efforts) or may be commissioned by policy-makers based on exact specifications (pull efforts) (17). The producer push modality may be passive, for example through posts on organizational websites, academic publications and conference presentations, or it may involve active promotion and communication through the preparation of policy briefs, targeted mail to policy-makers or sharing results on health information exchange platforms. Producers may facilitate user pull by providing access to health data and information (e.g. setting up rapid response units to meet users' needs) and contribute to training of users to create capacity to acquire, assess and use evidence in decision-making (17).

Push and pull activities may also coexist in a modality termed exchange. In this case, producers and policy-makers work in real partnership, often facilitated by knowledge intermediaries or brokers, with division lines between stakeholders becoming fuzzy. They may co-design approaches to generate evidence and execute the necessary steps together, from agenda setting to implementation (16).

Finally, when knowledge translation platforms, incorporating elements of push, pull or exchange efforts, are institutionalized in an organization or in the broader health system, the modality is known as integrated efforts (17). Integrated efforts include setting up a transparent governance structure with key stakeholders represented, establishing a clear objective for action, regularly assessing priorities to ensure that efforts remain relevant, and facilitating both push and pull efforts.

1.1.4. The objective of this report

While there is extensive literature on how to translate knowledge of research-based evidence into policy, there is limited literature on how to incorporate health information into policy, particularly on suitable tools and mechanisms by which that integration can be accomplished. This report aims to fill this gap by undertaking a systematic literature review to describe the tools and mechanisms that can help to increase the use of health information in health systems and policies. In doing so, it is assumed that health information is of quality, available and accessible, and attention is focused on the tools and mechanisms that facilitate the uptake of health information by policy-makers.

Considering the complexity of health information, health information systems and stakeholder types (e.g. governments, health policy-makers, health professionals, knowledge brokers, nongovernmental organizations (NGOs), researchers, patients and the wider community), a broad typology has been devised to catalogue the tools and mechanisms and to describe these with their modalities and intended outcomes. The use of research and health information tools is illustrated with real-world examples to provide guidance to policy-makers for future applications.



1.2. Methodology

Prior to the systematic literature review, a scoping review was performed to map key concepts and identify the main data sources. Sources for the review published worldwide from January 2005 to July 2016 were identified from the peer-reviewed and grey literature sources using both English and Russian search terms.

A total of 4056 articles were identified during the first screening and assessed based on article title and then on abstract. After clustering and assessing for eligibility, 108 full text articles were downloaded and analysed in detail and a final group of 54 were included in this review (9,11–13,15–64).

Annex 1 gives full details of the methodology.

2. RESULTS

This section describes the tools and knowledge translation mechanisms that are available for health information producers, public health and health systems policy-makers, and networks and knowledge brokers. To reflect the primary mechanism/modality of facilitating uptake of health information by policy-makers, the tools are grouped into four broad categories: packaging tools, application tools, dissemination and communication tools, and linkage and exchange tools. The relevant primary mechanisms (17) are:

- push efforts, which involve providing knowledge to users in appropriate formats (i.e. packaging and dissemination);
- facilitated pull efforts to enable policy-makers to identify relevant information (e.g. one-stop shops, websites, application tools);
- pull efforts by end-users to draw relevant evidence into policy-making (e.g. through knowledge brokering); and
- linkage and exchange efforts that aim to build relationships between health information producers and users.

Table 1 summarizes and highlights the modalities, intended outcomes and stakeholders for the tools discussed below. Although the intended outcomes of the tools were not always explicit in the literature, the main intended outcomes could be inferred from the context-specific uses described. Nevertheless, there may be other intended outcomes in other circumstances.

Table 1. Tools in relation to changes in attitude, knowledge and intention to facilitate use

Tools	Stakeholders	Modality	Intended outcome
Health information packaging			
Synthesis tools			
Policy briefs	Experts/researchers, policy-makers, health practitioners, civil society, NGOs, media, citizens	Push, pull, exchange	To provide access to or package health information in a user-friendly manner, to change stakeholders' knowledge, to respond to stakeholders' needs
Local health messages/memoranda	Experts/researchers, policy-makers, health practitioners, civil society, NGOs, media, citizens	Push, pull, exchange	To provide access to or package health information in a user-friendly manner, to increase the ability to access and apply health information in policy-making
Visualization tools			
Graphs/charts	Experts/researchers, policy-makers, health practitioners, civil society, NGOs, media, citizens	Push	To provide access to or package health information in a user-friendly manner
Maps	Experts/researchers, policy-makers, health practitioners, civil society, NGOs, media, citizens	Push	To provide access to or package health information in a user-friendly manner
Interactive graphs	Experts/researchers, policy-makers, health practitioners, civil society, NGOs, media, citizens	Push, pull (as user can choose data)	To provide access to or package health information in a user-friendly manner, to increase the ability to access and apply health information in policy-making

Table 1. (Contd)

Tools	Stakeholders	Modality	Intended outcome
Applications			
Simulation and modelling	Experts/researchers, policy-makers, health practitioners	Push, exchange, integrated	To make health information more accessible for policy-making, to use an institutionalized setting to facilitate effective integration of key stakeholders
Surveillance	Experts/researchers, policy-makers, health practitioners	Exchange, integrated	To make health information more accessible for policy-making, to use an institutionalized setting to facilitate effective integration of key stakeholders
Dissemination and communication			
Electronic methods			
Health information sharing platforms/ health information exchange	Experts/researchers, policy-makers, health practitioners, civil society, NGOs, media, citizens	Push, pull, exchange, integrated	To provide access to or package health information in a user-friendly manner, to use an institutionalized setting to facilitate effective integration of key stakeholders
Automated electronic methods			
Newsletters	Experts/researchers, policy-makers, health practitioners	Push	To provide access to or package health information in a user-friendly manner
Email messages	Experts/researchers, policy-makers, health practitioners	Push	To provide access to or package health information in a user-friendly manner
Phone messages	Health practitioners, citizens	Push	To provide access to or package health information in a user-friendly manner



Table 1. (Contd)

Tools	Stakeholders	Modality	Intended outcome
Person-to-person communications			
Oral presentations	Experts/researchers, policy-makers, health practitioners, civil society, NGOs, media, citizens	Push, exchange	To change stakeholders' attitude or knowledge, to encourage acceptance and adoption of health information by policy-makers, to gain insight into policy-makers' needs
Deliberative dialogue	Experts/researchers, policy-makers, health practitioners, NGOs, citizens	Exchange	To change stakeholders' attitude or knowledge, to encourage acceptance and adoption of health information by policy-makers
Linkage and exchange tools			
Different stakeholders exchanging their expertise			
Dedicated groups of stakeholders	Experts/researchers, policy-makers, health practitioners	Exchange, integrated	To provide access to or package health information in a user-friendly manner, to change stakeholders' attitude or knowledge, to encourage acceptance and adoption of health information by policy-makers
Knowledge networks	Experts/researchers, policy-makers, health practitioners, civil society, NGOs, media, citizens	Exchange, integrated	To provide access to or package health information in a user-friendly manner, to change stakeholders' attitude or knowledge, to encourage acceptance and adoption of health information by policy-makers

Table 1. (Contd)

Tools	Stakeholders	Modality	Intended outcome
Experts acting as individual knowledge brokers linking stakeholders to relevant information	Experts/researchers, policy-makers, health practitioners	Push, pull, exchange, integrated	To provide access to or package health information in a user-friendly manner, to change stakeholders' attitude or knowledge, to increase the ability to access and apply health information in policy-making, to encourage acceptance and adoption of health information by policy-makers

2.1. Health information packaging tools

The use of health information for decision-making can be encouraged by employing tools that present or package it in such a way that the information “speaks” to users more easily. This can be achieved by making the information more accessible through synthesis and visualization.

2.1.1. Synthesis

Synthesis tools pull together existing evidence, including health information, for users. It involves the aggregation of explicit and tacit knowledge, often from diverse sources. The collected information is compared and presented in a form that can be readily used by the stakeholders. Examples include:

- evidence briefs for policy (or policy briefs)
- local health memoranda
- public health reports.

