Health research in the Eastern Mediterranean Region

Current status and challenges

World Health Organization
REGIONAL OFFICE FOR THE Eastern Mediterranean

Department of Science, Information and Dissemination
WHO Regional Office for the Eastern Mediterranean
Monazamet El Seha El Alamia St
PO Box 7608, Nasr City
Cairo 11371, Egypt
www.emro.who.int
emrgosid@who.int

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Foreword

Health research generates evidence for the implementation of cost-effective interventions for health-related problems, especially those with a high morbidity and mortality burden. In addition, it supports the monitoring of health systems performance and produces new knowledge for better health technologies. If health research is driven by the principles of quality, impact and inclusiveness, the knowledge it generates can help health systems deliver services of better quality that are fairer and more equitable, leading to improved health outcomes and indicators.

The World Health Organization (WHO) is mandated by its constitution to support and promote health research. Indeed, three of WHO's core functions are research-related: shaping the research agenda and stimulating the generation, translation and dissemination of valuable knowledge; articulating ethical and evidence-based policy options; and providing technical support, catalysing change and building sustainable institutional capacity. In *The world health report 2013: Research for universal health coverage* (WHO, 2013), it states that, "WHO's role is to advance research that addresses the dominant health needs of its Member States, to support national health research systems, to set norms and standards for the proper conduct of research, and to accelerate the translation of research findings into health policy and practice".

Moreover, Vision 2023, WHO's strategy for the Eastern Mediterranean Region, emphasizes the importance of health research in supporting evidence-based policy-making. In fact, scientific production, as reflected by the number of publications by institutions in the Region in peer-reviewed journals, is one of the key performance indicators for Vision 2023. Analysis of the health research landscape of the Region is important because it paves the way for better policy and management decisions for health and for progress on the Sustainable Development Goals.

This publication describes two linked studies undertaken to map the health research institutions in the Region and to perform a detailed bibliometric analysis to assess health research production within the Region, especially over the past two decades. It links the inputs obtained through the mapping exercise to the outputs identified through the bibliometric analysis from a systems perspective. The resulting data it presents helps us to identify the Region's strengths and weaknesses in health research, and the resulting need for aligning research production with national health research priorities and enhancing knowledge translation and dissemination activities.

I hope that this report will support improved health research priority-setting in the Region, the identification of national capacity-building needs and the better generation and use of evidence for health policy-making.

Dr Ahmed Al-Mandhari
WHO Regional Director for the Eastern Mediterranean

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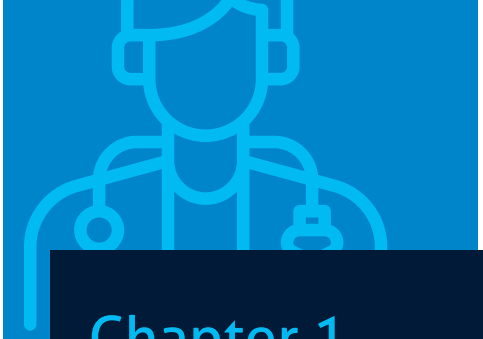


Chapter 1
Introduction

Background

Improvements to global health and health equity rely on research evidence, as does economic development. The WHO Constitution (2006) calls for research for health to be supported and promoted and *The world health report* (WHO, 2013) emphasizes that "WHO's role is to advance research that addresses the dominant health needs of its Member States, to support national health research systems, to set norms and standards for the proper conduct of research, and to accelerate the translation of research findings into health policy and practices". That document also defines the strategy, criteria and role of WHO with respect to research, and proposes a number of goals: (a) consolidate the organizational culture of research across WHO; (b) help build the capacity of national health research systems; (c) standardize research practices; (d) translate research evidence into policy; and (e) emphasize priority areas. Health research should also be driven by the principles of quality, impact and inclusiveness (WHO, 2013).

High-quality health research requires a supportive research environment, not only for planning, designing and implementing research, but also for sharing, using and translating findings into evidence-based policies and cost-effective interventions (Haines, Kuruvilla & Borchert, 2004). Research in medical science plays a significant role in global economic growth and contributes to living standards (Durieux & Gevenois, 2010). However, a framework should be available to guide health research.

Mapping studies of the Eastern Mediterranean Region have indicated that health systems research, across all areas, is relatively weak (El-Jardali et al., 2014). Reports typically refer to critical deficits in stewardship, a lack of research translation into policy and practice, and a research agenda insufficiently based on emerging priorities (Kennedy et al., 2008; El-Jardali et al., 2011; Mandil, Chaaya & Saab, 2013).

Health research indicators in the Eastern Mediterranean Region

Most research on health research processes has tended to focus either on inputs (e.g. the resources used by academic and research institutions) or output indicators (manuscripts). This kind of research measures the input costs associated with a certain outcome. Instead, understanding health research from a systems perspective can help clarify other kinds of enablers and constraints that act on research outputs.

Efforts to operationalize assessments of health systems research have led to three categories of indicator: (1) "functional", in which the focus is on the root activities of health systems research; (2) "process/system", in which the research cycle is inspected to assess the required downstream influence; and (3) "institutional", in which the focus is on institutions that undertake, use or perform research (Ismail, 2013; Kennedy et al., 2008).

The WHO Regional Office for the Eastern Mediterranean recently examined the core indicators of the health-related Sustainable Development Goals (SDGs) (WHO, 2020), and found that only three or four

countries have actually established national guideline development programmes. However, 57% of health ministries have a research coordination unit or a national research strategy, 77% of countries have a national bioethics or ethics committee, and 83 academic journals in the Region are indexed in PubMed and the Index Medicus for the Eastern Mediterranean Region (IMEMR).

Health research system mapping in the Eastern Mediterranean Region

In 2005, collaborative efforts between the WHO Regional Office for the Eastern Mediterranean, the Council on Health Research for Development (COHRED) and the Health Ministers' Council for Cooperation Council States initiated a study to map the governance and management mechanisms of the national health research system (NHRS) of 10 countries in the Region. The results showed that few countries have a formal NHRS and most lack the basic building blocks of a functional system. Just four countries reported official governance and management structures, while two countries had a dedicated national health research policy, plan or strategy. Six countries had national health priorities but only three countries specified a national health research priority. One country had founded a monitoring and evaluation system for its national health research system, but no country reported systematic efforts to translate research evidence into policies within the health sector (WHO Regional Office for the Eastern Mediterranean, 2008). This implies significant deficiencies in the stewardship of turning research evidence into policy, and an ambiguous research agenda or sense of priorities (Ismail et al., 2013; Mandil, Chaaya & Saab, 2013).

Research for health

The term "research for health" reflects the fact that improving health outcomes requires the involvement of many sectors and disciplines (WHO, 2012). As identified in the work of the Global Forum for Health Research, research of this type seeks to: understand the impact on health of policies, programmes, processes, actions or events originating in any sector; assist in developing interventions that will help to prevent or mitigate that impact; and contribute to the achievement of health equity and better health for all.

Research for health covers the full spectrum of research, which spans the following five generic areas of activity:

- measuring the magnitude and distribution of the health problem;
- understanding the diverse causes or the determinants of the problem, whether they are due to biological, behavioural, social or environmental factors;
- developing solutions or interventions that will help to prevent or mitigate the problem;
- implementing or delivering solutions through policies and programmes;
- evaluating the impact of these solutions on the level and distribution of the problem.

Research for health does not include biomedical research. The Global Ministerial Forum on Research for Health separated the concept of biomedical research from health research, to make research in the health field more inclusive. For example, research on the social determinants of health covers such concerns as food security, environment, education and work conditions (Ijesselmuiden et al., 2008). Research for health is also deemed to be a guide for economic development. The key behind improving public health is to translate research evidence that draws on both the economic and health fields (WHO, 2012).

History of health research mapping in the Eastern Mediterranean Region

The first NHRSs in the Eastern Mediterranean Region were piloted in the Islamic Republic of Iran and Pakistan. WHO funded 28 research studies in the Eastern Mediterranean Region from 1997 to 2002, with the overall objective of assessing the magnitude of health problems through prevalence studies. WHO summarized the research in the Region, finding that organizations in Egypt and the Islamic Republic of Iran were the most frequent beneficiaries of research funds (WHO Regional Office for the Eastern Mediterranean, 2004, 2008). The WHO Regional Office for the Eastern Mediterranean now has a Research in Priority Areas of Public Health (RPPH) grant scheme, which has, so far, supported 69 grants since 2014 (through 2020).

Over the years, the global direction of health research mapping has increasingly influenced mapping in the Eastern Mediterranean Region. In 1995, the Tropical Disease Research (TDR) unit in the WHO Regional Office began funding a small number of studies of national health research systems, initially called research mapping grants. The purpose of these grants was to carry out comprehensive, systematic analyses of health research in a number of countries and initiate dialogue among policy-makers, ideally leading to consensus on the future strategic direction of NHRSs for effective governance. Findings indicated a significant variation in the quality of research and countries' participation and capacity and concluded that an electronic information system was needed to make research findings more widely accessible across the Region (WHO Regional Office for the Eastern Mediterranean, 2004).

In January 2002, the WHO Regional Office convened a workshop to finalize a conceptual framework for health research systems to guide the development of further operational work within the then recently-launched Health Research System Analysis (HRSA) initiative of WHO. The holistic view taken of an NHRS included an analysis of: (a) the perspectives of policy-makers, health planners, managers and the community; (b) current national policies and legislation covering research and mechanisms that create demand for research; (c) researchers and research institutions; and (d) research outputs and funding mechanisms. The TDR unit collaborated with sister organizations to support a systematic situation analysis of health research in five countries: Egypt, the Islamic Republic of Iran, Morocco, Pakistan and Sudan. The studies were carried out during 2003 and 2004 and were largely descriptive in nature. Data were gathered on a number of relevant areas, including: (a) facilities for science and technology; (b) governance mechanisms; (c) research policy priorities, ethical review mechanisms, institutional output and research training programmes; (d) the dissemination and utilization of research findings; and (e) funding (WHO Regional Office for the Eastern Mediterranean, 2004).

However, while the concept of an NHRS seemed to have been generally accepted, it had not yet been implemented. All five countries expressed concerns about ethics in health research and a situation analysis highlighted an absence of a combined, well-designed health research management information system (in the cases of Pakistan and Sudan), or the inadequate development of one (in the cases of Egypt, the Islamic Republic of Iran and Morocco), even though sufficient infrastructure was present in all five countries. None of the countries had an institutional mechanism for screening research results, and the report called for existing coordination mechanisms to be improved through updating communication technology between research institutions and facilitating linkages between demand and supply. There was a need to strike a balance between biomedical research and development and policy or system-oriented research. The studies highlighted a need for improved managerial capacity at various levels in the health research system (WHO Regional Office for the Eastern Mediterranean, 2004). However, the impact on policy or programme implementation seems to have been negligible, except in the Islamic Republic of Iran.

Bibliometric methods of analysis

Health policy refers to "decisions, plans, and actions that are undertaken to achieve specific health care goals within a society" (WHO Regional Office for Europe, 2020). From this perspective, strengthening health systems has become a top priority in the drive to improve health outcomes. WHO's (2007) framework for strengthening health systems identifies six attributes of a health system: (1) a health workforce; (2) health services; (3) health financing; (4) governance and leadership; (5) medical products, vaccines and technologies; and (6) health information. Within the interdisciplinary field of health information, researchers and public health agencies are using health informatics and big data tools in public health "infoveillance" activities (Eysenbach, 2009). This innovative discipline may assist the formulation of evidence-informed public health policies in each of the other five health system pillars, and help build research capacity (Oxman et al., 2009; European Commission, 2014; Mavragani, 2020).

Bibliometric analysis is a research evaluation method scholars use to scale or rank research on various levels from micro (institutional) to macro (regional/global). Recently, it has been used to assess the research performance of organizations. Analysis of manuscript modalities allows an accurate comparison of institutions with respect to the degree their readership is international, frequency of publication, level of quality control and the relative distribution of articles between the scientific and "synthetic" literature (Wallin, 2005). Bibliometric methods are used to discover international linkages (Wagner & Leydesdorff, 2005), and journal impact factor is used not only to assess the number of citations, but also the quality of publications indexed in journals (Massarrat & Kolahdoozan, 2011).

Prior attempts at bibliometric analysis in the Eastern Mediterranean Region were made either on a national scale, using more than one country, or with a disease-specific focus. Bibliometric studies have been attempted in Africa (Uthman & Uthman, 2007), the Arab countries (Shaban & Abu-Zidan, 2003; Tadmouri & Bissar-Tadmouri, 2003), Egypt (Afifi, 2007; Zeeneldin, Taha & Moneer, 2012), the Gulf Corporation Council countries (Deleu, Northway & Hanssens, 2001), Islamic Republic of Iran, (Mohammadhassanzadeh et al., 2010; Massarrat & Kolahdoozan, 2011; Borzabadi & Etemadi, 2011; Rasolabadi et al., 2015), Islamic Republic of Iran, Pakistan and Egypt (Ghaleh, Siadat & Azizi, 2004), Lebanon (Dakik, Kaidbey & Sabra, 2006), Lebanon and United Arab Emirates (Bissar-Tadmouri & Tadmouri, 2009), Libya (Bakoush, et al., 2007), Morocco (Badrane & Alaoui-el-Azher, 2003), occupied Palestinian territory (Tadmouri, 2006), Oman (Rohra & Azam, 2011), Qatar (Zeeneldin & Taha, 2014), Saudi Arabia (Tadmouri & Tadmouri, 2002), Tunisia (Ben Abdelaziz, Abdelali & Khmakhem, 2006; Ben Abdelaziz, Abdelali & Khmakhem, 2007; Ben Abdelaziz et al., 2007) and United Arab Emirates (Lammers & Gondek, 1994; Lammers & Tahir, 1996;). Another bibliometric analysis was used to assess the degree of research activity on noncommunicable diseases (Jones & Geneau, 2012) and radiology (Durieux & Gevenois, 2010).

In summary, while more than 40 bibliometric analyses have taken place in the Eastern Mediterranean Region to assess the publication situation, there are not enough data to establish a national health research agenda or to systematically map the research output of the health and related biomedical fields (Kennedy et al., 2008). The Region still lacks consistent coverage across all countries.

This report attempts to comprehensively gather all health research in the Region. It is unique in linking the inputs (mapping survey) with the outputs (bibliometric analysis) from a systems perspective. WHO initiated this project in order to analyse the health research landscape in the Region and ease the uptake of research evidence for improved policy and management decisions as progress is made on universal health coverage and the SDGs.

Overall, health research production in countries of the Eastern Mediterranean Region is less than ideal and varies widely between countries. Health research systems in the Region are not developed well

enough to generate and use knowledge to improve health, reduce inequities and contribute to economic development (Kennedy et al., 2008). This demands an examination of the current situation of health research institutions and resources in countries of the Region.

The perceived need for health research mapping in the Region is complemented by an argument for connecting it with a detailed bibliographic analysis, in order to present an input–output analysis. This helps identify the Region's strengths and weaknesses, as well as the need for research capacity-building, ranging from basic to advanced training. Prior attempts to map health research were not comprehensive, as they did not cover all Member States, and were institutional (rather than national) (WHO Regional Office for the Eastern Mediterranean, 2008). Prior studies have stressed the necessity of analysing the existing status of research foundations, resources and research production in the Region (WHO Regional Office for the Eastern Mediterranean, 2004, 2008, 2014a; Kennedy et al., 2008).