A policy brief is a concise summary of a high-priority issue that explores ways to address an issue and provides suitable policy options and implementation considerations for policy-makers in an objective way (18,20). It aims to convince policy-makers about the urgency of the problem and offers strategies of intervention. A policy or evidence brief can take various forms (65). For example, the WHO Evidence-informed Policy Network (EVIPNet) produces evidence briefs as cooperative productions between researchers, policy-makers and other stakeholders for policy.



The briefs do not provide any policy recommendations but include descriptions of a problem, policy options and implementation considerations (66). Political choice (determined by factors beyond evidence) governs which options will be implemented.

A policy brief uses a synthesis approach and may be structured in a variety of ways to provide information in a format and language that is understood by policy-makers, thereby enhancing the likelihood of the information being useful to inform policy. This tool first identifies a current priority issue where policy intervention is sought then draws on evidence, including systematic reviews and local data and studies, to contextualize findings and support policy decisions (19). Policy briefs can be created because an organization sees a need to collate the available information (e.g. WHO on an issue such as immunization) or as a response to a specific request for an evidence brief. In the latter case, a rapid response mechanism is usually required to provide timely information (Box 1) (21).

Box 1. Providing evidence briefs upon users' requests with a rapid response mechanism

A consortium of researchers at the Makerere University College of Health Sciences in Uganda set up a rapid response mechanism to provide evidence syntheses as requested by users. This was as partners of the EVIPNet Africa platform within the framework of the SURE project (21). The service is run by a dedicated team that receives and responds to policy-makers' urgent requests for evidence about health systems. After receiving a request, the unit assesses how it can best be addressed and its scope defined. Members of staff then search for relevant research and health information, which is appraised, contextualized and summarized. The resulting evidence brief is then reviewed by subject experts, both local and international. The evidence briefs are ready within a maximum of 28 days, depending on the specifications from policy-makers. This service has been well received by policy-makers, supporting them in decision-making. One evidence brief produced using this rapid response mechanism was on Optimizing the health workforce for effective family planning services, where systematic reviews were conducted to identify data on efficacy and safety of contraception provision by health care providers. Another evidence brief was on Task shifting to optimize the roles of health workers to improve delivery of maternal and child health care, where systematic reviews were used with underlying information sources such as the Uganda Health and Demographic Survey, Uganda Population Census and Uganda Bureau of Statistics.

Box 1. (Contd)

These evidence briefs helped to inform a discussion between policy-makers, civil society and researchers on possible health policy decisions, bringing about a change in stakeholders' knowledge (66).

Policy briefs are not exclusively for synthesizing health information but also allow the collection and use of quantitative health information (e.g. through systematic reviews or databanks) and/or local evidence (e.g. local programme evaluations) to explore factors relevant for implementing new interventions (Box 2) (22,66).

Box 2. EVIPNet Africa workshop on drafting policy briefs about artemisinin-based combination therapies for malaria

In 2008, a joint workshop was convened by EVIPNet Africa at the Ethiopian Health and Nutrition Research Institute (22). As part of this workshop, six EVIPNet Africa country teams as well as the East African Community produced a draft policy brief on how to support the widespread use of artemisinin-based combination therapy (ACT) to treat uncomplicated falciparum malaria in their respective countries. Country teams considered (i) treatment delivery, such as who should dispense ACTs, who should be involved in surveillance and pharmacovigilance; (ii) finances, such as drug subsidies and implementation costs; and (iii) government-level arrangements, such as choice of drugs and suppliers, marketing and prescription policies and regulation. Subsequently, each team produced policy briefs with three viable policy options accompanied by an assessment of impact in terms of costs and consequences of implementing the policy. In 2009, the policy briefs were further developed and used in the respective countries to convene a national policy dialogue involving senior government officials and key stakeholders, including civil society groups. A policy brief arguing for improved access to ACTs in Mozambique used health information (national and regional prevalence figures in children and women) gathered by the Malaria Indicator Survey in its problem statement. EVIPNet Burkina Faso's policy brief directly informed Burkina Faso's successful application to the seventh round of the Global Fund to Fight AIDS, Tuberculosis, and Malaria, and has helped to secure funding for three community-level pilot projects on the impact of community health workers (one of the policy options in the brief). The policy brief was based on systematic reviews and statistics from health facilities on admission, consultation and mortality data.



Box 2. (Contd)

Health information such as incidence of and death rates from malaria, individuals' access to physicians and community health workers, and usage rates of different malaria treatments helped to define and contextualize the problem, for example the low coverage rates for ACTs (20). Subsequently, information on treatment costs, cost-effectiveness and likely outcomes also fed into the formulation of practical policy options for increasing the coverage rate for ACTs, such as financial subsidies or target payments for ACTs and allowing community health workers to diagnose malaria and prescribe ACTs (20).

Several how-to guides and manuals are available for preparing and using policy briefs. One example is the guides produced by the Supporting Use of Research Evidence (SURE) project, available from WHO (65). There are eight guides: two presenting background information on how to get started, four taking readers step-by-step through the process of preparing policy briefs and two giving advice on how to use policy briefs in policy dialogues and to inform and engage stakeholders. Similarly, the SUPPORT tools for evidence-informed health policy-making also include a guide for preparing and using policy briefs, which consists of questions that should be considered while preparing and using evidence-based policy briefs (20,67).

Local health memoranda (or messages) can be used by national policy-makers and researchers to brief local health policy actors and health professionals about the local health situation and provide them with policy recommendations. These tools can be used to promote national health policy priorities at the local level. Formal and informal input from health information producers (e.g. health service epidemiologists) as well as local stakeholders (e.g. policy advisors and local health officials) increases the relevance and uptake of the recommendations (23). Local health memoranda are typically developed for specific social contexts, and it could be argued that using knowledge generated in one context in a different context changes its relevance and hence corresponding policy recommendations may have to be adapted (Box 3).

Box 3. Local health messages for municipalities in the Netherlands

In the Netherlands, a set of local health messages were created for 48 municipalities based on key messages of the National public health status and forecast report (23). The local health memoranda included information from epidemiological analysis and policy recommendations tailored to the

Box 3. (Contd)

local health situation. The concise local health profile showed a comparison of municipal figures against regional and national figures, wherein the health profile indicators were related to key messages and based on national and international epidemiological health indicators, such as life expectancy, death rates and incidences of chronic diseases and their influence on the quality of life. The local health messages emphasized the possibilities of preventive measures for determinants such as obesity, smoking, alcohol use and physical inactivity. The memoranda were produced after deliberation from actors including local policy-makers, politicians, health care and welfare professionals and client representatives. Several benefits of this tool were reported, such as accessibility and comprehensibility, links with national health policies, the local orientation and the involvement of officials and administrators at the development stage, resulting in enhanced credibility and relevance of the local health messages.

Public health reports are another way to synthesize health information for a broad audience including policy-makers, politicians, public health specialists and journalists (68,69). These are typically published by governments (national and local), international organizations such as WHO, and think tanks. For example, the European Health Report, which is published every three years, gives readers a vital snapshot of health in the WHO European Region and progress towards the goals of Health 2020, the European health policy framework, and reveals gaps, inequalities and areas of concern and uncertainty where action should be taken (69). The WHO Regional Office for Europe also publishes Highlights on Health, which gives an overview of a country's health status, including recent data on mortality, morbidity and exposure to key risk factors and trends over time (70). The reports are prepared with the collaboration of Member States and link health information to public health policy considerations. Comparisons are made with a reference group of countries, and, therefore, data are usually taken from the European Health for All database of the WHO Regional Office for Europe (71).

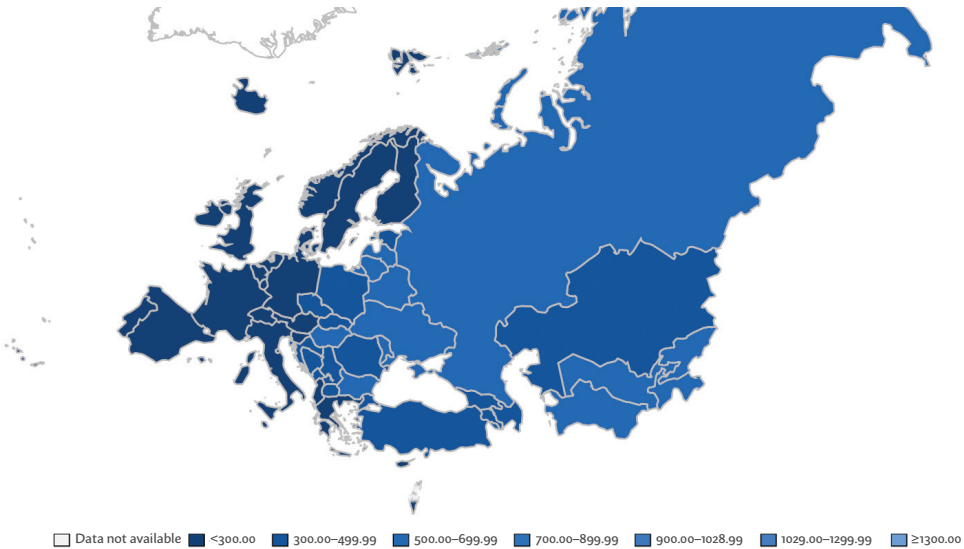
2.1.2. Visualization tools

For health information to be useful, it needs to be analysed and communicated in a way that is easy to use and practical, allowing both specialists and nonspecialists to understand and use it (72). Presenting health information visually can help users to capture and comprehend complex information more quickly, and, therefore, makes it easier to draw conclusions. Various tools to visualize health information

are available, ranging from the most common static graphs, charts and maps through to infographics and complex interactive graphs. However, visualization is not a straightforward task and it is essential that the underlying information is represented accurately and consistently throughout.

Simple graphs and charts, such as line graphs, bar charts or pie charts, are the most common types of visualization and can be used to depict a variety of health information including time-series and statistical data. For example, vaccination rates according to factors such as socioeconomic status or geography could be visualized using bar charts or pie charts. Maps and e-atlases are often used for reporting health information according to geographical location (Fig. 1). For example, heat maps that display higher to lower value data as colours can be used to visualize health statistics across a particular geographical region. Such maps can usefully convey diverse data, for example antimicrobial drug consumption and resistance (74), or tobacco burden (75), disaggregated by country, allowing easy comparison.

Fig. 1. Map of premature mortality rates for four major noncommunicable diseases (cardiovascular diseases, cancer, diabetes mellitus and chronic respiratory diseases) as deaths per 100 000 population.



Source: WHO Regional Office for Europe, 2017 (73).

A visual overview of key health information including health data and actionable messages can be delivered by combining text, figures, graphs and pictures. This is called an infographic and it helps stakeholders convey complex information and associations in a simple, easily understandable format (24). Infographics are now part of the standard visualization arsenal of major health policy organizations such as WHO (76), the United States Centers for Disease Control and Prevention (77), the Institute for Health Metrics and Evaluation (78), the Kaiser Family Foundation (79) and The King's Fund (80). Even leading media houses such as the New York Times and the Guardian in the United Kingdom have invested heavily in this area because of its perceived potential for communicating information in a visually appealing and engaging manner (72).

Publicly available visualization tools may be preconfigured for particular health information datasets, and users can choose which ready-made graphs and charts they are interested in (81). Alternatively, some visualization tools allow users to select health information according to their interest, and the interactive tool then visualizes their chosen information (82,83). Relevant examples are the WHO European Health Information Gateway (Box 4) (84), the WHO European health statistics mobile app (85) and the Portuguese National Health Service's Transparency website (86), which aggregate all health information and provide a wide range of tools for visualization.

Box 4. The WHO European Health Information Gateway

Health information is often scattered and difficult to access in a format that policy-makers and the public can easily understand. The WHO European Health Information Initiative opened a new public portal in 2016 called the European Health Information Gateway to provide access to curated health data and information from official sources at WHO and partner organizations at the United Nations and many other data sources (e.g. the European Commission and the Organisation for Economic Co-operation and Development) (84). The Gateway provides access to health information under various headings, including noncommunicable diseases, foodborne diseases, antimicrobial resistance, mental health, health literacy, health system performance and national policies about e-health.

The Gateway features an interactive section, where the user can customize datasets to visualize and compare data across countries and over time; the data can be exported as images and data files or disseminated as graphs



Box 4. (Contd)

directly via social media. It also provides important notes and metadata to aid understanding. A new tool, the Health for All explorer, is available to explore and compare health data from a range of databases across the WHO European Region, including the European health policy framework, Health 2020, indicators, the European Health for All database, European mortality data and the Health Behaviour in School-age Children survey data. A new feature launching in October 2017 will be an integrated and responsive search for information across data and information in the Gateway. It will make the Gateway closer to an information discovery tool, providing statistical data side by side with the relevant contextual information.

The Gateway is complemented by a WHO European health statistics mobile app (85), which provides immediate access to data on indicators measuring the implementation of Health 2020, indicators from the WHO Health Behaviour in School-aged Children study. This off-line functionality is an ideal statistics reference in essential indicators for international comparisons for policy-makers and anyone who works in public health.

Consequently, both the Gateway and the mobile app facilitate access to health information, enabling its use for evidence-informed policy-making.

Data dashboards are another popular way to display data from health information systems. A data dashboard is an information management tool that often involves a central platform to visually track data and then to analyse and display key performance indicators as tables, line charts or bar charts. Dashboards are often customized to the specific needs of national or local health policy-makers. For example, the Portuguese National Health Service provides a public dashboard that shows data at regional or aggregated national level and for several key health indicators related to service delivery in the health sector (87).

In addition, dynamic graphs that display animated statistics or videos showing how health indicators change over time can be used for visualization. Interesting examples are the online tools Gapminder (88) and Health for All explorer of the European Health Information Gateway (84), which let users produce videos with their choice of health information and indicators.

2.2. Application tools

Application tools enhance existing empirical knowledge by creating a conceptual model and using it to forecast and test various future scenarios. These tools can be conveniently integrated in online health information and surveillance platforms so that data interpretation is made easier for decision-makers.

2.2.1. Modelling and simulation tools

A model is a simplified, mathematical representation of a real phenomenon, often built on existing data and variable parameters. Simulation tools can, in turn, extend such models by applying an algorithm and exploring the behaviour and performance of processes and interventions. These tools are frequently used to predict the possible impacts of a policy change (e.g. health care policy options), test the sensitivity of the results and manage the risks of interventions. Models can, therefore, explain a complex phenomenon and serve as the basis for simulations to predict the course of an event or help to assess the efficacy (or cost–benefit implications) of interventions (25). Economic models are widely used in government (26), while epidemiological models are typically used in research and surveillance environments to address questions that arise from health policy concerns. For example, pandemic models, based on epidemiological data derived from disease surveillance data or field studies, help to inform strategic planning and risk assessment for future pandemic outbreaks (25). Another example is assessing life expectancy, a crucial health indicator of population health, which requires statistical modelling using mortality rates and demographic factors (89).

A good model, one that predicts scenarios accurately, has two main requirements: first, knowledge of the phenomenon so that the most relevant parameters are fed into the algorithm, and second, accurate data for those parameters that are available (Box 5). Problems with either of these two factors would bring undue uncertainties into the model, thus affecting the quality of projections. For this reason, some policy-makers are wary of models, either because they disagree with the starting assumptions or do not understand the modelling process itself. The best strategy, therefore, is to involve policy-makers in the modelling team and keep the model as simple as possible (26).

Simulation models are critical components of health information systems. These are used to create links between observation and theory and to help to determine risks and outcomes based on existing health information. Since health policy-making relies mostly on observational rather than experimental information, simulation can add



an additional layer of knowledge generated from health information. In addition, some simulation tools then facilitate access to the results through visualization (32). An interactive element is included in some simulations, where users can change certain parameters. This can offer policy-makers a deeper understanding of the underlying health information by giving them the opportunity to explore how different parameters affect the results of the simulation (Box 6) (33). In addition, such tools can be used to forecast health indicators, predict future scenarios and test hypotheses or interventions quickly and relatively cheaply (25).