The objectives of the two linked studies were to map the health research institutions in the Eastern Mediterranean Region and to perform a bibliometric analysis to identify health research production in the Region. A systems approach is taken that takes into account the dynamic cycles of inputs and outputs. The input data are from a 2016 mapping survey of research for health, focusing on health research institutions, with the assistance of focal points in each country using a specific web-based tool. The output data are the result of a bibliometric analysis of published research for health by researchers based in the Region during 2004–2018.

The present study is the first of its kind to take an institutional approach that links inputs and outputs at the national level. The scope of the approach includes: (a) existing resources (institutional, human, laboratories and financial); (b) training facilities and programmes; (c) priority-setting mechanisms; (d) research areas, scope and registration; (e) mechanisms for observing the ethical conduct of researchers; (f) partnerships (national and international); (g) mechanisms for sharing information within institutions; (h) methods of dissemination of findings and their impact on health policy-making; and (i) the perceived problems in carrying out research.

Chapter 2
Institutional mapping survey

The need for mapping was first identified in a meeting convened by the WHO Regional Office for the Eastern Mediterranean,[1] which included participants from the regional Advisory Committee on Health Research (ACHR) and eminent research experts from within and outside the Region. One of the main recommendations was to map activities in the Region related to research for health (WHO Regional Office for the Eastern Mediterranean, 2014b). This resulting mapping study aimed to review the landscape of existing health research in the Eastern Mediterranean Region and identify the challenges that need to be addressed in order to promote health research within the Region. The specific objectives of the project were to:

- synthesize prior mapping attempts in the Eastern Mediterranean Region and identify important shortcomings; and
- carry out a comprehensive situation analysis of the landscape of Eastern Mediterranean Region health research, covering existing resources and identify gaps in the research cycle and support systems.

Methods

The research was conducted in two stages. The first stage comprised a literature search for prior studies that mapped health research in the Eastern Mediterranean Region, and then shortcomings were identified. The second stage comprised a survey of institutions currently undertaking health research in the Region.

We searched the following electronic databases: Medline, PubMed, Academic Search Complete, the WHO Global Health Library (IMEMR) and Google Scholar. We searched the internet for reports by relevant organizations such as WHO, the Council on Health Research for Development (COHRED) and the Alliance for Health Policy and Systems Research. We also reviewed the reference lists of relevant studies to retrieve additional studies.

Based on the gaps identified in the literature search, a survey questionnaire was developed to collect data at the institutional and country levels (see Annex 1). The questionnaire was adapted from previous mapping exercises, both regional and global (Gonzalez Block & Mills, 2003; Lavis et al., 2003; Tugwell et al., 2006; Sharan, Ulitsky & Shamir, 2007; Kennedy et al., 2008; WHO Regional Office for the Eastern Mediterranean, 2008; Dobrow et al., 2010; Adams et al., 2011; Gholami et al., 2011; Ismail et al., 2013).

Items were divided into 10 sections:

1. Background information
2. Institutional characteristics

[1] Integrating research in shaping the future of health in the Eastern Mediterranean Region, Cairo, Egypt, 18–16 February 2014.

3. Scope of research
4. Training and capacity-building
5. Ethics, leadership and governance
6. Resources
7. Institutional planning for research
8. National planning of research for health
9. Knowledge management
10. Translation and dissemination.

Questions regarding the challenges that institutions faced were open-ended, and the questionnaire was pilot tested for validity and reliability and to estimate the completion time using a guiding protocol.

Focal persons were identified in each of the countries/territories to assist with data collection. The responsibilities of the focal person were to:

- identify the name(s) of institutions and corresponding focal persons
- collect data from the identified institutions using the survey tool
- submit the data to the core team.

Instructions and issues with tasks were clarified with the core team. Respondents were contacted via an email, which included a link to the online questionnaire.

Data were collated and analysed using the Statistical Package for the Social Sciences (SPSS) version 24. Descriptive analyses included means and standard deviations. Testing for significant differences across groups was performed using chi-square and analysis of variance (ANOVA). Responses were coded and recurring themes were categorized and tabulated.

Results

A total of 575 facilities were contacted across all 22 countries/territories in the Region, of which 223 (38.8%) responded to the survey (Table 1). The main organizational positions of respondents included directors (27.1%), deans (15.4%), chairpersons (12.7%), programme managers (4.5%) and other (40.3%).

Some 44.7% of the organizations that responded were academic research institutions, 60.4% of which were established after 2001. Organizations were mostly public (64.2%), and 40.0% of non-academic research institutions were nongovernmental organizations.

Table 1. Survey response rate by country/territory in the Eastern Mediterranean Region

Member State	No. of contacts	No. of responses	Response rate (%)	Relative contribution to survey (%)
Afghanistan	15	1	6.7	0.4
Bahrain	6	3	50.0	1.3
Djibouti	4	0	0.0	0.0
Egypt	63	15	23.8	6.7
Iran (Islamic Republic of)	120	66	55.0	29.6
Iraq	45	13	28.9	5.8
Jordan	20	11	55.0	4.9
Kuwait	7	2	28.6	0.9
Lebanon	13	8	61.5	3.6
Libya	11	4	36.4	21.8
Morocco	19	12	63.2	55.4
Occupied Palestinian territory	17	9	52.9	4.0
Oman	7	7	100.0	3.1
Pakistan	56	20	35.7	9.0
Qatar	17	5	29.4	2.2
Saudi Arabia	29	10	34.5	4.5
Somalia	8	3	37.5	1.3
Sudan	42	7	16.7	3.1
Syrian Arab Republic	17	7	41.2	3.1
Tunisia	21	7	33.3	3.1
United Arab Emirates	16	10	62.5	4.5
Yemen	22	3	13.6	1.3
Total	**575**	**223**	**38.8**	**100**

The following results are organized around the four pillars of WHO's strategy on research for health: (1) capacity-building; (2) prioritization; (3) standards; and (4) translating evidence for policy-making.

Pillar 1: Capacity-building

Facilities were asked if they provided capacity-building or training for students in health research. Some 57% reported that their institutions provided such workshops, training and courses to students. Respondents also reported on a number of areas in which capacity-building is provided. These included research methodology (qualitative and quantitative), research design, data collection, data analysis, statistical software, proposal and manuscript writing, research ethics, systematic reviews, meta-analysis and knowledge translation. Four respondents mentioned providing financial support for students as part of capacity-building.

Incentives

Institutions were asked about the types of incentive offered to staff to engage in health research. Some 54% offered incentives to staff to engage in health research, mostly financial (47%), including grants, scholarships, awards and other monetary incentives and support for publishing in peer-reviewed journals. The second most common incentive was linking career promotion to research activities and publications (24%). Other incentives included participation in local and regional conferences and sponsored participation in international conferences, collaboration with local and international research centres and organizations, technical support, paid research leave, workshops and training.

Calls for proposals

No significant differences were observed in the frequency of issuing calls for proposals by facility type, sector or income level of country. However, high-income countries issued calls annually (37.8%), while upper- and lower-middle-income countries never issued these calls (33.3% and 38.8%, respectively). Schools and faculties, in addition to non-academic research centres, were also more likely to issue these calls annually (32.4% and 33.3%, respectively). Public institutions and international organizations were more likely to report never issuing calls for proposals (36.4% and 35.7%, respectively). Some institutions called for proposals monthly or quarterly, and some irregularly.

Continuing education and training

Training modalities were generally lecture-based (50.8%) with no statistically significant differences across facility type, sector or country income level. Other modalities included workshops (n = 12), which were counted as lecture-based, and three mentioned conferences. Table 2 shows the range of responses.

Table 2. Continuing education training modalities reported by respondent health research institutions

Training modality	*n (%)*
Lecture-based	62 (50.8)
Web- and lecture-based	23 (18.9)
Web-based, lecture-based and other	13 (10.7)
Lecture-based and other	9 (7.4)
Other	9 (7.4)
Web-based	6 (4.9)

Human resources

The average numbers of male and female researchers were similar across facilities. As for qualifications, the average number of PhD holders was higher than those with MSc, BSc/BA and MD qualifications. International organizations were found to have a higher number of MSc degree holders than public organizations. Public organizations had the highest number of MD and BA/BSc degree holders. These associations were not found to be statistically significant.

A total of 57.4% of facilities provided research management services, 52.9% provided health proposal writing services, and around 65.5% had support staff in data collection, management and analysis services (see Table 3). Around three quarters (73.1%) of institutions reported having information technology (IT) support; this figure was highest for academic/research centres.

Table 3. Services for researchers and staff reported by respondent health research institutions

Services available	No	Yes
	n (%)	*n (%)*
Proposal writing	105 (47.1)	118 (52.9)
Research management (financial management and control of research funds)	95 (42.6)	128 (57.4)
Data collection, management and analysis	77 (34.5)	146 (65.5)
IT support	60 (26.9)	163 (73.1)
Total	**342***	**551***

*Note: Total exceeds the number of respondents, as categories are not mutually exclusive.

Financial resources

In terms of institutional funding, most respondents received funding from their own institutions (64.1%) or local public institutions (39.5%). Only 11.2% received funding from private regional institutions. There were no statistically significant differences across facility types, sectors or country income levels. Table 4 shows the research funding by source.

Public funding (71.8%) was more common than private funding (45.7%), but there were no significant differences by facility type, sector or country income levels.

Table 4. Source of research funding reported by respondent health research institutions

Sources	*n (%)*
Own institution	143 (64.1)
Local public institution	88 (39.5)
Regional public institution	49 (22.0)
World Health Organization	46 (20.6)
International aid companies	36 (16.1)
Local private institution	35 (15.7)
Pharmaceutical companies	34 (15.2)
Other UN agencies	31 (13.9)
Regional private institution	25 (11.2)
Total	**487***

Note: Total exceeds the number of respondent institutions, as categories are not mutually exclusive.

Technical resources (information and communication technologies)

Most institutions reported that researchers had access to computers (84.1%), telephones (82.1%), internet connections (80.0%), printers (79.0%) and scanners (70.3%). Only 47.2% reported consistent access to national databases and 33.8% had consistent access to international databases (see Table 5). Academic research centres (86%) and upper-middle-income (84.8%) countries were significantly more likely to report having an internet connection (p = 0.04; p = 0.01, respectively).

Table 5. Access to technical resources reported by respondent health research institutions

	Never	Rarely	Occasionally	Frequently	Always
	n (%)	*n (%)*	*n (%)*	*n (%)*	*n (%)*
Computers	4 (2.1)	-	12 (6.2)	15 (7.7)	164 (84.1)
Internet connection	5 (2.6)	2 (1)	11 (5.6)	21 (10.8)	156 (80.0)
National databases	11 (5.6)	9 (4.6)	41 (21)	42 (21.5)	92 (47.2)
International databases	15 (7.7)	23 (11.8)	41 (21)	50 (25.6)	66 (33.8)
Scanners	8 (4.1)	3 (1.5)	20 (10.3)	27 (13.8)	137 (70.3)
Printers	5 (2.6)	1 (0.5)	12 (6.2)	23 (11.8)	154 (79.0)
Telephones	5 (2.6)	1 (0.5)	16 (8.2)	13 (6.7)	160 (82.1)

Research laboratories

Clinical laboratories (41.6%) and biotechnical laboratories (36.3%) were the most commonly reported facilities (see Table 6). Other laboratories were less common in upper-middle-income countries (14.1%), but no other significant differences were observed by type of facility, sector or country income level.

Table 6. Availability of research laboratories reported by respondent health research institutions

	n (%)
Clinical laboratories	89 (41.6)
None	77 (38.5)
Biotechnical laboratories	74 (36.3)
Other	44 (22.3)
Public health	39 (19.9)
Tropical laboratories	17 (8.5)

Pillar 2: Prioritization

Scope of research

Some 84.2% of organizations conducted population or public health research, 76.9% conducted social and behavioural research and 74.6% conducted clinical or experimental research (see Table 7).

Table 7. Scope of research reported by respondent health research institutions

Type of research	*n (%)*
Population/public health research	184 (84.2)
Social/behavioural research	167 (76.9)
Clinical/experimental research	165 (74.6)
Health policy/systems research	149 (71.6)
Biomedical/basic science research	139 (37.7)

The research fields and topics with the highest number of studies reported by institutions included medicine (*n* = 23), public health (*n* = 22) and epidemiology (*n* = 21). The topics with the lowest number of studies (*n* = 1) were anatomy, botany, cardiology, emergency preparedness and response, epidemics, financial arrangements, histology, parasitology, physics, preventive medicine, physical activity, radiotherapy and vaccinology. The average number of published research articles per institution was highest for surgery (average = 290.0), medicine (average = 178.3), clinical health (average = 151.2) and obstetrics and gynaecology (average = 148.1).

Calls for proposals

Organizations were asked about the number of proposals submitted, funded and initiated in response to national, regional and international calls for proposals during the last five years. Most organizations had submitted less than 10 proposals and received less than 10 grants, regardless of funding source. However, recipients of funding from pharmaceutical companies were found to have submitted more than 51 proposals. Recipients of funding from international aid agencies were found to have submitted between 21 and 30 international proposals.

Priority-setting

Half of the sampled organizations reported conducting priority-setting exercises. However, 60.2% did not follow a standardized priority-setting approach. There were no significant differences across facility types, sectors or country income levels. When asked about their methodology, responses were diverse and lacked comprehensive description. Some reported conducting literature reviews, focus groups, or surveys, without providing details on the exact methodology.

Some 40.5% of organizations reported frequently or always involving policy-makers and stakeholders in setting priorities for research for health (see Table 8). Nongovernmental organizations were significantly more likely to involve policy-makers and stakeholders ($p = 0.013$).

Moreover, 43.1% frequently or always translate high-priority policy concerns into priority research on health themes and/or questions. Around a third of institutions reported either never/rarely, occasionally,

or frequently/always, making available an up-to-date list of the country's research on health priorities to researchers, and this was also the case for involving policy-makers and stakeholders in research projects. These three observations were not significantly different across facilities of different type, sector or country income level.

Table 8. Trends in priority-setting exercises reported by respondent health research institutions

Questionnaire item	Never/rarely	Occasionally	Frequently/always
	n (%)	*n (%)*	*n (%)*
Institution involves policy-makers and stakeholders in setting priorities for the institution's research on health	53 (27.2)	63 (32.3)	79 (40.5)
Institution translates high-priority policy concerns into priority research on health themes and/or questions	41 (21.0)	70 (35.9)	84 (43.1)
Institution makes available an up-to-date list of the country's research on health priorities to the institution's researchers/scientists	62 (31.8)	63 (32.3)	70 (35.9)
Institution involves policy-makers and stakeholders in its research projects (in the development of joint proposals/research methodology and tools/analysis and write-up/publications)	56 (28.8)	72 (36.9)	67 (34.3)

Organizations reported not having (49%) or not knowing (43%) whether their countries have national health research priorities. This observation was not significantly different across facilities of different type or sectors, but low-income countries were more likely to report having national health research priorities, although only four low-income countries were represented. Upper-middle-income countries were most likely to report not having national health research priorities. Lower-middle-income countries were most likely to report not knowing whether their country had such research priorities.

As for the number of proposals that addressed national health research priorities, 71.3% reported nil or not applicable. This observation was significant across countries of different income level, in that high-income countries were most likely to report nil or not applicable ($p = 0.003$). When asked about emerging priorities, a total of 113 priorities were identified.

Table 9 shows the five most recurrent priority themes.