Box 5. DYNAMO-HIA: a dynamic modelling tool for generic health impact assessments

DYNAMO-HIA is a simulation tool that has been devised with two main objectives: to provide health evidence and predict future consequences of implementing different policy options on population health and to aid decision-makers in choosing between options (27,90). The tool aims to provide a sufficiently accurate model for describing dynamic changes over time with modest data requirements and an accessible graphical user interface to ensure wide usability in applied settings. This is particularly important for decision-making by policy-makers, where time and resources are often scarce. The tool is also capable of simulating realistic counterfactual scenarios, which are notoriously difficult to obtain in evaluations.

DYNAMO-HIA is available freely to all with a user guide and manual; training seminars have been offered to public health officials, decision-makers and epidemiologists. It has already been used to inform policy-makers about a wide range of health issues, including the impact of second-hand smoke exposure (28), health gains by salt reduction (29), health impacts of increasing alcohol prices (30) and increased physical activity from changes in transportation infrastructure (31).

Box 6. Use of epidemiological modelling to support public health policy: a policy effectiveness–feasibility loop

The policy effectiveness–feasibility loop is a collaborative effort between researchers and policy-makers, bringing together epidemiological modelling, local situation analysis and option appraisal to develop evidence-informed public health policy (33). First, the major determinants of trends in disease incidence and mortality are identified and associated parameters can then be used to explore the impacts of different policy options. The parallel situation

Box 6. (Contd)

analysis (covering existing policy conceptualization and implementation and attitudes of key stakeholders) provides an insight into existing policy gaps as well as the feasibility and acceptability of policy options aimed at filling those gaps. Results of the epidemiological modelling and situation analysis are used to prepare a list of policy options, which are then prioritized, and the options with high priority are further examined in terms of costs and benefits. The iterative involvement of policy-makers and researchers in the collection and appraisal of evidence is a key aspect of the loop (33).

2.2.2. Integrated public health surveillance platforms

Public health surveillance programmes are part of national public health systems and often provide a platform for ongoing systematic collection, analysis and interpretation of health data, coupled with timely dissemination to support public health action (34). The provision of relevant and timely evidence by surveillance platforms serves to empower decision-makers to lead and manage more effectively, and hence substantial attention is given to the prompt and complete production of surveillance data (35). Surveillance systems may include periodic population-based surveys; laboratory-based surveillance; sentinel surveillance, where a prearranged sample of sources report on specified health indicators; and integrated disease surveillance and response. The last system is used in the integrated collection of epidemiological and laboratory data related to infectious diseases with response, evaluation and policy change at all levels in the health system (35). The importance of linking policy action to disease surveillance is emphasized by Foege, Hogan and Newton, who stated: “the reason for collecting, analysing, and disseminating information on a disease is to control that disease. Collection and analysis should not be allowed to consume resources if action does not follow” (36).

Health information generated by surveillance may be indicator based or event based (37). Indicator-based surveillance is widely used to collect and analyse structured data through regular reporting by health care providers and diagnostic laboratories (37). This approach is useful to signal possible health threats based on predefined indicators and thresholds, which can then be addressed through policy. However, it is unable to track unexpected threats or provide a timely analysis of fast-moving events. In contrast, event-based surveillance relies on the rapid capture of information about events through monitoring real-time events or communication channels such as news media, Internet, public health networks or



NGO communication channels. Importantly, event-based surveillance systems can be useful in areas where formal health care systems do not exist and surveillance data are not collected systematically.

An electronic real-time mortality monitoring system in Portugal automatically analyses public health information on mortality and makes it accessible to health administrators, public health authorities and health planners. Other examples of integrated surveillance data platforms include monitoring the public health impact of heat-waves by the Québec National Institute for Public Health (Box 7) (38,91,92), environmental public health tracking in the United States of America at the local, state and federal levels (Box 8) (39), and surveillance for injury prevention and control by the Pan American Health Organization (40).

Box 7. An open source web application for the surveillance and prevention of the impacts on public health of extreme meteorological events: the SUPREME system

The Québec National Institute for Public Health developed and implemented SUPREME, an integrated web application based on open source software for the real-time surveillance and prevention of impacts of extreme meteorological events on public health (38,91). This decision-support system is composed of four modules: (i) data acquisition and integration; (ii) risk analysis and alerts; (iii) cartographic application; and (iv) climate change and health information dissemination. Through a secure web information portal, it provides health specialists access to weather forecasts, historical and real-time indicators (including deaths and hospital admissions), alerts and various cartographic data. Based on these data, specialists can decide when to undertake prevention activities or launch emergency measures.

The SUPREME system was successfully used during a heat-wave in 2010. The system provided all the relevant heat-related information in real time to all actors involved, allowing appropriate measures to be deployed in a coordinated and timely manner, and reducing the impact of the heat-wave on the population's health.

Since 2010, the Québec National Institute for Public Health has produced annual reports that document the health impacts of heat-waves at regional level, supporting policy-makers for future health protection measures (92). The SUPREME project is now part of the 2013–2020 Climate Change Action Plan of the Government of Québec (91).

Box 8. Centers for Disease Control and Prevention's National Environmental Public Health Tracking programme

Established in 2002, the tracking programme is based on the National Environmental Public Health Tracking Network, which is a multitiered, web-based system that functions at the local, state and federal levels (39). The network provides a system for collecting and linking multiple datasets on health, environmental and other factors, and then channels the information towards activities to improve the health of communities. Twenty-three states and New York City have developed their own networks along the same lines to collect the standard data as well as data specific to their own needs. In addition, the environmental public health workforce has been enhanced and collaborations between state and local public health practitioners, academic institutions, federal agencies and NGOs have been established. Impacts of the programme and network have included identifying populations at risk, responding to emerging threats, examining the relationship between hazards and disease, and informing policy-makers and communities regarding potential environmental health risks. Using health information from the network, over 200 public health actions were initiated between 2005 and 2013, at the request for (emergency or routine) assistance from communities, state or local government and other agencies.

2.3. Dissemination and communication tools

2.3.1. Electronic tools for dissemination and communication

Platforms for sharing health information allow users to select and access health information electronically. Some provide information to users, others let users link up with each other in networks to share information, and some fulfil both of these functions. The Swiss health information exchange e-toile, which moves patient-level information between different organizations, is an example of the last, with participating health care professionals holding their own data rather than a centralized health information database (41). It took more than 10 years from the initial mandate to first implementation, mainly because of tensions between stakeholders and perhaps the fragmented structure of the Swiss health system. However, a clear e-health law and e-health strategy were key enablers in ultimately establishing the new exchange service. Internationally, the potential of health information exchanges to address cost and quality issues in health care continues



to motivate governments to invest in such systems; however, functioning health information exchanges are not common across the world. Efforts vary in terms of scope, scale and motivation. Usual challenges include ensuring interoperability, record linking, fit-for-purpose infrastructure, governance issues and interorganizational relationships (93). Other electronic dissemination tools, which also provide advanced visualization capabilities, are the WHO European Health Information Gateway and the WHO European health statistics mobile app (Box 4) (84,85) and the Portuguese National Health Service's Transparency website (86).

Health information-sharing platforms may provide electronic versions of short opinion pieces (blogs), reports, manuals, policy briefs or fact sheets (94–98). The dissemination materials are then used in stakeholder discussions, project implementation, training or further research. These publications often explore the effectiveness of public health interventions, for example health facility surveys, promotion of healthy lifestyles or mental health interventions at the workplace.

Similarly, stakeholder networks provide a space for members to share health information directly with each other, and often also provide health information in the form of reports (99,100). Such networks may facilitate exchanges and interactions by providing mailing lists and group spaces in an online knowledge hub, as well as organizing national face-to-face meetings, regular web conferences and web-based seminars (webinars). The Knowledge into Action Network of the NHS Education for Scotland Knowledge Services was specifically created for a knowledge brokering role in health and social care (100).

National clinical databases can also be a source of health information and can be used to inform and evaluate health care policies. In the United States, electronic health record databases have been used for postmarketing safety surveillance and for evaluating the effectiveness of risk management interventions (42). In these instances, medical record data provided a context for interpreting spontaneous adverse events and a means to conduct epidemiological studies to test specific hypotheses related to drug adverse events. Both data and research based on data from national clinical databases have been used by policy-makers to inform policies, for example in the United Kingdom for policies on waiting lists (42), adult critical care, renal services and stroke care, among others (43).

Some health information platforms also have interactive elements, where users can answer questions about their situation or health information needs, hence allowing them to receive tailor-made recommendations based on their input (101).

Some platforms also provide an opportunity for users to interact, thus allowing them to share and discuss relevant health information and its analysis and interpretation.

Health information is increasingly disseminated via online toolkits such as educational materials, templates, instruction sheets, literature reviews, videos and posters in a variety of formats (44). These help to build awareness, inform, and change public and health care provider behaviour.

2.3.2. Tools for automated electronic dissemination of information

Health information can be electronically delivered to stakeholders directly. Newsletters, email messages, tweets or phone messages are all tools that can be used to disseminate information in this way.

Newsletters include the most recent health information and are distributed to interested stakeholders at fixed intervals, for example quarterly. They often cover emerging or current health topics; for example Health Horizons, a quarterly summary newsletter published by the Ontario Ministry of Health and Long-Term Care in Canada, combines information from all jurisdictions relevant to the topic (45). Messages may be targeted towards recipients more directly using emails that contain health information specifically relevant to their interests. For example, evidence briefs and synthesis reports may be attached directly to the email or provided through web-links (46). In addition, phone messages, tweets and text messages can be used to share health information instantly, although the amount of information that can be shared in this way is limited and information overload is a potential problem. For example, reminders to take medication or be vaccinated could be sent by these means, as could succinct information regarding the importance of vaccinating a particular target population (47). Harvard Medical School also operates a twitter account (@HarvardHealth) that provides health information to policy-makers and the wider public. While these specific examples do not include an option for users to indicate their preferences and consequently receive tailored information, a customization option could potentially be offered for any of these tools.

2.3.3. Tools for person-to-person communication of health information

Health information can also be disseminated through personal contacts. By exchanging knowledge on a personal level, trust can be created between stakeholders, which, in turn, increases the likelihood of health information being



used (46,48,49). Examples of person-to-person dissemination tools include oral presentations, discussions and deliberative dialogues.

Oral presentations can be given by one person or several people for an audience and are often supported by visualization aids (e.g. PowerPoint slides). These may contain health information embedded in different example scenarios and personal interest stories, and they can be targeted towards the audience in terms of content as well as tone (49). Discussions usually follow presentations, allowing exchange of opinions between different stakeholders on a specific topic. Deliberative dialogues are a specific form of discussion that aim at developing a common understanding among participants (16). They are focused on specific issues, and participants are encouraged to explore strategies to address them as well as consider potential solutions. Deliberative dialogues can themselves be informed by health information presented through tools such as evidence briefs and oral presentations. However, they go beyond discussing the presented evidence and aim to harvest the tacit knowledge of key health system actors and those likely to be affected by related policy decisions. Deliberative dialogues thus strengthen interactions among policy-makers, stakeholders and researchers; create ownership of the evidence (which, in turn, increases the prospects of its use in policy-making); and further strengthen exchange efforts. Key features of a specific approach for deliberative dialogues used by the McMaster Health Forum include (i) addressing a high-priority policy issue based on a precirculated evidence brief; (ii) providing an opportunity to discuss options for addressing the problem; (iii) providing an opportunity to discuss key implementation considerations; (iv) balancing the representation of stakeholders who could be involved in or affected by future decisions; and (v) facilitating deliberations following the Chatham House rule (i.e. any information disclosed in the meeting may be reported but the source of the information may not be identified) and without aiming for consensus (50). The McMaster Health Forum website provides some guidance on the constituent steps for stakeholder dialogues, which are built around a deliberative dialogues approach (102). The website also has advice for facilitating such dialogues, building a consensus and organizing and hosting stakeholder dialogues. While deliberative dialogues are generally well received by all parties, the lack of consensus-seeking was identified as the least helpful feature, which may prevent participants from acting on what they had learned (51).

Knowledge exchange on a personal level can take place at workshops and conferences. It can also occur at regular public stakeholder meetings of research

and health information producers and policy-makers as an additional agenda item in order to improve attendance (52). Now, through technological advances, person-to-person communication can also take place among participants who are at distant geographical locations through teleconferencing and webinar facilities.

2.4. Linkage and exchange tools

Tools used to achieve linkage and exchange are dedicated to groups of stakeholders, knowledge networks and individual knowledge brokers; they are used to facilitate exchange and institutionalization of knowledge translation. Stakeholder groups are brought together within dedicated structures or semi-permanent groups with a defined membership and regular meetings. Dedicated structures may include long-term partnerships with research centres, where members physically sit together and work mostly for the centre itself (53,54), or advisory groups/committees, mostly at a national level, where members come together only for meetings but otherwise belong to their own institutions (55,56). Similar committees also exist at the international level, but these are less common (57). On the one hand, institutionalization of committees can be an advantage through offering continuity, particularly in contexts with less political stability (55). On the other hand, higher independence can increase confidence in the impartiality of a committee's advice (48).

Institutional knowledge brokers or knowledge translation platforms are other ways to facilitate linkage and exchange (58–61,103). For example, the Central Asian Republics Health Information Network (CARINFONET) was established in 2014 with the aim of distributing reliable and timely health information to policy-makers across five central Asian countries, as part of the activities of the WHO's European Health Information Initiative (104). The EVIPNet knowledge translation platforms are another example where a state-level entity is created at country level to link up stakeholders, including research and health information producers and policy-makers, virtually or physically (103).

Knowledge networks can be a potentially effective mechanism for disseminating health information, increasing the chance of its translation into policy and refining the information-gathering process (62). Knowledge networks can operate at both national and local levels and can include one or more stakeholder groups, including researchers, health professionals, policy-makers and the wider community. Involving policy-makers as part of knowledge networks helps to explore mutual needs, build trust and change attitudes towards health information. It also helps to increase



the use of health information in policy-making by pooling expertise and resources, sharing best practice models and providing knowledge management (62).

Knowledge brokering has been an effective strategy for knowledge translation (46,59,98). Knowledge brokers are intermediaries who establish relations between research and health information producers and users, and in this way encourage linkages that facilitate the transfer of knowledge (59,98). Knowledge brokering can be carried out by a unit, be the function of individuals within organizations or be conducted by outside experts seconded to organizations, possibly on a part-time basis (59). Brokers are usually recognized by their peers for their credibility in their specialist area. They may carry out a variety of tasks (and functions), for example helping users to identify, collect and assess data on health; promoting knowledge exchange and understanding between producers and users of knowledge; and encouraging organizations to value the use of research and health information in their decision-making processes (59,63). Knowledge brokers may also package information and share knowledge through presentations adapted to their audience's interest (63). Consequently, knowledge brokers can potentially have a high impact, with support tailored specifically to the individual user's needs. Furthermore, trust can be established between users and dedicated knowledge brokers through regular interactions, making the uptake of the evidence suggested by the broker more likely. However, there is currently a lack of support for knowledge brokering for health systems information across Europe (98) and it is also relatively costly to provide dedicated experts to fulfil brokering roles (46). WHO EVIPNet is currently supporting the creation of knowledge translation platforms (Box 9) (103).

Box 9. EVIPNet knowledge translation platforms

One strategy to create a fertile knowledge translation environment is to adopt country-level knowledge translation structures or platforms that can provide cohesion and leadership for national-level knowledge translation efforts (60,64). The WHO's EVIPNet programme is a successful example. It comprises 26 platforms, also known as country teams, that can be found in countries including Brazil, Burkina Faso, Cameroon, Uganda and Zambia (103). The programme functions as a global social network and the main aim of each platform is to promote evidence-informed decision-making in public health in their countries. This aim is accomplished through:

- continuous engagement with individuals involved in policy-making, such as researchers, decision-makers, patients and health care workers;

Box 9. (Contd)

- capacity-building workshops to enhance the knowledge translation capacity of policy-makers, health information providers and other stakeholders; and
- encouragement of stakeholders to learn by doing together.