Table 9. Top five priority topics reported by respondent health research institutions

Type of research	*n (%)*
Noncommunicable diseases	15
Maternal and child health	12
Cancer	10
Reproductive health care	8
Mental health	7

Recognition and coordination of national health priorities

Respondents indicated that funders occasionally (35.4%) or frequently (24.2%) formulate their priorities and calls for proposals for research for health in response to national or regional needs. There were no significant differences by facility type, sector or country income level.

As for the question of having a national health council that regulates funding priorities, 47% did not know whether such a council existed in their country. High-income countries were most likely to report not knowing whether such a council existed in their country.

Only 29.6% of organizations were involved in a national priority-setting exercise between 2010 and 2014. These exercises were held either by the organization itself, or in collaboration with WHO, ministries of health or national research councils. International organizations were most likely to conduct such an exercise.

Some 55.8% of respondents reported that their country's ministry of health has a department that coordinates health research and 46.9% reported having a national health sector strategy. Further, 55.4% of respondents did not know whether their countries had specific legislation on health research. However, 57.0% reported that their countries had a national ethical review committee. There were no significant differences by type, sector or country income level.

Dissemination of research findings

Organizations were asked how frequently they disseminated health research findings through specific media. Respondents mostly disseminated research findings through seminars and conferences (64.1%), peer reviewed scientific journals (58.7%) and the organization's website (52.9%). Methods that were never or rarely used included policy briefs, policy dialogue, letters/briefs/tailored messages to policy-makers/stakeholders, and the organization's own peer-reviewed scientific journal.

Using an institution-specific peer-reviewed scientific journal was more likely in lower-middle-income countries (52.3%), while using the organization's website (43.3%) and newsletters, emails or printed reports to research networks (33.3%) were least likely in high-income countries.

A total of 62.8% of respondents reported that their researchers had the skills to disseminate research findings to policy-makers in government. This was most likely the case for non-academic research centres and institutes (86.7%). A total of 74.9% reported that their researchers had the skills to disseminate research findings to directors of nongovernmental organizations. Respondents from high-income countries were less likely to report such skills (56.7%).

Pillar 3: Standards

Advisory board

There were no significant differences in the presence of an advisory committee by facility, sector or country income level. However, public organizations and nongovernmental organizations were significantly ($p = 0.029$) more likely to have an advisory board than other types of facility. Generally, advisory boards comprised multiple representatives, but the majority (61.7%) reported having other academic faculties/schools/research institutions among those representatives. Choice of representative did not vary by institutional sector, type or country income level.

Collaborating partners

Nongovernmental organizations were more likely than other types of organization to have collaborating partners. Respondents from upper-middle-income countries were also more likely to collaborate. Respondents were asked to specify whether their collaborators were national, regional or international. Generally, all three levels were represented, but national collaborators were the most common (77.0%).

Ethics board

Having an ethics board was not found to be significantly associated with a particular sector or type of facility. However, respondents from high-income countries were most likely to have an ethics board.

Table 10 shows that the most common areas represented by an ethics board were medicine (58.5%), health systems (44.7%), allied health sciences (42.3%) and public health (41.5%). When asked about other areas, most respondents mentioned specific areas of medicine while some respondents mentioned statistics, epidemiology and sociology. While the areas were not found to vary significantly across facility types or sectors, respondents from low-income countries were more likely to have a board that covers dentistry.

Table 10. Areas represented by an ethics board reported by respondent health research institutions

Health area	*n (%)*
Medicine	93 (58.5)
Health systems	71 (44.7)
Allied health sciences	69 (42.3)
Public health	66 (41.5)
Pharmacy	40 (25.2)
Nursing	39 (24.5)
Legal	33 (20.8)
Public	33 (20.8)
Dentistry	24 (15.1)

Policies and enabling settings

While having a policy on the structure and functions of ethics review committees was not statistically ($p = 0.042$) related to the facility type or sector, lower-middle-income countries were significantly less likely to have such a policy.

Verification and auditing

Only 50.5% of the sampled institutions reported having a policy for conducting on-site audits of their ethics committee's rules. Some 43.4% had a conflict-of-interest policy and 63.1% reported providing information to participants on publicly accessible websites. Only 34.8% conducted internal/external assessments of the functioning of the research ethics committee as part of quality improvement. Other verification methods included annual or bi-annual internal and external audits (12 respondents). There were no significant differences by facility type, sector or country income level.

Pillar 4: Translation of evidence for policy-making

Knowledge transfer and translation

Table 11 shows that respondents most frequently reported transferring or translating knowledge to the following: other academic faculties/schools/institutions/departments (39.9%), policy-makers in the government (36.3%), health care providers (36.3%) and directors of health care institutions (34.1%).

Respondents from high-income countries were least likely to report frequently/always knowledge transfer and translation to policy-makers (26.7%) and directors of nongovernmental organizations (10%). Those from lower-middle-income countries were least likely to report transferring and translating knowledge to directors of donor agencies (52.3%) or directors of a health professional association or group (21.5%).

Table 11. Frequency of knowledge transfer and translation reported by respondent health research institutions

Target reach for research translation	Never/rarely	Occasionally	Frequently/always
	n (%)	*n (%)*	*n (%)*
Policy-makers in the government (e.g. Ministry of Health, Ministry of Social Affairs, Ministry of Education, etc.)	57 (25.6%)	85 (38.1%)	81 (36.3%)
Directors of nongovernmental organizations.	120 (53.8%)	57 (25.6%)	46 (20.6%)
Directors of international agencies (e.g. United States Agency for International Development, World Bank, WHO, etc.)	123 (55.2%)	54 (24.2%)	46 (20.6%)
Directors of donor agencies	143 (64.1%)	46 (20.6%)	34 (15.2%)
Directors of health care facilities (e.g. primary health care centres, hospitals, etc.)	71 (31.8%)	76 (34.1%)	76 (34.1%)
Directors of a health professional association or group (e.g. Syndicate of Hospitals, Order of Physicians, Order of Nurses, etc.)	79 (35.4%)	79 (35.4%)	65 (29.1%)
Health care providers (e.g. clinicians, nurses, pharmacists, etc.)	64 (28.7%)	78 (35.0%)	81 (36.3%)
Other academic faculties/schools/institutions/ departments	55 (24.7%)	79 (35.4%)	89 (39.9%)
General public or health care recipients (e.g. citizens, patients, clients, etc.)	98 (43.9%)	80 (35.9%)	45 (20.2%)

Research impact

Only 26.5% reported that they frequently or always examine the extent to which health policy-makers used their institution's health research findings. Moreover, only 23.3% frequently or always measured the impact of their health research outcomes (see Table 12). These observations were not significantly different by facility type, sector or country income.

Table 12. Utilization of research results and impact reported by respondent health research institutions

	Never/rarely	Occasionally	Frequently/always
Question	***n (%)***	***n (%)***	***n (%)***
How often do you examine the extent to which health policy-makers use your institution's health research results?	86 (38.6%)	78 (35.0%)	59 (26.5%)
How often do you measure the impact of your health research outcomes (did it influence policy-making)?	93 (41.7%)	78 (35.0%)	52 (23.3%)

Some 55.2% of respondents believed that health research produced by their institution had an impact on health policy. There were no significant differences by facility type, sector or country income. Several respondents reported success stories where evidence generated in their institutions had an impact on health policy. One respondent reported that a locally produced drug to treat schistosomiasis was prohibited by the Ministry of Health after it was reported by their institution to be ineffective. Another respondent mentioned that a project on autism resulted in the establishment of a national organization. Another success story was the development of a nutrition policy (the canteen policy) following the findings of a nutrition survey. A further success story was how evidence on tobacco control research led to a national ban on smoking tobacco in closed public spaces.

Further challenges for conduct of research

The challenges identified from the responses given to the open-ended questions are described below under the categories of financial, human resources, technical and national governance challenges.

Financial challenges

The majority reported that funds were limited for health research. Respondents also experienced challenges at the institutional level, including a lack of internal funding and the lack of a grant management system. Other financial challenges included conditional funding, the mismatch between funding opportunities and priorities, the sustainability of funding and the competitive aspect of international funding. One respondent from Sudan mentioned that sanctions imposed by the United States of America against Sudan were restricting funding opportunities.

Human resources

Most respondents reported a shortage of researchers, experts and staff working in health research. Some respondents mentioned the shortage of qualified and trained research staff. Respondents raised the

need to build the capacities and skills of researchers. Some areas where training was needed included proposal writing, complementary and integrative medicine, research and health policy, and systems research. Some respondents mentioned the difficulty in recruiting and retaining qualified researchers, mainly research assistants and associates. Emigration, or the "brain drain", was another challenge reported by some respondents. Two respondents mentioned the need for technical support staff.

Technical challenges

The most common challenge reported by respondents was the limited availability of laboratory facilities, equipment and devices. One respondent mentioned the poor infrastructure (water and electricity), which impeded the functioning of their laboratory. The second most commonly reported challenge included the limited technical skills and capacities of staff. Capacity needs to be built in research methodology and writing skills. Four respondents commented on the lack of collaboration between their research institution and other national, regional and international institutions. Problems with internet connections and limited access to international databases were also mentioned. Sanctions imposed by the United States are also challenging some institutions in the Eastern Mediterranean Region from adopting new technologies, buying equipment and accessing websites. One respondent mentioned the absence of an ethical review committee as a technical challenge for the institution.

Research governance at the national level

Most pointed to a lack of a research culture and lack of awareness among policy-makers of the importance of research. Respondents also cited the lack of a national strategy for health research as a barrier for health research. National policies and regulations that govern the conduct of health researchers were lacking. For example, one respondent mentioned a lack of regulations regarding clinical trials. A number of respondents expressed a need for setting national research priorities and raising awareness of the importance of research and evidence-informed policy-making. Limited availability and access to data, mainly governmental data, was another challenge raised by respondents. One respondent reported the lack of a national ethical review committee. Other challenges reported were excessive bureaucracy, limited national funding and a mismatch between funding levels and national priorities. Respondents also reported a lack of collaboration between national and international institutions, political instability, and limited availability and access to databases.

Discussion

Results from the health research mapping survey indicate a number of action points for the improvement of capacity development in the Eastern Mediterranean Region. Only half of the institutions that responded had implemented capacity-building activities, provided continuing education or training, or provided incentives to staff to engage in health research. Most health research institutions in the Region appear to be experiencing challenges in developing capacity. Tehran University of Medical Sciences provided a significant number of responses to the input survey and generates almost 6% of the Region's research output (in terms of PubMed-indexed biomedical and health research articles published between 2004 and 2018). Understanding how this university addressed the problem of capacity development may help guide similar institutions.

More than 15% of respondents to the health institution survey did not have access to a computer, which might account for the low output of less than 1000 biomedical and health articles from some countries (as indexed in PubMed) for the years 2004–2018. This may have an effect beyond health research promotion and development and should be addressed.

It is evident that urgent action is required to ensure that efforts made by health research institutions are aligned with country priorities and communicated appropriately. Only half of the respondents reported conducting priority-setting exercises and less than one third followed a standardized priority-setting approach. Some 30% of respondents had participated in national priority-setting exercises. This may explain why, between 2004 and 2018, 45% of the research output in the Region was focused on noncommunicable diseases, yet only 0.45% was focused on emergency preparedness and response. Following the COVID-19 pandemic, it may be argued that more research on emergency preparedness and response is required to support countries to implement evidence-guided activities that are of increasing relevance to the Region. This would tie in with WHO's goal of 1 billion more people better protected from health emergencies.

The subsection on standards showed that 66% of respondents reported the presence of a health research advisory board and 74% of organizations had an ethics board. The significant presence of both implies the active promotion of good research practice. A follow-up study of the maturity and level of activity of these boards may provide countries with actionable points for strengthening public trust in health and medical research.

Although the survey attempted to capture comprehensive data from all identified institutions, the response rate was just 38.8% and countries are not equally represented. Additionally, we were unable to consider the context for understanding the situation of health research institutions because of the cross-sectional nature of the study and incomplete responses. Hence, findings should be read with these caveats in mind.

Chapter 3
Bibliometric analysis

Background

In so-called big data analytics, a number of techniques are used to find patterns in very large structured, semi-structured or unstructured datasets. It is often claimed that such analytics allow for better and faster decisions through gaining new insights from previously untapped data sources, or from data that appeared previously unusable (EMA, 2017; Mählmann et al., 2017). Text mining and bibliographic analysis conducted on scientific literature at a large scale is now an integral part of a broader set of evaluation methods, including case studies, peer reviews, surveys, evaluation of health indicators and deep analyses of health research outputs using bibliometrics. Collectively, these methods can be applied to public health surveillance and forecasting, health research systems and innovation networks in the biomedical and health sciences to identify emerging areas of science, predict the behaviour of scientists in specific priority areas and aid in resource allocation decisions (Jones & Geneau, 2012; El-Jardali et al., 2018; Tadmouri, Mandil & Rashidian, 2019; Chahrour et al., 2020).

Bibliometric methods may complement narrative accounts of scientific developments since they offer the advantage of using data collected from bibliographic databases with minimal bias or involvement from the researchers themselves. This approach helps reduce the administrative burden of many classic evaluation methods, while ensuring that the data gathered are more likely to be representative because they are gathered on entire research communities, not only for those researchers who give their consent (Smith, 2001). The increasing reputation of bibliometric analysis derives in part from the multitude of comprehensive infometric indicators it offers, including activity measurement, knowledge transfer measurement, linkage measurement, interdisciplinary cooperation and citation analysis. An additional strength is that bibliometrics can be used to assess trends in the scientific productivity of individual researchers, research groups, or research communities over time. Some derivative activities of the approach include the identification of the most active and most cited authors and institutions, most relevant publications and most used keywords within a certain research field (Rashidian et al., 2013; Helal, Abou-ElWafa & El-Gilany, 2014; Mahmudi et al., 2015; Jamaluddine et al., 2016; Tadmouri, Mandil & Rashidian, 2019).

In biomedical and health bibliometrics, researchers mainly use the online barrier-free bibliographic database PubMed[1] to analyse global trends in biomedical and health research and to provide objective and useful tools to evaluate the results of scientific activity in different locations (Hefler, Tempfer & Kainz, 1999; Thompson, 1999; Tadmouri & Bissar-Tadmouri, 2003; Uthman & Uthman, 2007). PubMed provides extensive biomedical and health indexing coverage and catalogues over 30 million biomedical articles in more than 49 000 journals in at least 37 languages (PubMed, 2020).

Many attempts have been made to study the geographical distribution of biomedical publications in the Eastern Mediterranean Region by using data either raw or weighted according to population size and

[1] https://pubmed.ncbi.nlm.nih.gov/.

gross domestic product (GDP) (Tadmouri, Mandil & Rashidian, 2019). Although the output of biomedical research in many Eastern Mediterranean Region countries has increased over the last decades, countries have been slow to prioritize their national health research agendas and systematically map research outputs in the health and biomedical domains (Kennedy et al., 2008).

In 2015, the WHO Regional Office for the Eastern Mediterranean began a comprehensive regional-level analysis of biomedical and health research outputs in the Eastern Mediterranean Region for the period 2004–2013 at various levels of geographical distribution. The study was part of a larger endeavour to map the scope of health research in the Eastern Mediterranean Region and encourage the use of research evidence in policy and management decisions. Results from a related survey indicated that 59% of health research institutions disseminated their findings through peer-reviewed scientific journals (El-Jardali et al., 2018).

To complement this initiative, Tadmouri, Mandil & Rashidian (2019) studied the detailed annual rates of biomedical and health research publications in countries/territories of the Eastern Mediterranean Region for the years 2004–2013, identified the most prolific institutions in each country, estimated the number of researchers that contributed to the production of research and analysed some basic indicators of the social aspects of biomedical and health research networks in the Region.

The second phase of the project extended coverage to an additional 5-year period, 2014–2018, and provides a detailed overview of the biomedical and health research landscape in the Eastern Mediterranean Region. A big data corpus of more than 300 000 articles was subjected to comprehensive quantitative and qualitative analyses. Quantitative analyses determined the overall productivity rates at the country level and conferred an in-depth assessment of research activities at the institutional level. The novelty of the project lies in the deep qualitative investigations that offer an unprecedented portrait of research directions in the Eastern Mediterranean Region and their year-to-year alignment with WHO's strategic health priorities. To the best of our knowledge, our analysis of this large dataset represents the most comprehensive attempt so far to analyse the collective quantitative and qualitative aspects of biomedical and health research outputs in the Eastern Mediterranean Region.

Methods

We have improved the PubMed search strategy published by Tadmouri, Mandil and Rashidian (2017) by building a new bibliographic thesaurus (see Annex 2) to precisely mine data on biomedical and health research productivity in countries/territories of the Eastern Mediterranean Region. The resulting country-specific datasets were collected in Medline-format text files and then imported into offline local databases and were subject to quality checks to manually remove any articles with false positive addresses or those with affiliations to countries/territories of the Eastern Mediterranean Region, but not belonging to the papers' first authors. This task became more important because at the beginning of October 2013, the United States National Library of Medicine (NLM) ceased performing quality control reviews and editing the author affiliation field in citations indexed in PubMed and started to rely on data supplied directly by journal publishers (NLM, 2013).

Furthermore, NLM changed its policy from indexing the affiliation of the first author only to including the affiliations of all authors in every citation in the PubMed database for citations indexed after October 2013. As a result, publications in which the first authors resided outside the Region were excluded from this exercise to maintain a balance between the data collected for the years 2004–2013 and data from the period 2013–2018. Although this could be considered a possible limitation, affiliation of the main author reflects a major involvement of that institution with health research and, when aggregated, can adequately represent the research direction of the Region, as well as ensure that each article is uniquely

assigned to a specific country/territory to avoid overlapping results. In addition, an address-based search on PubMed automatically excludes letters to the editors and commentary articles; published articles investigated in this study were limited to reviews, journal articles and case reports.

The number of biomedical and health articles originating from each country/territory of the Eastern Mediterranean Region for the years 2004–2018, as obtained from the PubMed search, was used as an indicator of a country/territory's total biomedical research production level. To allow for a balanced comparison, data were weighted to take into account global research output, represented by the total number of articles indexed in PubMed per year from 2004 to 2018, and the population size of each country/territory. For the latter, historical population data were obtained from the International Data Base maintained by the United States Census Bureau (2019).

In the Microsoft Excel graphs produced from the results of this analysis, fourth degree quartic polynomial trend lines were used to make comparisons over the 5-year periods 2004–2008, 2009–2013 and 2014–2018. The quality of the trend line is represented by calculating R2, the coefficient of determination, where a value near to 1.0 indicates a good fit of the trend line with the actual data. The choice to use fourth degree quartic polynomials in trend lines is based on our observation that linear polynomial trend lines do not reveal sufficient periodic differences, whereas polynomials of a higher order portrayed unwanted noise.

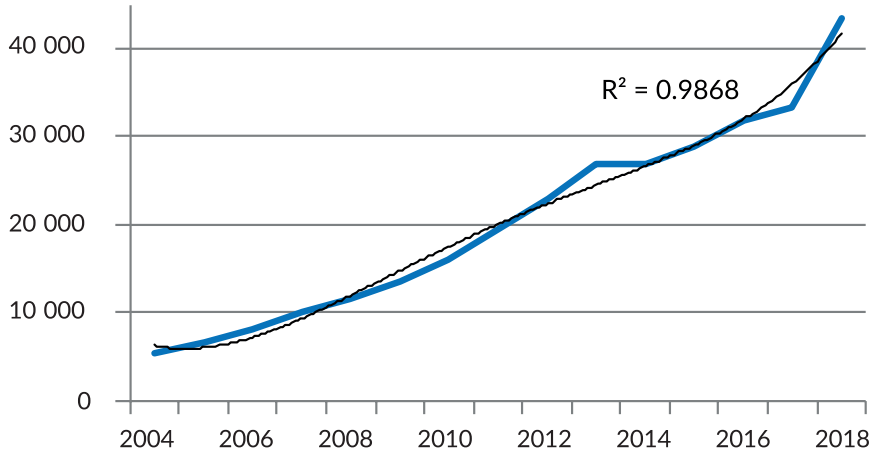
To analyse biomedical and health research directions in the Eastern Mediterranean Region, each of the collected articles was closely inspected by reviewing its various components – title, keywords, co-author affiliations, place of publication – and carefully inspecting the abstract to check its proximity to any of the five priorities set by WHO in 2012, namely: (1) strengthening health systems towards universal health coverage; (2) maternal and child health; (3) noncommunicable diseases; (4) health security and communicable diseases; and (5) emergency preparedness and response. To perform this task, the WHO regional Strategic Health Priority Area (SHPA) classification scheme was consulted. Initially, a pilot sample was subjected to this type of analysis. Along the way, the methodology was further refined by developing elaborate terminology dictionaries to facilitate the sorting process (Assad, 2018; Salma, 2018; Soukarieh, 2018).

For many countries of the Eastern Mediterranean Region, the full spectrum of biomedical and health research publications indexed in PubMed for the period 2004–2018 was fully covered in this type of analysis. Because of the overwhelming size of publications in highly productive countries, a systematic sampling method was tested, validated and applied. Article data from some sizeable countries were fully screened and results were compared to various systematic sampling frames (i.e. 1%, 5%, 10%, 20%, 30% and so on), while keeping the final sample size to no less than those obtained from neighbouring countries. The minimal ordered sampling frame that offered results that did not deviate from the full-scale analysis was 20% (Assad, 2018; Salma, 2018). By testing the ordered sampling frame of 20% on data of various sizes, results obtained from samples of 2000 or more articles were comparable to those obtained from full-scale analyses (Assad, 2018). As a practical application of computing the size of a sampling frame, the sample size target (n) was calculated to be no less than 20% of the overall article count (N). For instance, with an estimate N = 15 000 articles, n is 15 000 x 20% = 3000. The interval of the sampling frame (k) is computed using the formula $k = N/n$; hence, k would be 15 000/3000 = 5; so articles are to be selected at regular intervals using an ordered sampling frame including 0 and 5. In this study, the systematic sampling method was applied for data from the Islamic Republic of Iran (period 2004–2013, sampling frame 20%; period 2004–2018, sampling frame 2% – ongoing), Egypt (period 2004–2018, sampling frame 20%), Tunisia (period 2004–2013, sampling frame 20%) and Morocco (period 2004–2013, sampling frame 20%). The annual variance of health research focus on health systems strengthening was conducted for each country to depict the possible dynamics of research in this field and relate them to the historical development of health research policies and available resources in the countries/territories of the Eastern Mediterranean Region.

Research output

By plotting the overall raw data for biomedical and health research production in the Eastern Mediterranean Region over the period 2004–2018, a clear trend is observed in Fig. 1 (total 305 159 articles; mean of 13 871 articles per year with lead author from the Eastern Mediterranean Region). Notably, the Islamic Republic of Iran accounted for nearly 43% of all published research articles, followed by Egypt (14%), Saudi Arabia (11%), Pakistan (8%) and Tunisia (6%). These five countries accounted for nearly 82% of all published biomedical and health research in the Region over the period (see Table 13). According to the World Bank Group's economic classification, countries with the highest output in the Eastern Mediterranean Region belong to the lower- and upper-middle-income categories. All other countries in the Region contributed less than 4% to the overall total.

Fig. 1. Number of biomedical and health research articles indexed in PubMed, Eastern Mediterranean Region, 2004–2018



Note: The thick line represents the annual raw counts of articles. The thin black line represents the trend line. R2 represents the coefficient of determination.

The raw data in Table 13 demonstrate some noteworthy observations. In the Maghreb, Tunisia slightly reduced its health research output in 2012 until a slow recovery in 2015. Morocco reached a peak in 2014, which was followed by a gradual decrease in output in subsequent years. In the Arabian Peninsula, Kuwait exhibited an undulating pattern throughout the period with successive rises and falls in publication rates. Oman displayed a similar pattern between 2014 and 2018. In Afghanistan, Bahrain, Libya, Sudan, the Syrian Arab Republic and Yemen, a comparable pattern is seen, but conclusions cannot be drawn because of the small number of publications from these countries. Most of the countries with a low growth rate in research output are classified as either low-income or lower-middle-income countries. These countries also tend to suffer from weaker health indicators, lower expenditures on health and research and development, a lower density of hospitals and hospital beds, fewer academic and research institutions and fewer researchers and technicians.

Overall, data from the Eastern Mediterranean Region, when weighted for global biomedical citation outputs, indicate a meagre, but expanding, contribution of 0.85–3.25% of global biomedical research output for years 2004–2018 (mean = 2.01%).

Unsurprisingly, most publications originate in upper-middle- and high-income countries. Population-adjusted data from the Eastern Mediterranean Region confirms that the output of biomedical research in the Region grew over the period 2004–2018 (from 1.02 to 6.04 publications/100 000 population; mean = 3.12).

Table 13. Number of biomedical and health articles indexed in PubMed by country and year, Eastern Mediterranean Region, 2018–2004

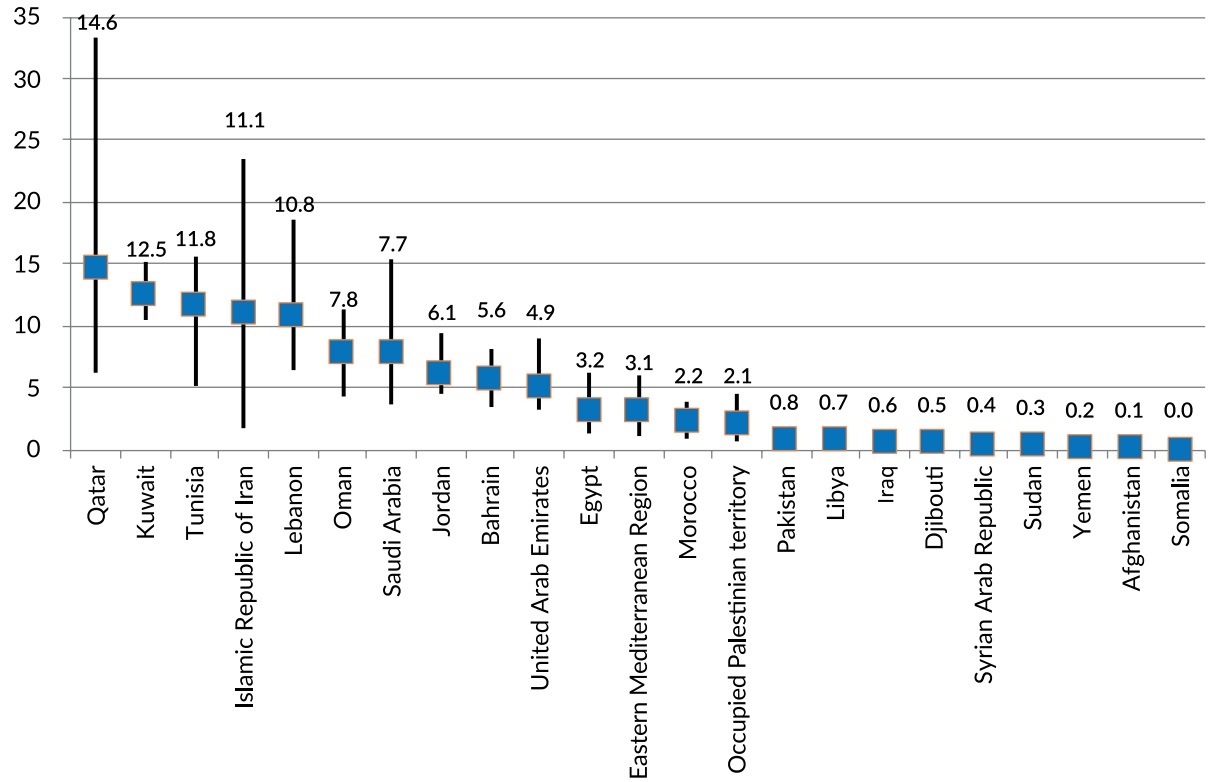
Country	2004	2005	2006	2007	2008	2004-2008	2009	2010	2011	2012	2013	2009-2013	2014	2015	2016	2017	2018	2014-2018	Total
Iran (Islamic Republic of)	1 169	1 643	2 459	3 832	4 301	**13 404**	4 930	6 104	7 972	10 511	12 401	**41 918**	12 566	13 124	14 486	15 076	19 574	**74 826**	**130 148**
Egypt	871	1 003	1 153	1 383	1 597	**6 007**	1 949	2 413	2 866	3 085	3 569	**13 882**	3 364	3 860	4 333	4 374	6 225	**22 156**	**42 045**
Saudi Arabia	893	884	887	936	1 004	**4 604**	1 227	1 620	2 073	2 440	3 038	**10 398**	3 243	3 570	3 761	3 949	5 064	**19 587**	**34 589**
Pakistan	378	563	629	738	973	**3 281**	1 165	1 404	1 556	1 669	1 934	**7 728**	1 952	2 222	2 713	3 016	3 735	**13 638**	**24 647**
Tunisia	502	690	869	1 016	1 188	**4 265**	1 334	1 407	1 531	1 455	1 403	**7 130**	1 230	1 488	1 537	1 545	1 801	**7 601**	**18 996**
Morocco	255	306	346	402	447	**1 756**	518	567	707	870	978	**3 640**	1 263	1 105	964	1 041	1 116	**5 489**	**10 885**
Lebanon	261	312	379	389	459	**1 800**	430	450	484	546	624	**2 534**	620	637	769	851	1 136	**4 013**	**8 347**
Jordan	235	273	316	341	390	**1 555**	481	476	471	486	531	**2 445**	432	437	508	636	975	**2 988**	**6 988**
United Arab Emirates	165	192	206	202	266	**1 031**	274	321	382	355	464	**1 796**	428	552	559	615	880	**3 034**	**5 861**
Kuwait	255	305	287	305	324	**1 476**	302	322	348	325	367	**1 664**	289	309	309	336	440	**1 683**	**4 823**
Qatar	53	73	71	80	90	**367**	122	176	195	271	362	**1 126**	421	498	574	570	785	**2 848**	**4 341**
Oman	121	116	130	158	185	**710**	224	219	250	271	356	**1 320**	313	323	313	313	347	**1 609**	**3 639**
Iraq	37	67	92	91	110	**397**	111	127	118	219	235	**810**	240	226	271	289	471	**1 497**	**2 704**
Sudan	67	74	70	86	102	**399**	112	112	145	147	164	**680**	167	178	191	169	196	**901**	**1 980**
Occupied Palestinian territory	23	30	41	55	69	**218**	72	71	80	89	113	**425**	117	104	115	129	205	**670**	**1 313**
Syrian Arab Republic	32	42	29	37	49	**189**	57	86	99	121	123	**486**	99	111	119	83	137	**549**	**1 224**
Bahrain	56	50	58	52	40	**256**	49	40	65	65	81	**300**	75	66	108	84	117	**450**	**1 006**
Yemen	24	31	23	26	30	**134**	42	58	42	44	52	**238**	63	61	64	53	55	**296**	**668**
Libya	9	15	30	30	44	**128**	45	57	37	54	56	**249**	67	62	55	46	46	**276**	**653**
Afghanistan	7	2	3	7	9	**28**	17	15	15	22	23	**92**	22	15	17	28	23	**105**	**225**
Djibouti	1	3	1	3	5	**13**	7	5	5	5	4	**26**	4	5	3	5	2	**19**	**58**
Somalia	0	0	0	0	2	**2**	0	1	0	1	2	**4**	1	1	1	9	1	**13**	**19**
Total (Eastern Mediterranean Region)[1]	**5 414**	**6 674**	**8 079**	**10 169**	**11 684**	**42 020**	**13 468**	**16 051**	**19 441**	**23 051**	**26 880**	**98 891**	**26 976**	**28 954**	**31 770**	**33 217**	**43 331**	**164 248**	**305 159**
World	639 273	699 964	749 306	786 096	836 554	**3 711 193**	877 093	941 524	1 019 338	1 088 165	1 148 471	**5 074 591**	1 202 639	1 254 099	1 279 310	1 294 601	1 332 838	**6 363 487**	**15 149 271**
Percentage[2]	0.85	0.95	1.08	1.29	1.40	**1.13**	1.54	1.70	1.91	2.12	2.34	**1.95**	2.24	2.31	2.48	2.57	3.25	**2.58**	**2.01**
Population size[3]	532 552	543 968	556 625	569 941	584 028	–	598 408	612 219	625 437	638 374	652 241	–	665 998	678 311	691 543	704 069	717 625	–	–
Articles/100 000[4]	1.02	1.23	1.45	1.78	2.00	–	2.25	2.62	3.11	3.61	4.12	–	4.05	4.27	4.59	4.72	6.04	**Average:**	**3.12**