There is an emphasis on producing tangible outputs such as policy briefs and organizing deliberative dialogues. This approach helps not only to bring relevant health information to users but also to build skills in problem identification, framing a problem, context mapping, priority-setting and so on. Moreover, the diversity of the participants promotes sustainable partnerships at the individual and institutional levels and facilitates sharing of best practices and feedback, thus contributing to health systems strengthening. The platforms can also provide a forum for mentoring and training the next generation of stakeholders as well as those from the wider community. Pointers on how to create or use a knowledge translation platform can be found among the real-life examples on the EVIPNet's Country knowledge translation platforms (103).

2.5. Linking tools to intended outcomes

Health information tools may be used in different ways by different stakeholders, depending on the context, the tool and its modality. For example, health information producers or knowledge brokers may use packaging tools such as synthesis tools (e.g. policy briefs) to present health information in a format suitable for a specific user (46,59). They may do so on their own initiative (push), on demand from the user (pull), in partnership with users (exchange) or in an institutionalized setting (integrated).

Health information tools and mechanisms may also have different intended outcomes:

- acceptance and adoption of health information by policy-makers;
- change in stakeholders' attitudes;
- change in stakeholders' knowledge;
- change in stakeholders' intentions to facilitate the use of health information in policy-making;
- provision of access or packaging health information in a user-friendly manner; and
- increased ability to access and apply health information in policy-making.



3. DISCUSSION

3.1. Strengths and limitations of the review

This review has several limitations. First, systematic literature review methodology was unable to identify all the latest innovations and practices from peer-reviewed literature because not all available tools and cutting-edge approaches are formally published. Second, there was a bias towards English language literature because of the greater representation of such publications in PubMed and Scopus. Third, it was not possible to explicitly appraise methodologies or qualities across the studies included in this review as studies were primarily of a descriptive nature. Finally, there was a gap in evidence regarding tools specifically used for incorporating health information into policy-making as well as for achieving behaviour change among policy-makers and health information producers. This may be because most authors do not make a distinction between tools or mechanisms for evidence in general and those for health information. In addition, information on how policy-makers actually employ knowledge translation tools and mechanisms to generate the intended outcomes was also limited. Hence, it was difficult to comprehensively list the support (e.g. technical, organizational, administrative, legislative, infrastructural) required to implement the mechanisms and tools.

Nevertheless, this review should prove useful for health policy stakeholders, including national policy-makers, knowledge brokers and health information producers, in understanding the variety of mechanisms and tools that may be used to incorporate health information into policy-making and, thus, improve the relevance and effectiveness of health policy. The taxonomy of tools and mechanisms, although not exhaustive or comprehensive, provides a good starting point for policy-makers to explore ways in which they may use health information, consider various options based on their policy requirements and build fit-for-purpose health information systems.

3.2. Additional considerations: health information quality

The quality of the health information is an important consideration when deciding whether to use it for policy-making. Health information tools and mechanisms will only have added value when the underlying health information and analysis

is relevant, accurate, timely and interpretable. It is also important to understand its strengths and limitations. This will depend on the type of data collected and the availability of guidelines for policy-makers to assess the quality of health information in manuals and toolkits as well as in the literature (105). For example, Walker et al. suggest five questions that decision-makers should ask about disease burden estimates (106).

A common problem with health information is that it is typically aggregated from different sources and different geographical regions, and it often lacks harmonization and, therefore, requires careful interpretation. Further, data collection processes may not be uniform or complete. The key to interoperability is to establish standards for core datasets and data for interchange, quality and use (102). Hammond et al. propose some ways to accomplish this (107), as do Michelsen et al. (108).

These include development of robust and comparable health indicators, which requires innovation in tools and instruments; enhanced national capacity to collect, process, archive and share data; norms and standards for indicator definitions and computation; multiple independent analyses of data; and effective translation of results into policy (109). Crucially, countries need to take a comprehensive strategic approach to build systems that not only allow the generation and use of high-quality health information for the present but can also accommodate greater capacity in the future (105). Moreover, these systems should cover a full variety of data sources, ranging from routine service data and population-based surveys to civil registration systems with detailed data on births and deaths.

The WHO Regional Office for Europe is actively supporting its Member States in strengthening their health information systems through the European Health Information Initiative and associated support tools (67,104). Progress towards increased use of health information in national policy requires technical, legal and coordination strategies. Technical issues include standard data collection and harmonization; data integration from multiple sources; analysis, interpretation and reporting; quality assurance; creation of information platforms and products that are fit for purpose; maintenance of data confidentiality; and provision of a mechanism for information to feed into policy-making. Increasingly, some of these problems are circumvented by providing interactive access to a database whereby a user can obtain harmonized and packaged information on demand without having to access the raw data itself. Another important consideration is building capacity for leadership, oversight and coordination among personnel responsible for a health information system and provision of a strong knowledge translation mechanism in a country.



Capacity-building for evidence-informed policy-making is best conducted in a safe environment where experimentation and practice are allowed. Connecting traditional tools and mechanisms with, for example, the recent theory of gamification can lead to new behaviours in government and public policy (110). New approaches such as experimental learning through tools such as Knowledge Brokers, an innovative game-based workshop to support decision-making for public professionals (111), and open policy-making (112) through “policy labs” will undoubtedly bring about changes in health policies and in the delivery of health care.

The emergence of what is termed big data is currently the subject of a major ongoing debate in the field of evidence-informed policy-making, highlighting the need for linking medical, administrative, consumer, economic and personal activity data in an ethically (113) and legally sound manner.

In a recent briefing on big data for health and well-being (114), the WHO Regional Office for Europe considered it to include data sources and approaches that:

- enable better and/or new use of existing data sources either by innovations in methods of analysis or through integration/linking across data sources;
- contribute to the collection of information and enable data sharing for synthesis of data sources in health and feed into advanced analysis methodologies; and
- allow identification of new data sources and analysis methods that can support existing knowledge with new evidence and contexts.

Social media data for public policy (115) also gain traction where creating traditional datasets is expensive, slow or cumbersome, for example for surveillance (116), or for detecting areas of poor health service delivery (116). However, it will be essential to validate and refine such datasets to ensure their relevance and utility for policy-makers.

3.3. Tools and mechanisms to support the use of health information

The availability and use of health information for policy- and decision-making by public health authorities is fundamental to improving population health and reducing health inequality (104). Therefore, countries need to strengthen efforts to gather information that can contribute to health policy formulation and implementation. For the same reason, collection of, access to and incorporation of health information for policy-making are promoted by the WHO Regional Office for Europe through its European Health Information Initiative.

Both data held in national clinical databases and research based on such data have been used by policy-makers to inform policies, but this review has indicated that these databases are not currently used to their full potential, partly because many data custodians are clinicians, who may not be fully aware of the usefulness of databases for policy or are simply not interested in applications of the data outside clinical research. In addition, data privacy laws may also restrict the use of data outside the clinical setting. Use can be improved if there is greater awareness among custodians and policy-makers of this potential, through the signing of data-sharing agreements that maximize opportunities for using the data, and if necessary, by improving the coverage of data that are more useful for policy-making purposes.

This report has examined the available literature describing tools and mechanisms for using health information in policy-making. The relative strengths and applicability of these tools and mechanisms depend on the contexts and the stakeholders in question, which range from health information producers, brokers and networks through to the intended end-users.

The tools and mechanisms discussed are expected to be largely transferable even in countries of low and middle incomes because of their applicability in low-resource settings. However, context and environment will impact on the choice of tools to incorporate health information into policy-making. One or more tools should be selected to fit the local context and the purpose of the intended policy intervention. In the first place, the availability and quality of health information will depend on the underlying health information systems. Since most countries are implementing electronic systems to handle health information, potential problems may arise during transitioning from paper-based governance to electronic governance. In such cases, historical and current health information may not be effectively integrated, thus making it difficult to access and/or use relevant longitudinal health information. Importantly, the future success and effectiveness of evidence-informed policy-making will depend on an engaged community of information producers, brokers and users. Policy-makers' attitudes towards health information will depend on whether they are surrounded by a culture of evidence-informed or ideology-based policy-making.