[1] Row indicates the overall combined values for all Eastern Mediterranean Region countries. Dark-coloured cells indicate years of higher productivity.
[2] World/percentage rows show the overall biomedical article % values for the Eastern Mediterranean Region normalized to global citation outputs registered in PubMed for the period from 2004 to 2018.
[3] Values indicated are in thousands. Source: USCB, 2019.
[4] Articles per 100 000 population row shows overall articles indexed in PubMed for the Eastern Mediterranean Region normalized to corresponding population size (articles per 100 000 population) for the period from 2004 to 2018.

Collectively, the Eastern Mediterranean Region countries witnessed an 8-fold increase in the number of articles published annually between 2004 and 2018. This may be compared with just a doubling globally in published biomedical research articles over the same period. At the country level, the Islamic Republic of Iran achieved a staggering 16-fold increase in biomedical and health research output, followed by Qatar (14-fold increase) and Iraq (12-fold). Egypt achieved a 7-fold increase while Saudi Arabia achieved a 5-fold increase. On the other hand, Djibouti, Kuwait, Oman, Sudan and Yemen doubled their figures.

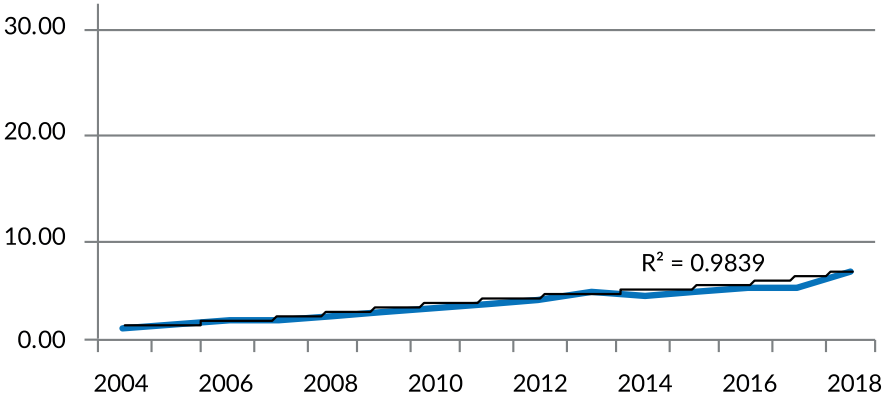
When adjusted for population, Qatar led the Region with an average of 14.6 biomedical research papers published per 100 000 population per year over the period 2004–2018 (Fig. 2). In fact, Qatar achieved a 5-fold increase in output from a publication rate of 6.4 in 2004 to 33.2 articles per 100 000 population for the year 2018. This corresponds with the findings of Zeeneldin & Taha (2014), who evaluated Qatar's biomedical and cancer publications indexed in PubMed 2000–2012. Fig. 3 shows the overall rate by year for the entire Region.

Fig. 2. Number of biomedical research publications by country, Eastern Mediterranean Region, adjusted for population, 2018–2004



Note: Values indicate average health research publications per 100 000 population per year. Boxes represent means and vertical lines represent minimum-to-maximum. Eastern Mediterranean Region represents the overall average value for the entire Region.

Fig. 3. Annual rate of publication, Eastern Mediterranean Region, per 100 000 population size, 2004–2018



Note: Thick lines represent annual raw counts of articles. Thin black lines represent fourth degree quartic polynomial trend lines. R2 represents the coefficient of determination.

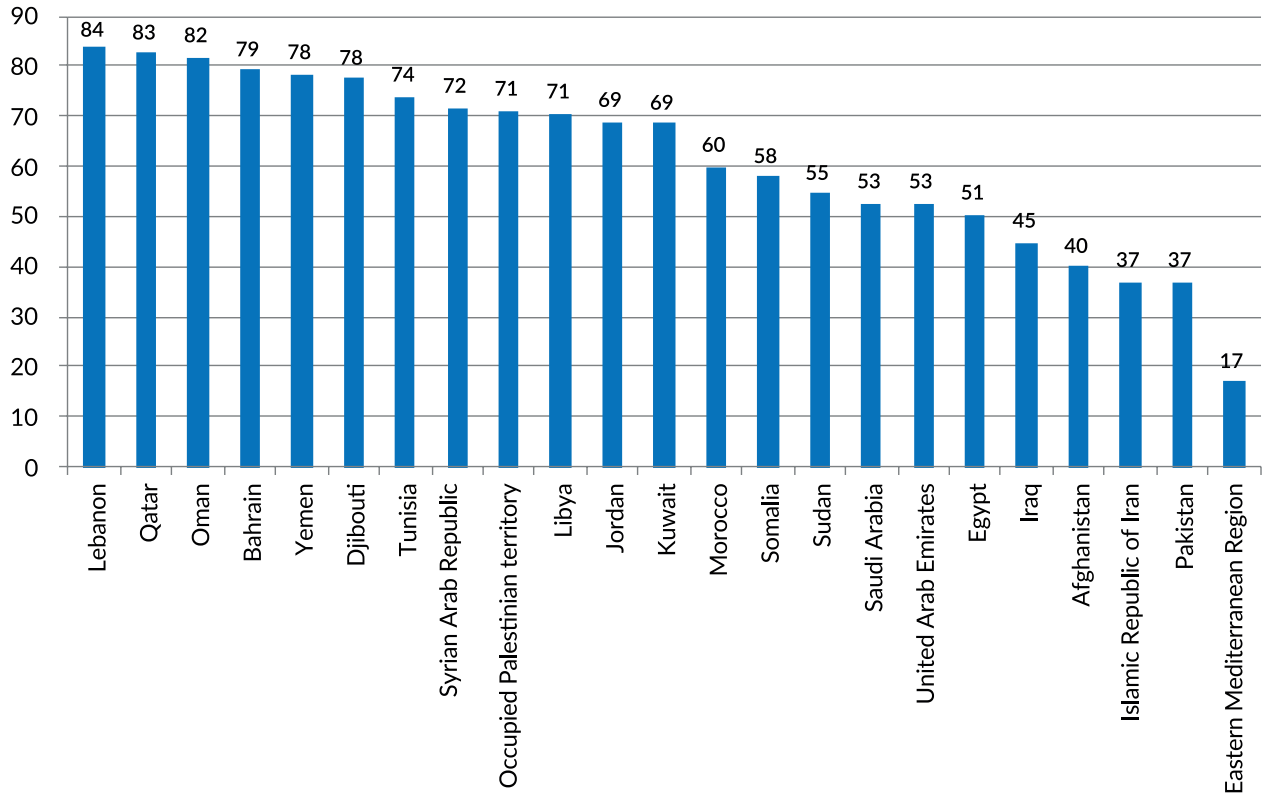
Despite the fluctuations observed in Kuwait over the period, the country performed well with an average of 12.5 articles per 100 000 population per year. Tunisia plateaued over the later years with an average of 11.8. The Islamic Republic of Iran demonstrated a substantial increase coming off a low base of 1.7 in 2004 to a sizeable 23.6 in 2018. Lebanon followed closely with an average of 10.8. Most of the countries that performed well according to this indicator are classified as middle-income or high-income countries.

Institutional output

The geographical distribution of biomedical and health-research outputs was analysed at the institutional level. An exhaustive review of the institutional affiliations of lead authors resulted in 4334 unique addresses. Around half of these were located in a small number of high- and middle-income countries, including the Islamic Republic of Iran (24%), Pakistan (13%), Saudi Arabia (8%) and the United Arab Emirates (7%).

In some countries, a handful of institutions were responsible for nearly all of the country's output (Lebanon, Qatar, Oman, Bahrain, Yemen and Djibouti). In other countries, a large number of institutions shared the load (Pakistan, Islamic Republic of Iran, Afghanistan, Iraq and Egypt). Fig. 4 shows the contribution of the five most prolific institutions by country.

Fig. 4. Contribution of the five most prolific institutions by country, Eastern Mediterranean Region, 2004–2018 (%)



Universities and affiliated teaching hospitals are the major types of institution producing health and biomedical research in the Eastern Mediterranean Region (Tadmouri, Mandil & Rashidian, 2019). Universities, including teaching hospitals and research centres, seem to play a central role in steering biomedical and health research. In the Islamic Republic of Iran, the top 10 performing institutions were all universities. In Egypt and Pakistan, they were nine universities and one independent research centre. In Jordan and Saudi Arabia, the greatest output was produced by eight universities and two hospitals/research centres.

In some countries, medical centres seem to be the major incubators for biomedical and health research activities. A major example is Kuwait, where the 10 most active institutions include six medical centres, two government bodies and one university. In Qatar, most research activities take place in four medical centres, four universities and one research institution. In Oman, activities take place in three universities, five major hospitals, one government body and one research centre.

Of the whole Eastern Mediterranean Region, Tehran University of Medical Sciences was the most prolific, where first authors affiliated with the university contributed nearly 6% of all health research published in the Region. Shahid Beheshti University of Medical Sciences (Islamic Republic of Iran) and King Saud University (Saudi Arabia) followed with a contribution of 3% each. Other institutions contributed less than 2.5%. Only two research centres are featured among the most prolific institutions of the Eastern Mediterranean Region, namely the National Research Center (Egypt) and King Faisal Specialist Hospital and Research Center (Saudi Arabia).

Table 14 shows that, collectively, the 25 most prolific institutions in the Eastern Mediterranean Region generated 43.3% of all published biomedical and health research in the Region.

Table 14. The 25 most prolific institutions by relative contribution, Eastern Mediterranean Region, 2004–2018

Rank	Country	Institution	*n*	%
1	Islamic Republic of Iran	Tehran University of Medical Sciences	17 368	5.69
2	Islamic Republic of Iran	Shahid Beheshti University of Medical Sciences	10 246	3.36
3	Saudi Arabia	King Saud University	9 484	3.11
4	Egypt	Cairo University	7 352	2.41
5	Islamic Republic of Iran	Isfahan University of Medical Sciences	7 171	2.35
6	Islamic Republic of Iran	Shiraz University of Medical Sciences	6 939	2.27
7	Islamic Republic of Iran	Islamic Azad University	6 315	2.07
8	Tunisia	Tunis El Manar University	5 800	1.90
9	Islamic Republic of Iran	Tabriz University of Medical Sciences	5 645	1.85
10	Islamic Republic of Iran	Mashhad University of Medical Sciences	5 593	1.83
11	Egypt	Mansoura University	4 195	1.37
12	Islamic Republic of Iran	Iran University of Medical Sciences	4 130	1.35
13	Lebanon	American University of Beirut	4 091	1.34
14	Egypt	Ain Shams University	3 809	1.25
15	Tunisia	University of Sfax	3 738	1.22
16	Pakistan	Aga Khan University	3 693	1.21
17	Islamic Republic of Iran	University of Tehran	3 656	1.20
18	Saudi Arabia	King Abdul Aziz University	3 542	1.16
19	Islamic Republic of Iran	Tarbiat Modares University	3 506	1.15
20	Egypt	Alexandria University	3 172	1.04
21	Kuwait	Kuwait University	2 764	0.91
22	Egypt	National Research Center	2 703	0.89
23	Saudi Arabia	King Faisal Specialist Hospital and Research Centre	2 569	0.84
24	Oman	Sultan Qaboos University	2 465	0.81
25	Jordan	Jordan University of Science and Technology	2 247	0.74
		Others	172 966	56.68
		Total	**305 159**	**100.00**

Note that extracting institutional details was challenging because of variations in the proper spelling of institutional names. This problem has been documented in previous bibliometric attempts (Tadmouri & Tadmouri, 2002; Rasolabadi et al., 2015). For example, among medical institutions in the Islamic Republic of Iran, Isfahan University of Medical Sciences had 27 name variants, while Tehran University of Medical Sciences had 21, Shiraz University of Medical Sciences had 20, and Iran University of Medical Sciences had 18 (Mohammadhassanzadeh et al., 2010).

In the current study, a large number of institutional name variations were either the result of a complete name change (e.g. Imam Abdulrahman Bin Faisal University, formerly known as University of Dammam, and Latifa Hospital, formerly known as Al Wasl Hospital, United Arab Emirates), typographical errors (e.g. "Loghman -Hakim", "Loghman e Hakim", "Loghman Hakim" or "Loghman-e Hakim" Hospital; "Namazi" versus "Nemazee" Hospital; Payam Noor University, Payame Noor University and Payam-e Noor University), or the absence of consensus on transliteration from Arabic to Roman script (e.g. Menoufia, Menoufiya, or Menophiya University; Buraidah, Buriydah, Buraydah or Buryadah).

The large number of name variants complicated the process of automatically retrieving information by institution, potentially resulting in an underestimate of research output. The importance of correct spelling in institutional affiliations is a subject that should be emphasized in activities aimed at training scientists in best practices in research writing.

On the contribution of academia

Public health problems pose increasingly complex challenges. Understanding them and designing solutions requires the rigorous translation of fundamental scientific findings into clinical and public health outcomes (Tadmouri, Mandil & Rashidian, 2019). The scarcity of dedicated national research centres in many countries of the Eastern Mediterranean Region has led biomedical and health research activities to concentrate in academic institutions.

For example, as a proportion of research output at the country level, Tehran University of Medical Sciences contributed 13%. The university is characterized by its large scientific community (11 schools, 16 hospitals, over 1600 faculty members and about 1000 international students) and a comparatively high impact factor in its research publications (Rezaei-Ghaleh & Azizi, 2007; Borzabadi & Etemadi, 2011). Other major contributors to biomedical and health research in the Islamic Republic of Iran include Shahid Beheshti University of Medical Sciences, Shiraz University of Medical Sciences and Isfahan University of Medical Sciences. All these universities are ranked among the most productive health research institutions in the Eastern Mediterranean Region (see Table 14). In Shahid Beheshti University of Medical Sciences, reforms supporting research activities resulted in increased levels of scientific production of up to 56% from 2009 to 2011 (Sohrabi, Rahmati-Roodsari & Rahmdar, 2014).

In Egypt, nearly 17% of the published research from the country was conducted at Cairo University and its affiliated teaching hospitals. Altogether, Cairo University, Mansoura University, Ain Shams University, Alexandria University and the National Research Center produced nearly half of all biomedical and health research output in the country. The 10 most active institutions in the country contributed a combined output of 70% of the total.

Nearly 27% of the published research from Saudi Arabia was conducted at King Saud University and its affiliated teaching hospitals. This proportion is similar to the 29.5% of total output for the same university found by Tadmouri & Tadmouri (2002) for the period 1982–2000. Collectively, King Saud University, King AbdulAziz University, King Faisal Specialist Hospital and Research Centre and King Abdullah University of Science and Technology produced nearly half of all biomedical and health research output in Saudi Arabia. The 10 most active institutions produced a combined output of 65% of the country's total.

Our observations indicate that academic mega-sites in the Eastern Mediterranean Region act as large incubators for research teams working in biomedical and health sciences. This is consistent with the idea that, globally, universities contribute an important share of science research activities (Choung & Hwang, 2000), and that academic institutions represent the majority of research-active centres in the Region (El-Jardali et al., 2018). This appears to be driven mainly by stringent academic promotion requirements and the foundation of research parks, units, centres and institutions in the Region with a wide range of activities, including education, patient care, service and outreach, and technology transfer (Tadmouri, Mandil & Rashidian, 2019). Moreover, scientists who migrated out, but then returned to the Region, may be characterized by their higher publication rates and relatively closer access to international research networks (Scellato, Franzoni & Stephan, 2015; Sweileh, 2018).

General aspects of health research networks in the Eastern Mediterranean Region

Collaborative health research networks (HRNs) are critical for producing and validating scientific evidence and accelerating scientific progress. Working under the umbrella of a research network alleviates the limitations caused by scarce funding and fragmented scientific communities. They enable shared learning, the exploration of new research opportunities and can facilitate technology transfer (Puljak & Vari, 2014).

Biomedical and health research publications can reflect the deep structure of scientific communication and how health research networks form, maintain or evolve. By tracing the connections between the thousands of research publications, it is possible to surmise the intellectual background of a research programme. Since these publications are also the works of traceable authors belonging to traceable institutions and collaboration networks, they can also be used to make suppositions about the social background of the research. In this way, both cited and citing co-authors can be viewed as interconnected through socio-cognitive networks that are open to historical and evaluative judgment (Wagner, Park & Leydesdorff, 2015).

Evaluating HRNs is often a challenging task (Djalalinia et al., 2020), but one that was not intended as part of the current project. However, the analyses conducted for this study generated two by-products that offer a glimpse into the social organization of HRNs in the Eastern Mediterranean Region, namely, research collaborations and co-authorship patterns.

Research collaborations

Results obtained thus far from co-authorship analysis indicate that each co-author partnered with at least 3–5 colleagues. Analysis of whether the researcher was a lead or secondary author can reveal the relative contribution of the corresponding country in research activities. Furthermore, address analysis of all co-authors of a publication can reveal the extent to which collaborations occur in biomedical and health research, and whether they are national, regional or international. As indicated earlier, country-specific databases compiled within the framework of the study were subject to quality checks to manually remove any articles where first authors were not from the Eastern Mediterranean Region. In late 2013, PubMed started to publish affiliation data for all co-authors, enabling us to conduct a secondary analysis to compute the ratio of articles led by authors from the Region to those where the co-author from the Region was a secondary partner in an international collaboration.

To express this concept with a practical example, a search of PubMed for years 2014–2018 led to a collection of 218 575 published articles. Of this pool, the lead author was from an Eastern Mediterranean Region country/territory in 164 248 cases, while 52 610 articles listed the Eastern Mediterranean Region author as a secondary or non-primary co-author among a collaborative group. In other words, 75% of the total pool of

articles listed the principal investigator as from an Eastern Mediterranean Region-country/territory, while in 24% of cases Eastern Mediterranean Region researchers took a secondary role within a collaborative group.

In the Islamic Republic of Iran, in 94% of cases an Iranian researcher was listed as lead author. In other words, Iranian researchers had a non-primary position in only 6% of publications. We observed that affiliation and institutional address of Iranian research indicated that the majority of biomedical and health research networks were based on collaborations among Iranian science groups affiliated to various national institutions.

Other important examples include Morocco and Tunisia, where 82–83% of biomedical and health articles published in years 2014–2018 included lead authors from these countries, while Moroccan and Tunisian scientists had non-primary co-authorship positions in only 18–17% of cases. This is indicative of the leadership role of Tunisian and Moroccan scientists when conducting collaborative research, which is mostly conducted at an international level, especially with research groups in scientifically advanced countries, such as France, the United States and the United Kingdom (Wagner & Leydesdorff, 2005; Ben Abdelaziz A, Abdelali M & Khmakhem A, 2007; Ben Abdelaziz et al., 2007). In Egypt and Pakistan (2014–2018), authors from these countries had a leading role in around 71% of cases.

It is interesting to note that most of the top countries where local scientists play leading roles in collaborative research belong to the middle-income country group. On the other hand, scientists from low-income countries contributed the least to collaborative research projects and were more likely to be non-primary co-authors.

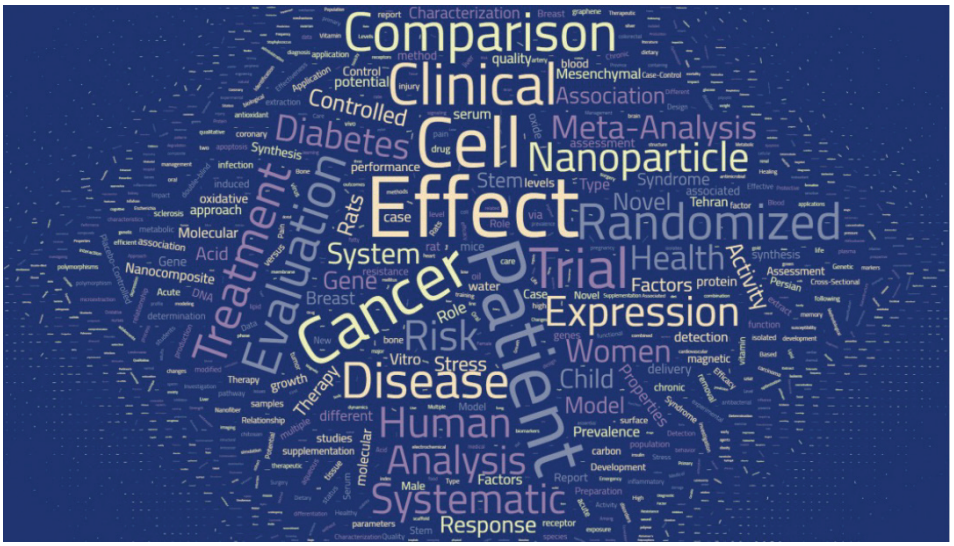
In high-income countries of the Eastern Mediterranean Region, it is more likely that local researchers take secondary positions in collaborative groups (e.g. Qatar 53%, United Arab Emirates 50%, Bahrain 44%, Saudi Arabia 43%, Oman 38% and Kuwait 34%). This observation is in line with the findings of Wagner & Leydesdorff (2005), who studied co-authorships and networks of global science, in which many of the Eastern Mediterranean Region countries displayed a tight association with the main core of advanced countries in the 1990s, including the United States. By the year 2000, however, collaborative networks had become more structured, but disconnected from the main grouping of more advanced countries. In contrast, countries in the Maghreb and Lebanon integrated themselves more closely with the core of more structured networks.

It is plausible that the growing specialization and complexity of scientific disciplines, including health sciences, and the increasing investments in large-scale biomedical sciences (e.g. public health genomics and translational health research) encourage scientists to engage in collaborative research. While attention is currently focused on precision and personalized health care deliveries, scientific explorations in biomedical and health sciences are shifting from individuals to groups, from single to multiple institutions and from a national to international focus.

From a sociological perspective, Pfaff & Ohlmeier (2017) suggest that the sustained viability of health research networks requires structures to ensure that four basic functions are fulfilled: (1) adaptation; (2) goal attainment; (3) integration; and (4) latent pattern maintenance. While data collected in this study offer a modest view of the social organization of HRNs in the Eastern Mediterranean Region through patterns of co-authorship and research collaboration, it is important to develop robust methodologies to investigate this important aspect in more detail. Future studies may provide a visual representation of networks of knowledge development in public health in the Eastern Mediterranean Region and demonstrate the usefulness of big data analytics (see Fig. 5). Understanding the potential role of collaborative partnerships, whether regional or international, might help to improve the quality of research in the Region and accelerate knowledge transfer into policy and practice.

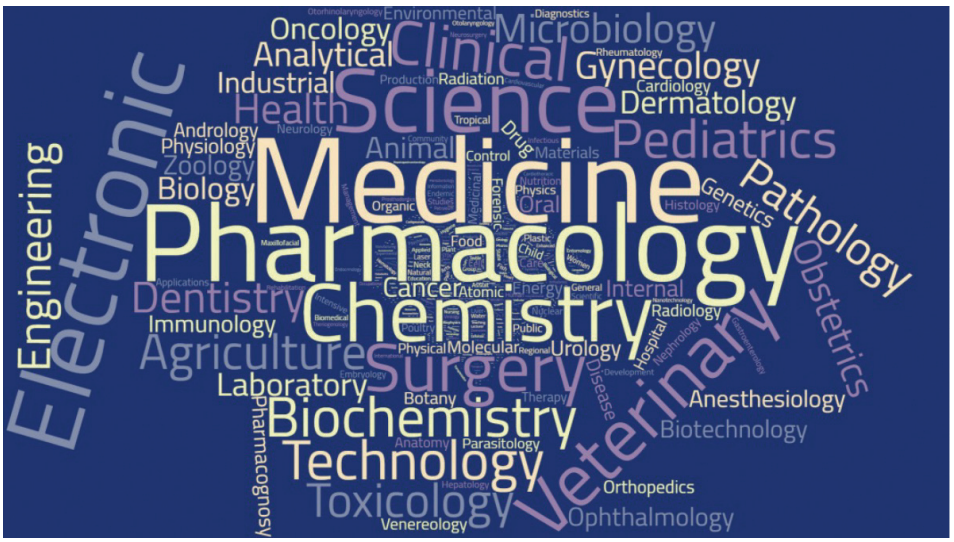
Fig. 5. Examples of data analytics illustrating: (a) the most common key terms in titles from the Islamic Republic of Iran, 2018; (b) scientific domain of primary author, Egypt, 2018; and (c) country of collaborating partners, Saudi Arabia, 2018

(a)



Title Term	%
Effect	15.08
Patient	10.61
Cell	9.14
Cancer	6.47
Clinical	4.73
Trial	4.68
Comparison	4.41
Evaluation	4.20
Disease	4.13
Randomized	4.10
Treatment	3.91
Human	3.52
Expression	3.47
Risk	3.44

(b)



Title Term	%
Medicine	3355
Pharmacology	2222
Electronic	1161
Science	970
Chemistry	814
Veterinary	480
Surgery	449
Clinical	370
Biochemistry	293
Technology	288
Paediatrics	284
Agriculture	259
Toxicology	250
Pathology	241

(c)

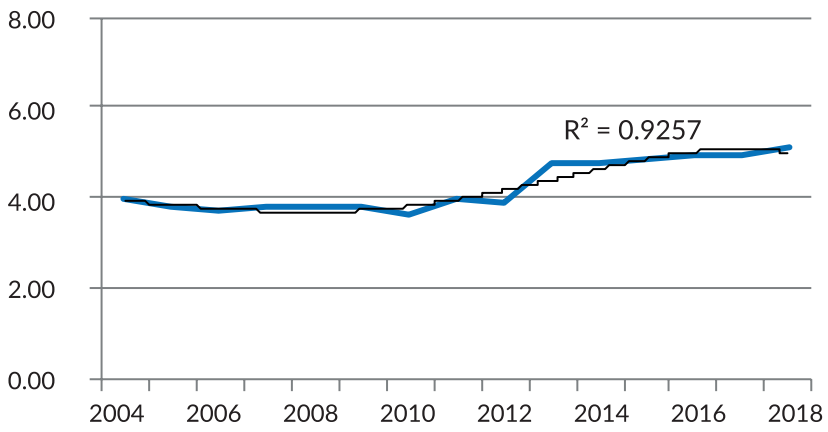
Title Term	%
USA	6.10
Egypt	4.04
China	3.37
India	3.01
Canada	2.90
Australia	2.82
Germany	2.35
France	1.94
Pakistan	1.91
Malaysia	1.24
Italy	1.20
Japan	0.96
Netherlands	0.93
Singapore	0.75

Co-authorship patterns

Levels of co-authorship can provide a measure of collaboration networks. Co-authorship data were obtained from the country-specific databases that were compiled within the framework of this study. Data on the total number of co-authors and the total number of published health research citations for each country were used to compute the average number of co-authors per article for each country for the period 2004–2018. Overall, more than 1 369 000 researchers contributed to the 305 159 articles included in this study (average = 4.2).

Annual values demonstrate an expansion in co-authorship from 3.9 co-authors per publication in 2004 to 5.1 in 2018 (See Fig. 6). These figures are consistent with a study of nearly two million papers published in the years 1995–1999, which showed that biological sciences had an average co-authorship rate of 3.8 (Newman, 2004). Further, a study of 2511 articles published in the period 2005–2014 demonstrated a co-authorship rate of 4.3 authors per article (Conner, Provedel & Maciel, 2017). In the multidisciplinary field of reproductive biology, co-authorship numbers average 5.2 per article (González-Alcaide et al., 2008).