Other considerations include whether to institutionalize mechanisms (e.g. advisory committees, statistics task forces or health information system coordinating groups) or to use complementary tools and approaches. For example, several tools may be combined to achieve optimal benefit from existing health information. As a first step, health information can be presented in a form that is easily understood by



stakeholders using packaging and application tools. Further, using dissemination and communication tools, this packaged health information can be brought to the attention of policy-makers, increasing the likelihood of them using the information. In addition, linkage and exchange tools could be applied to promote understanding of the health information among users and create mutual trust between stakeholders. Well-coordinated utilization of the tools described in this review, therefore, can be very effective for increasing the use of health information in evidence-informed policy-making. An example is provided in Box 10. This describes the packaging of health information into a synthesis report and its communication through discussions between stakeholders, which took place within steering committee and working group structures and, thus, created opportunities for linkage and exchange.

Box 10. Influence of the use of different, well-coordinated tools in bringing health information into the New South Wales Health breastfeeding policy

In 2003, the New South Wales Public Health Authority made the decision to develop a policy to support breastfeeding (53). The Centre for Public Health Nutrition at the University of Sydney provided a synthesis report on the topic shortly after this decision, based on existing evidence including health information. The Public Health Authority used the report as the basis for its policy formulation, aided by the strong ties between the two organizations – the Authority specifically funds the centre to provide support for health policy development. Additionally, the report formed the basis for discussions between the relevant stakeholders in a steering committee and working group. Stakeholders included health information providers, policy-makers, experts and practitioners. During the policy development process, the Public Health Authority gave the Centre further funding to collect additional health information on the topic. Hence, it had a vested interest in using the collected health information. Ultimately, this type of coordination led to the resulting breastfeeding policy being based on strong, relevant and timely evidence (including health information) and effective linkage and exchange between stakeholders.

As a recent review of knowledge translation platforms in low- and middle-income country settings showed, evidence-informed health policy-making is enhanced by tools that strengthen exchange efforts (16). In particular, deliberative policy dialogues informed by evidence briefs created meaningful partnerships (linkages) between information producers and users. Exchange efforts were suggested as a way to encourage the involvement of local community members, who are often unwilling to share local data (16). Deliberative dialogues were also key to closing

the gap between implementation research and health policy, using conversations about methodological rigour and feasibility constraints of evidence and its effective uptake by policy-makers (64).

While health information is increasingly available in an accessible format, its actual use by policy-makers is still largely undocumented. Nevertheless, health information has the potential to contribute to evidence-informed policy-making if packaged and communicated appropriately. This also requires “educating” decision-makers about the value of health information and strengthening assessments of health impacts of policies and actions on population health (117). Encouragingly, researchers and health information producers are starting to recognize the value of influencing policy priorities and the decision-making process and hence are making efforts to get the relevant data to policy-makers (118).

3.4. Policy options and implications

This synthesis report examined the use of health information for evidence-informed policy-making and found examples of how the use of tools and mechanism enabled better-quality information to be provided and disseminated for policy-making. Some examples showed how multiple tools could be used together or in sequence to derive the maximum benefit (16,53). Based on these findings, a number of options are set out for three stakeholder groups: health information producers, knowledge brokers and potential end-users of health information (e.g. policy-makers).

Health information producers might consider:

- ensuring that the health information produced meets the needs of, and is relevant to, the end-users by engaging with them on a continuous basis;
- establishing personal contact with brokers and end-users to build trust because trusted partnerships increase the prospects of health information being considered reliable and then used;
- fostering the use of packaging tools in conjunction with dissemination and communication tools to achieve the highest benefit from health information; importantly, the better the coordination between the tools, the greater the benefit is likely to be; and
- adding value to health information packaging by using application tools such as models and simulations to fill gaps and present scenarios.



Knowledge brokers might consider:

- establishing relationships with and acting as an active link between producers and users of health information to build a value chain and bring health information into immediate practical use;
- presenting suitably packaged health information, both on their own initiative (push) as well as when prompted by end-users (pull); and
- advocating a key role for knowledge brokers in increasing the capacity of policy-makers to use health information for decision-making.

Health information users might consider:

- ensuring effective strategic oversight over information integration and production;
- establishing personal contacts with health information providers to learn about available health information and its potential uses, and deepen personal understanding;
- informing health information providers about health information needs and working with them to identify and fill remaining information gaps; and
- institutionalizing links with health information providers to ensure an adequate supply of health information in terms of coverage and timeliness.

The most effective use of health information is when all stakeholders interact and communicate to ensure that the best available evidence is used to support the choice of policy options.

4. CONCLUSIONS

Knowledge translation mechanisms and tools that support the use of health information for policy decision-making have been presented, categorized and linked to intended outcomes for users. A taxonomy of four broad categories indicates the ways in which health information can be taken up by policy-makers: packaging tools, application tools, dissemination and communication tools, and linkage and exchange tools.

Health information is a key component of any health information system, together with active stakeholders, the end-users of health information (policy/decision-makers), knowledge brokers and networks, and health information producers. Mechanisms and tools can be used either through push efforts, where health information producers collect, analyse and make available data on their own initiative, or pull efforts, where policy-makers request specific health information to meet certain policy needs. The most productive scenario, however, is characterized by exchange efforts for information, where stakeholder groups for both the generation and the usage areas are engaged in a real partnership, often facilitated by knowledge brokers. This approach means that the prospects are higher for producing and using relevant and timely health information in policy formulation. Tools and mechanisms that work best in a given context can become integrated in organizational processes and the broader health system.

The use of health information may be enhanced by applying packaging tools, including policy briefs and visualization tools. Application tools provide an additional layer of knowledge to existing health information by forecasting and testing future scenarios. Finally, active dissemination and communication of health information is as important as producing and packaging the actual data.


A number of practical examples of the use of knowledge translation tools and mechanisms have been given in this review. This is important, because attitudes and behaviours often change slowly, and sharing examples that demonstrate the effective use of health information to improve decision-making may go a long way towards encouraging the use of health information in policy-making. Additionally, investing time and effort to build trust between users and producers of health information and maintaining a consistent focus on the ultimate goal of health policy-making, better health for all, can also motivate stakeholders to engage with




evidence-informed policy-making approaches. Nonetheless, further research is required to evaluate how knowledge translation tools and mechanisms are used in practice to generate the intended outcomes.

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ANNEX 1. SEARCH STRATEGY

Databases and websites

Searches were performed in July 2016 for articles published worldwide from 2005 to July 2016 using PubMed and Scopus (including Embase) databases for peer-reviewed articles and the Virtual Health Library, Grey Literature Database, Health Systems Evidence, Evidence-informed Policy Network and the Canadian Foundation for Healthcare Improvement for grey literature.

Study selection

Two experts first screened the publication titles independently and selected titles that met the inclusion and exclusion criteria:

- **inclusion:** a paper that discussed mechanisms and tools for using health information to influence/formulate health policy and change behaviour of policy-makers; and
- **exclusion:** tools aimed at directly changing clinical practice or behaviour of health professionals rather than policy-makers unless the health professionals acted as health information providers for new policy formulation or changing existing policy.

To harmonize the title-screening process, 10% of titles were initially screened by both experts independently and the individual selections were compared and discrepancies discussed. When there was any doubt regarding a specific title, the experts discussed and mutually agreed a course of action.

The abstracts of the selected papers were then screened for those that mentioned specific tools or mechanisms for using data or evidence to influence or formulate policy. Any abstracts that were broader in scope but unique in their description of the use of health information for policy-making were also included.

Because there was a large overlap of publications describing the same tool, publications were clustered based on the type of tool described and the corresponding knowledge translation mechanism (1), which also created a classification of tools based on modality and pre-identified outcomes. To ensure a thorough inspection of each tool without exceeding an effective volume of data, publications that were most comprehensive in their explanation of the tool and the evidence of its

effectiveness were prioritized and where multiple papers describing the same tool were found, the most recent one was used.