Fig. 6. Annual rate of co-authorship, Eastern Mediterranean Region, 2004–2018

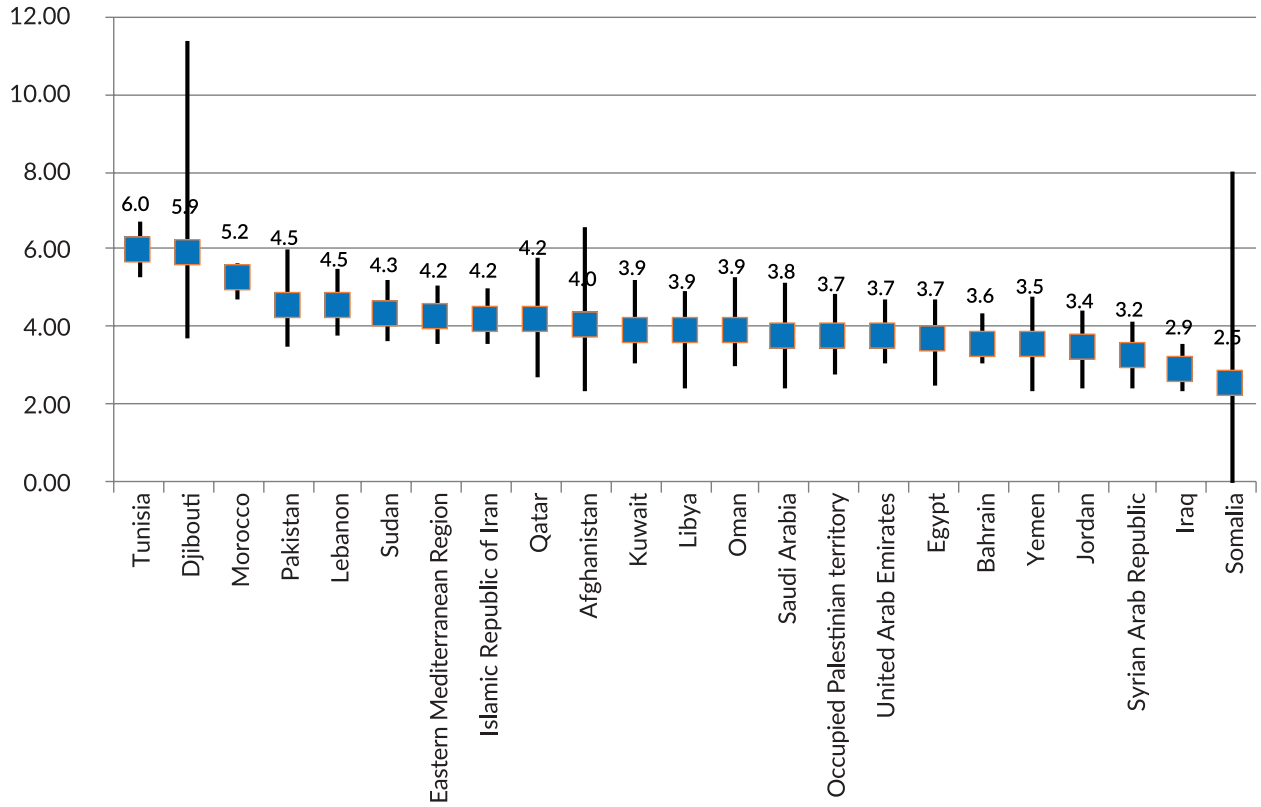


Note: The thick line represents the annual rate of co-authorship across the Region. The thin black line represents the fourth degree quartic polynomial trend line. R2 represents the coefficient of determination.

In a broad sense, co-authorship seems to be an established model in biomedical and health research in the Eastern Mediterranean Region, especially in lower- and upper-middle-income countries (Fig. 7). The lowest rates of co-authorship were found in Somalia, Iraq, the Syrian Arab Republic and Jordan (range 2.9–3.4). In Egypt, United Arab Emirates, occupied Palestinian territory, Saudi Arabia, Oman, Libya, Kuwait, Afghanistan, Qatar and the Islamic Republic of Iran, health research co-authorship is the order of 3.7–4.2. In Sudan, Lebanon, Pakistan, Morocco, Djibouti and Tunisia larger values of 4.3–6.0 co-authors per paper were witnessed.

In Tunisia and Morocco, co-authorship seems to be high throughout the period. Tunisia, with a total of nearly 114 000 articles, recorded a high of 6.7 co-authors per publication in 2018. In Morocco, average co-authorship rates for 2016–2018 were exaggerated because of outliers, with over 2900 co-authors associated with the ATLAS Collaboration, one of the largest collaborative efforts ever attempted in basic science in the pursuit of knowledge about elementary particles and their interactions (ATLAS Collaboration, 2019). Rates ranged from 40 to 79 (data not shown) contributors per article, but 78 articles for each of these years were excluded to remove outliers.

Fig. 7. Co-authorship by country, Eastern Mediterranean Region, 2004–2018 (averages)



Note: Values indicate the mean number of co-authors per publication. Vertical lines represent minimum-to-maximum ranges. The entry "Eastern Mediterranean Region" represents the average value for the entire Eastern Mediterranean Region.

In terms of growth, Qatar demonstrated the largest expansion in co-authorship cohorts, from 2.7 in 2004 to 5.8 in 2018. Pakistan, the Islamic Republic of Iran and Lebanon showed a gradual increase in co-authorship from 2004 to 2018. This may be attributed to the socio-political instabilities that predominated in that period in many countries of the Eastern Mediterranean Region.

Research directions in the Eastern Mediterranean Region

By far, noncommunicable diseases (NCDs) are the most researched priority in the Eastern Mediterranean Region, with around 45% share of the total, followed by communicable diseases (CDs) at around 11%. Fig. 8 shows the distribution of research within the priority areas, including health system strengthening (HSS), maternal and child health (MCH) and emergency preparedness and response (EPR), which is the least researched field in the Region.

However, nearly 24% of biomedical research conducted in the Region does not focus on WHO priority fields but is mainly directed towards basic science.

Fig. 8. Distribution of research by WHO priority, Eastern Mediterranean Region, 2004–2018

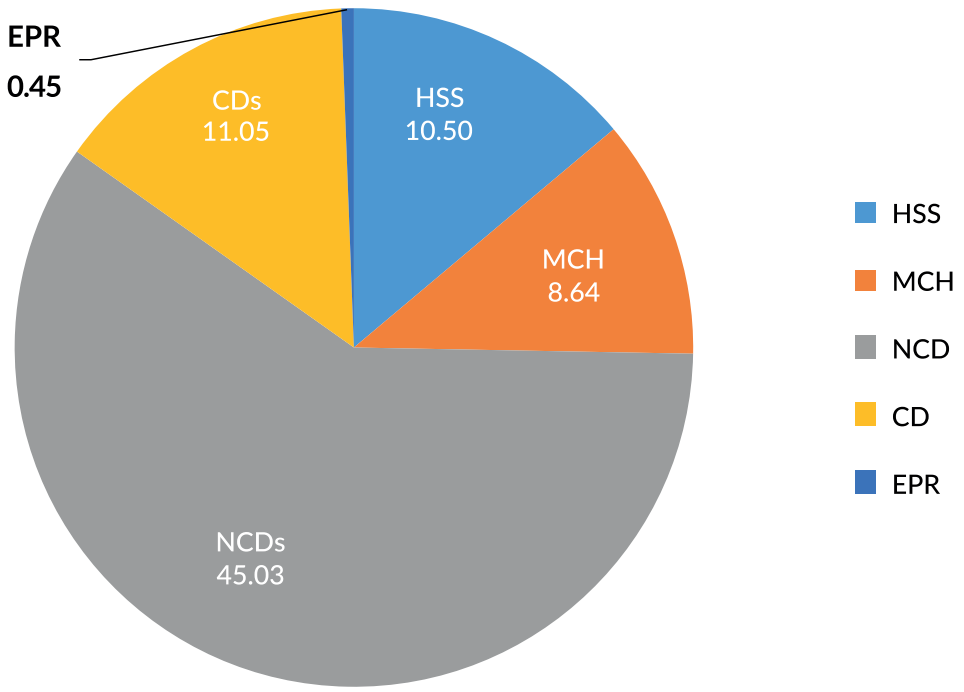
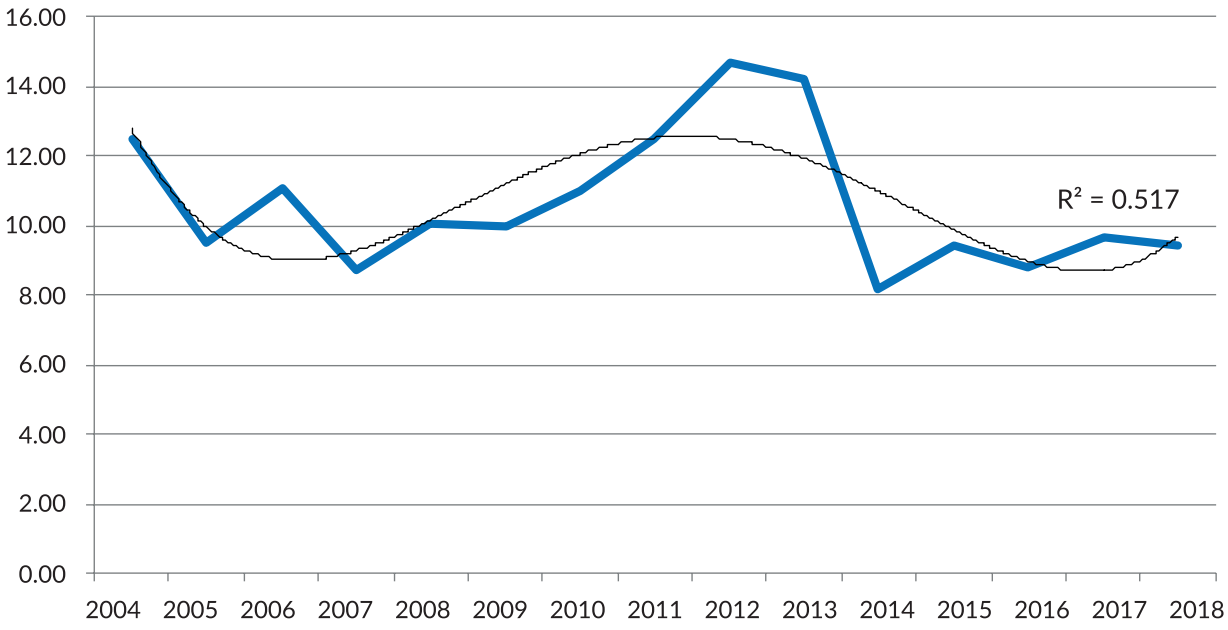


Fig. 9. Share of research on HSS by year, Eastern Mediterranean Region, 2004–2018 (%)

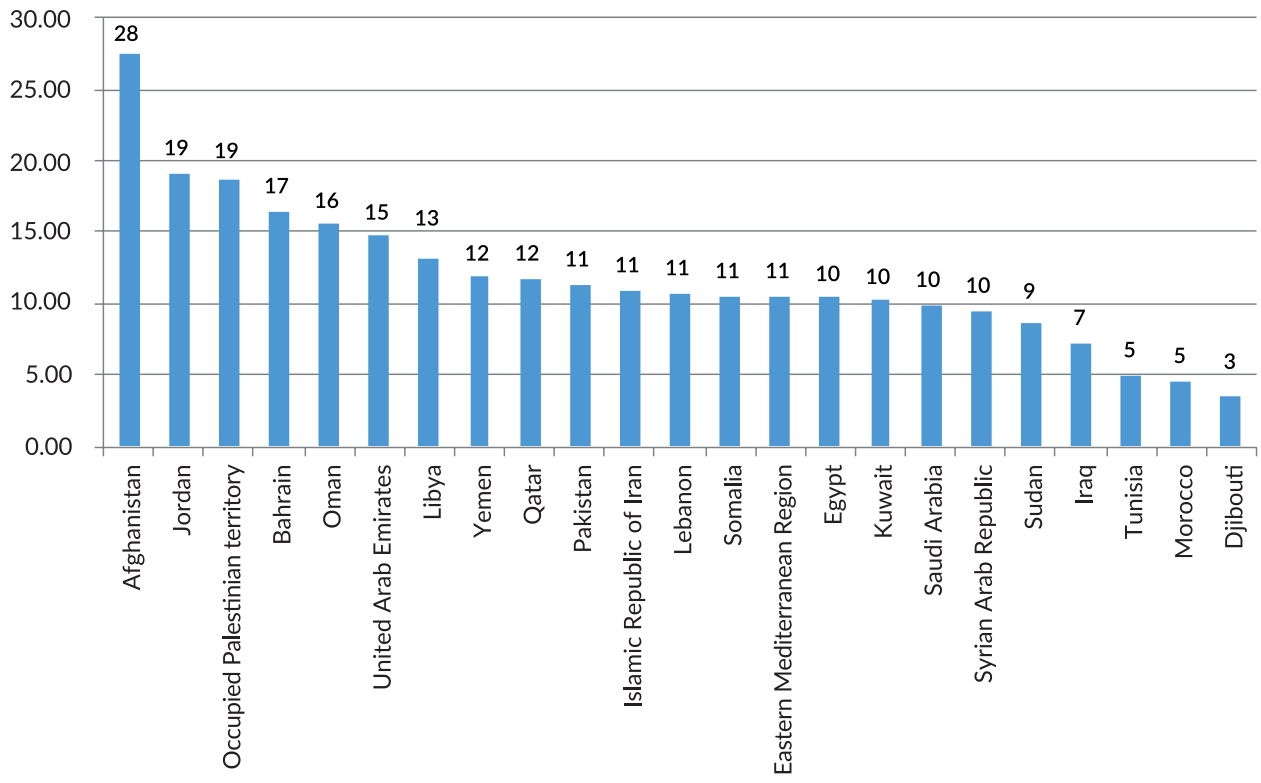


Note: The thin black line represents fourth degree quartic polynomial trend line. R2 represents the coefficient of determination.

Annual figures demonstrate that research in HSS surged in the period 2008–2012, reaching up to 15% of the total biomedical and health research activities in the Eastern Mediterranean Region (Fig. 9). The detailed landscape of research in HSS in the Region points to some activities in Afghanistan, Jordan and the occupied Palestinian territory, but fewer activities were recorded elsewhere in the Region (Fig. 10).

In Afghanistan, research in HSS ranged between 0% and 41% over the period 2004–2018 (average = 28%) and recovered well after the dip in 2010. Several articles focused on military health systems operated by foreign armed forces in the country (Eckart, Gentlesk & Shry, 2010). Efforts to reconstruct the heath infrastructure in Afghanistan accelerated in the previous decade, with total public health spending rising to US$ 280 million in 2008–2009, 85% of which was financed by external donors. Additionally, Afghanistan spent 10% of its GDP on health in 2015 (WHO Regional Office for the Eastern Mediterranean, 2018). Despite the inherent challenges in the health environment and the worsening security situation, the country strengthened the capacity of its health system and improved health service delivery (Edward et al., 2011). To achieve this, the government contracted out the provisioning of services to nongovernmental organizations. Consequently, access to and utilization of primary health care services in rural areas increased dramatically because the number of health service facilities more than doubled and the health information system became more functional (Newbrander et al., 2014). Some observers, however, look cautiously at such results, and suggest that possible exaggeration of official figures is used to market the contracting model (Michael, Pavignani & Hill, 2013).

Fig. 10. Share of research in HSS by country, Eastern Mediterranean Region, 2018–2004 (%)



In Jordan, HSS features in nearly 17% of all biomedical research output from the country. Studies grew steadily from 9% in 2004 to 23% in 2018. Jordan has made strides in strengthening its health system, especially by focusing on specific health information systems, such as disease surveillance and electronic medical records (Sheikhali et al., 2016; reviewed in Higman et al., 2019).

While the output of biomedical and health research increased in Egypt, the Islamic Republic of Iran and Saudi Arabia (Sibai et al., 2017), the stagnant situation in other countries can be attributed to the weak support for national health research systems (Kennedy et al., 2008), as well as major socio-political instabilities that impacted some countries that would have been otherwise active in research. The effects are visible in our data, especially for 2010–2012 when co-authorship contracted in most of the Region. The rates of growth of PubMed-indexed publications simultaneously decreased in several countries during this period, including Bahrain, Egypt, Iran (Islamic Republic of), Iraq, occupied Palestinian territory, Oman, Sudan and the United Arab Emirates, while other countries suffered more serious and extended effects (Jordan, Kuwait, Lebanon and Tunisia).