Snowballing or reference searching within identified articles was also used, particularly to support the background and discussion sections.

A total of 4056 articles were identified during the first screening and assessed based on article title. Of these 815 were selected for examination of the abstracts. After clustering and assessing for eligibility, 108 full text articles were downloaded and analysed in detail and a final group of 54 identified for this review (Fig. A1) (2).

Search terms

The following MeSH terms or keywords were used for searching the given databases.

Google search engine in English

1. “Health Information” AND (government OR policy-makers OR officials)
2. “Health Information” AND (Knowledge translation OR Knowledge transfer OR Knowledge Broker) AND (Tools OR mechanisms)
3. “Health Information” AND (citizens OR “general public” OR patient) AND (tools OR mechanisms)
4. “Health information” AND policy

Search terms translated into Russian

1. “информация о здоровье” AND (правительство OR политики OR государство)
2. “информация о здоровье” AND (передача технологии/передача знания” AND орудие OR устройство)
3. “информация о здоровье” AND (граждане OR общественность / население OR пациент)
4. “информация о здоровье” AND политика

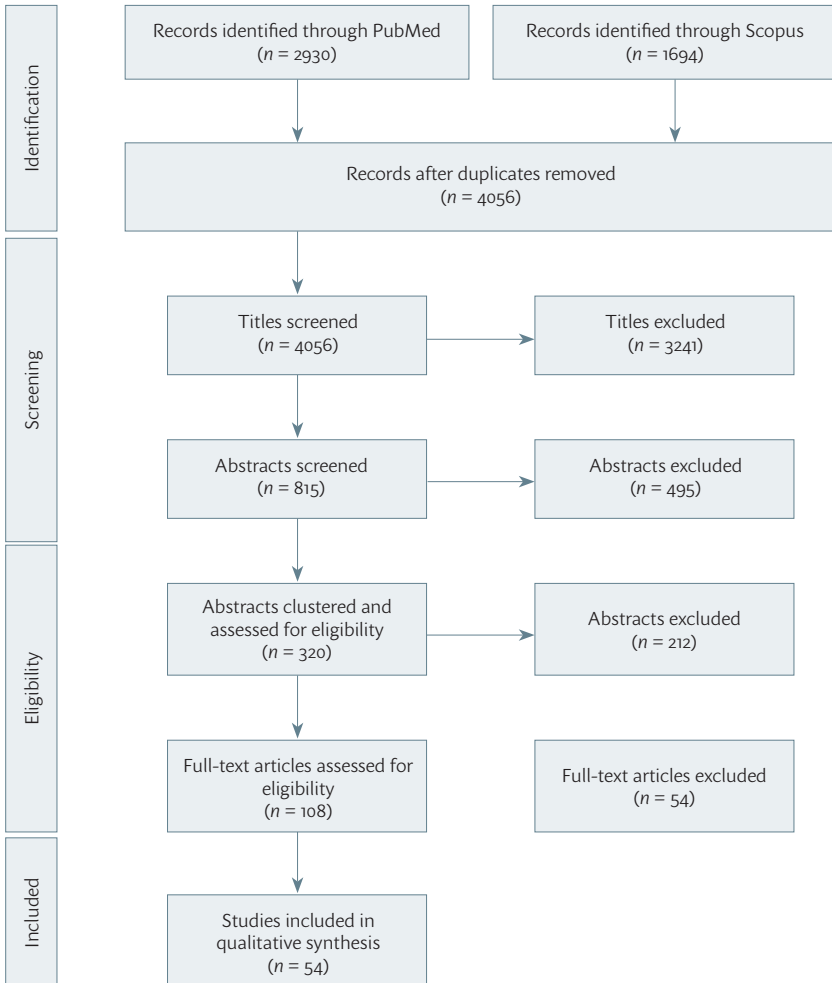
Additional terms used in conjunction to focus search results

“министерство здравоохранения” [Ministry of Health]

“проект” OR “программа” [Project or programme]

“Деятельность государства” [State actions]

Fig. A1. PRISMA flow diagram for the systematic literature review



Search string used for the remaining grey literature databases

“evidence-based policy AND (tool OR mechanism)” OR “evidence-based policy”.

PubMed database

PubMed uses indexing terms (not just MeSH terms but also keywords) and so the search needs to be a more restrictive than in Scopus searching to reduce the number of false positives; consequently “mechanism” is included in this search string but not in the one applied to Scopus.

(“health care” OR “healthcare” OR “health system” OR “public health” OR “health services”) AND

(“data” OR “information” OR “statistics” OR “knowledge” OR “evidence”) AND

(“Evidence translation” OR “Evidence utilisation” OR “evidence utilization” OR “Evidence uptake” OR “evidence-based medicine” [MeSH] OR “evidence-based policy” OR “evidence-informed policy” OR (“knowledge” AND “co-creation”) OR “Knowledge application” OR “Knowledge exchange” OR “Knowledge sharing” OR “Knowledge to action” OR “Knowledge transfer” OR “Knowledge translation” OR “knowledge utilisation” OR “knowledge utilization” OR “Knowledge uptake” OR “Behaviour change” OR “Behavior change” OR “Policy research” OR “Operational research” OR “Research uptake” OR “Research utilisation” OR “Research utilization”) AND


(“Policy making”[MeSH] OR “Policy making”[All fields] OR “Policy maker*”[All fields] OR “Health policy”[MeSH] OR “Health policy”[All fields] OR “Health systems policy”[All fields] OR “decision making” OR “decision-making” OR governance) AND

((“2005/01/01”[PDat]: “3000/12/31”[PDat])) AND

(“mechanism” OR “mechanisms” OR “tool” OR “tools” OR “pathway” OR “pathways” OR “method” OR “methods” OR “Framework” OR “Frameworks” OR “Activity” OR “activities” OR “network” OR “networks” OR “Platform” OR “platforms” OR “Workshop” OR “Workshops” OR “Knowledge broker” OR “Knowledge brokers” OR “Communities of practice” OR “Database” OR “Databases” OR “Training”)

Scopus database

TITLE-ABS-KEY (“health care” OR “healthcare” OR “health system” OR “public health” OR “health services”) AND TITLE-ABS-KEY (“Evidence translation” OR “Evidence utilisation” OR “evidence utilization” OR “Evidence uptake” OR “evidence-based



policy” OR “evidence-informed policy” OR cocreation OR “Knowledge application” OR “Knowledge exchange” OR “Knowledge sharing” OR “Knowledge transfer” OR “Knowledge translation” OR “knowledge utilisation” OR “knowledge utilization” OR “Knowledge uptake” OR “Research uptake” OR “Research utilisation” OR “Research utilization”) AND TITLE-ABS-KEY (“Policy Development” OR “Policy making” OR “Policy maker” OR “Policy-makers” OR “Health Policies” OR “Health policy” OR “Health systems policy” OR “decision making” OR “decision-making”) AND SUBJAREA (mult OR medi OR nurs OR vete OR dent OR heal OR mult OR arts OR busi OR deci OR econ OR psyc OR soci) AND PUBYEAR > 2004

TITLE-ABS-KEY (“health care” OR “healthcare” OR “health system” OR “public health” OR “health services”) AND TITLE-ABS-KEY (“surveillance” OR “health status” OR “health information”) AND TITLE-ABS-KEY (“Evidence translation” OR “Evidence utilisation” OR “evidence utilization” OR “Evidence uptake” OR “evidence-based policy” OR “evidence-informed policy” OR cocreation OR “Knowledge application” OR “Knowledge exchange” OR “Knowledge sharing” OR “Knowledge transfer” OR “Knowledge translation” OR “knowledge utilisation” OR “knowledge utilization” OR “Knowledge uptake” OR “dissemination”) AND TITLE-ABS-KEY (“Policy Development” OR “Policy making” OR “Policy maker” OR “Policy-makers” OR “Health Policies” OR “Health policy” OR “Health systems policy” OR “decision making” OR “decision-making”) AND SUBJAREA (mult OR medi OR nurs OR vete OR dent OR heal OR arts OR busi OR deci OR econ OR psyc OR soci) AND PUBYEAR > 2004

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