In Tunisia, the formation of the Ministry of Scientific Research, Technology and Competency Development (MSRTCD) in 1994 represented a turning point for promoting the research sector. Policies aimed at supporting the research culture contributed to the creation of 139 research laboratories and 624 research units, encompassing 23 000 part-time and full-time researchers (Madikizela, 2005). Unfortunately, political instability in the aftermath of the Tunisian revolution in 2010 halted many research activities, and this is visible in the plummeting rates of biomedical and health research outputs after 2011. Despite this, Tunisia published an average of 11.75 biomedical and health research articles per 100 000 population per year and is third to Qatar and Kuwait in terms of performance relative to population size.

In Kuwait, the rates of biomedical publications undulated from 2008 with successive rises and falls, while in the United Arab Emirates, rates stagnated for several years but accelerated in 2015. However, Egypt witnessed socio-political instabilities, yet the impact on biomedical and health research was not substantial, and the rate of growth of publications appears steady across the period.

Biomedical and health research activities in Djibouti and Somalia are relatively scant, as captured by PubMed. Djibouti is a small country with a population of 884 000 inhabitants and has produced a total of only 58 articles in 15 years (0.5 articles annually per 100 000 population). This is still double the figure for neighbouring Sudan. The most extreme case, Somalia, is classified by the United Nations as the least developed country worldwide. With a population of 11.26 million – similar to Tunisia – it published a total of just 19 articles from 2004 to 2019.

From available evidence, research directions in Djibouti and Somalia seem to be out of step with the countries' health needs. Periods of political instability, economic inequities and the slow pace of development are some of the main factors affecting research capacity (Assad, 2018). One way to properly orient research activities in Djibouti and Somalia would be to focus on the main causes of death as reported by the Global Burden of Disease (GBD) observatory (IHME, 2020). GBD data indicate that Djibouti and Somalia suffer mostly from communicable diseases, but what sets the two countries apart is the ever-changing main cause of death in Somalia because of conflicts and terrorist activity (IHME, 2020). Hence, any support for research in the fields of CDs and EPR could make a real difference (Assad, 2018).

Chapter 4
Implications of the two studies

Chapter 2 presented a survey of the inputs made by stakeholders, institutions and Member States to advance health research. Data were sought from 575 facilities across all Eastern Mediterranean Region countries/territories, with responses from 223 (38.8%), on the status of inputs that support the promotion and development of health research. Only two of the top 25 facilities (in terms of PubMed-indexed health research) did not respond, but all of the countries that host a top 25 facility are represented by at least one institution. Only three to four countries have established national guideline development programmes.

Findings from the mapping component of this project showed that health research institutions fair well on several aspects of health policy and systems research. At the time of the survey, a high number of staff with PhDs and masters degrees were observed and over 60% had between 11 and 30 years of experience. While 42% had been established less than 10 years ago, over two thirds have been established for over 10 years, and some had more than 40 years of experience, which reflects solid experience in their country contexts.

As far as capacity to conduct and manage research projects, more than two thirds had research management services within their institutions, in addition to capacity for data collection, management and analysis. Despite the lack of information on the specific amount of funding received, it was interesting to observe that 20% received funding from WHO. The scope of research was not solely clinical and encompassed all areas of public health, which demonstrates institutional capacity and expertise in a wide range of research areas. It is also noteworthy that the majority of the institutions have research ethics boards, particularly when it comes to clinical medical research.

Chapter 3 identified an average of 3.12 articles published per 100 000 population per year in the Eastern Mediterranean Region. From 2004 to 2018, Eastern Mediterranean Region research production increased from 1.02 to 6.04 articles per 100 000 population. At one end of the range, five countries contributed 80% of all published articles and, at the other, 10 countries/territories each produced less than 1%. The top 25 institutions published 43% of all biomedical and health research. Three universities alone produced over 10%.

The input mapping study showed that many Eastern Mediterranean Region countries/territories might be lacking a national strategy for health research, since almost half of respondents reported not having or not knowing whether their countries have articulated any national health research priorities. A prior mapping exercise of the Eastern Mediterranean Region (Kennedy et al., 2008) found that just three out of 10 countries surveyed set national health research priorities, and only two countries had a dedicated national health research policy.

The findings highlight the misalignment between national health research priorities and actual research production, since the majority of respondents indicated submitting proposals that did not address national health research priorities. This corroborates findings of previous regional studies that highlighted the gap in policy-relevant research (El-Jardali et al., 2012; El-Jardali et al, 2015a; El-Jardali et al, 2015b). This can be explained by the fact that only 31.7% of the surveyed institutions reported being involved in a national priority setting exercise over the past five years. Another survey of researchers in the Eastern Mediterranean Region found that just 16% of researchers interacted with policy-makers and stakeholders regarding the setting of priorities (Becerra-Posada et al, 2014). Even when institutions conducted priority-setting exercises, around 60% reported not following a standardized methodology, while the remainder provided no details on the exact methodology used.

The results of the present study also suggest that knowledge translation activities, including policy briefs, policy dialogues and other communications tailored to policy-makers, are still rarely undertaken by institutions in the Eastern Mediterranean Region. Another survey, conducted in 2008 in 10 countries in the Eastern Mediterranean Region, also found that none of those countries reported systematic efforts to feed research results into decision-making (WHO Regional Office for the Eastern Mediterranean, 2008). Indeed, only 26.5% of the institutions surveyed in this study reported frequently or always examining the extent to which health policy-makers actually use their health research findings, and only 23.3% measured the impact of their research outcomes. Policy briefs and similar documents are important tools for topics that are highly politicized or where the nature of the problem is contentious and lacks clarity. As such, there is a need to develop capacity for communicating findings to policy-makers and then to evaluate its effectiveness.

Future investigations should explore factors that protect research activities in certain countries and try to transfer this knowledge to vulnerable countries. National research policies that support and coordinate research activities are obvious candidates for implementation (Tadmouri, Mandil & Rashidian, 2019).

Importance of health research in the Eastern Mediterranean Region for policy-makers

Shaping the research agenda and stimulating the generation, translation and dissemination of valuable knowledge is one of WHO's core functions and the basis of the third strategic shift to focus on the "global public good" with respect to health impacts (WHO 13th General Programme of Work 2019–2023). Globally, health research evidence is vital for enhancing decision-makers' capacities to: (a) improve health policies and practices; (b) prioritize research areas, resources and the workforce; and (c) generate high-quality, convenient and feasible research outputs for priority agendas. Health system research is especially useful in regulating the overall research agenda and ensuring that resources for research are aligned with the needs of the health system as a whole (Alliance for Health Policy and Systems Research, 2004).

In fact, the Declaration of Alma-Ata emphasized the importance of health system research in reorganizing the national research system around the goal of enhancing the performance of national health systems. This was echoed in the Declaration of Astana on primary health care in 2018, which called for health systems to be driven by knowledge and capacity-building to strengthen primary health care and improve health outcomes, while ensuring access for all people to the right care at the right time, and at the most appropriate level of care, respecting their rights, needs, dignity and autonomy.

In WHO's strategy for the Eastern Mediterranean Region 2020–2023, specifically strategic priority 4 on transforming WHO, research is identified as important for streamlining the evidence base that informs

policy-making, with two main strategic directions: (1) investing in research capacity for regional and national priorities; and (2) supporting initiatives aimed at increasing national capacity for the ethical oversight of research and improving research standards. Furthermore, the number of public health research papers published by institutions based in the Eastern Mediterranean Region in peer-reviewed journals is one of the key performance indicators for the WHO Regional Office for the Eastern Mediterranean.

Health research mapping can be used to observe advances in policy-related activities. It is the cornerstone of fostering sustainable health research systems (El-Jardali et al., 2011). For example, policy-makers may use research findings to delay or justify certain decisions. The specific language of research findings may also be used in the drafting of policies (Haines, Kuruvilla & Borchert, 2004).

Limitations of the studies

Although only around 39% of institutions responded to the survey, we consider that the results provide sufficient insight into the questions of interest. At least one health research institution from each of the 22 Member States in the Eastern Mediterranean Region responded. Eight countries of the 22 exhibited a response rate greater than 50%, but one country was unable to respond to the survey and there may be a need to tailor approaches to better understand the challenges that determine the status of health research of certain countries. Four institutions were contacted in Djibouti, but none responded to the survey. Notably, 100% of institutions in Oman responded, whereas institutions from the Islamic Republic of Iran completed around 30% of the survey forms. It may be advisable to target specific countries with health research input surveys so as to produce a clearer understanding of their status and the challenges faced.

In some countries, focal people were more successful in terms of accessing respondents and encouraging them to complete the survey. In some instances, questions required respondents to report on their personal perceptions; these questions may have been subject to social desirability characteristics. Additionally, we were unable to consider the context of health research institutes, because of the cross-sectional nature of the study, and small number of cases in the sample.

With respect to the bibliometric analyses, only PubMed was used to gather information. Hence findings may reflect a lack of diversity with respect to publication streams. For upcoming regional bibliometric analyses, the inclusion of the IMEMR should be considered, as it may be more representative of local journals published in the Eastern Mediterranean Region.

The exclusive characteristics of the barrier-free PubMed search engine and the malleability of its built-in modules facilitate the implementation of large search syntaxes and seamless importing of data into offline systems where it can be analysed. While hundreds of bibliometric studies rely on data exclusively extracted from PubMed, this strategy may have limitations, since not all publications in scientific peer-reviewed journals are indexed in PubMed. This gap could be bridged by complementing the investigation with data obtained from other search engines (Utrobičić et al., 2012; Mandil, Chaaya & Saab, 2013). To prepare the ground for a more dynamic surveillance system based on literature-based data, we have started testing the results generated in this study using the robust technologies of big data analytics. It is anticipated that the use of high-performance analytic systems, involving the application of predictive models and statistical algorithms, would open up interesting opportunities for a more strategic approach to evidence-informed decision-making in health research policy in the Eastern Mediterranean Region over the long term.

The way forward

The research presented in this report attempted to link inputs to health research, as captured by a Region-wide survey, with outputs as measured by bibliographic analysis. It represents the best effort so far to understand the current situation of health research in the Eastern Mediterranean Region and the need for all organizational levels of WHO to support Member States and ministries of health to ensure an enabling environment is developed and maintained for health research in each country.

To our knowledge this study is the first comprehensive survey of its kind to involve all 22 countries/territories of the Eastern Mediterranean Region. The input survey targeted all categories of health research institutions (public and private, academic and non-academic) and all types of health research (from biomedical to health systems). The distinctive character of the study is that it links the input (mapping) to the output (bibliometric analysis) from a systems perspective. WHO initiated this project to analyse the health research landscape in the Region and ease the uptake of research evidence for improved policy and management decisions with respect to universal health coverage and the SDGs.

Efforts to establish national programmes to combat communicable and noncommunicable diseases and translate biomedical research outcomes into health care delivery are helping to improve various health indicators in the Region. Examples include the reduction in infant mortality below the global average of 44.1 per 1000 live births and the increase in life expectancies beyond the global level of 66.1 years (WHO Regional Office for the Eastern Mediterranean, 2020). The Region is currently undergoing a crucial phase involving geopolitical and socioeconomic shifts that will affect entire health care systems. Conflict, political unrest, ageing demographics and population growth all have major impacts on the Region's health and resources (Maziak, 2005; Ben Taleb et al., 2015; Mokdad et al., 2016).

Relative to estimates of disease burden, investment in health research is disproportionately low in the Region (Kennedy et al., 2008). In fact, it was estimated that the Region accounted for just 1.1% of global health research resources in 2013 (Røttingen et al., 2013).

Health research outputs in the occupied Palestinian territory indicate the presence of a mismatch between the health burden of certain diseases and the number of published research reports on those diseases (Albarqouni, Elessi & Abu-Rmeileh, 2018; Soukarieh, 2018). Further discordances between research output and disease burden have been demonstrated with respect to NCDs in seven Arab countries (Sibai et al., 2017). These pioneering observations are enough reason to further explore the qualitative, organizational and social characteristics of biomedical and health research in the Eastern Mediterranean Region and how they are aligned with the major health priorities of the Region (Tadmouri, Mandil & Rashidian, 2019).

A lot has been done to improve national capacity for health research in the Eastern Mediterranean Region and this should be continued and expanded. Still, many gaps and challenges remain that need to be addressed at the institutional, subnational, national and regional levels. More attention and technical support are needed on research priorities, standards, dissemination and ethics, and evidence for policy-making.

Several actions need to be taken to address the challenges identified here and strengthen health research across the Region. These include fostering individual and institutional capacities to plan, implement, use and promote research, which includes the requisite training in techniques and methodologies for research priority-setting, the ethical conduct of research involving human subjects, and knowledge translation and dissemination.

Recommendations

For WHO

1. Discuss the findings of this report in upcoming Regional Committee meetings and include updates from ministries of health.
2. Report updates on the inputs and outputs of health research by Member State annually.
3. Evaluate existing networks and support establishing additional health research networks in the Region.
4. Encourage national and regional priority-setting exercises that focus on identifying short-, medium- and long- term priorities for research. This is particularly important since survey results showed that many proposals and ongoing projects did not address national health priorities.
5. Provide technical support to research institutions in Member States and support those that have no access to national and international scholarly databases in obtaining subscriptions. Also consider supporting the costs of open access publications, particularly for studies that WHO has funded in Member States.
6. Support Member States by building capacity in dissemination of research findings through knowledge translation and transfer. The most frequently used modes of dissemination are scientific meetings and peer reviewed journals. WHO should provide platforms to network research institutions in Member States and establish knowledge translation hubs in the Region and beyond in an effort to support collaborations that build capacity in knowledge translation and evidence-informed health policy-making.
7. Provide technical support to Member States to establish national monitoring and evaluation systems to improve accountability and the relevance of research to national priorities.
8. Provide technical support on the preparation of research priorities that are based on local needs and available resources.
9. Increase the number of designated WHO Collaborating Centres in the Region to better support WHO's strategy on research for health and its five interrelated goals.
10. Encourage opportunities for networking and collaborations across the Region and link research institutions to existing WHO Collaborating Centres with relevant research interests and agendas.

For Member States

11. Include health research policy as a key component of policy frameworks for science, technology and innovation.
12. Establish a national health research system with strong collaboration between research institutions that operate under strong leadership, governance and management structures.
13. Build the capacities and skills of researchers in writing proposals, complementary and integrative medicine, and health policy and systems research.

14. Set national health research priorities, linked to national health/public health priorities, based on rigorous priority-setting exercises.
15. Raise awareness on the importance of evidence-informed health policy-making.
16. Develop knowledge translation products and evidence briefs for priority health problems to support uptake of research findings at national level.
17. Collaborate with regional WHO Collaborating Centres on relevant areas of research.
18. Raise awareness on the importance of research and evidence-informed policy-making.
19. Scale up the dissemination of research findings and the use of research knowledge in decision-making processes using policy briefs and policy dialogues.
20. Strengthen health research institutions through joint partnerships with WHO Collaborating Centres on research promotion and development, innovation and dissemination.
21. Encourage participation of health researchers, investigators and innovators in scientific meetings and gatherings to support dissemination of research findings and identify opportunities for networking and collaboration.

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Annex 1
Health research mapping tool

Dear Colleague,

WHO/EMRO has the pleasure to invite you to participate in this mapping survey on the landscape of research on health in countries of the Eastern Mediterranean Region (EMR). Your participation in this project will contribute to strengthening research for health production and translation in the Region.

It is estimated that completing this tool would take about 20-30 minutes of your valuable time, which we highly appreciate.

Section 1 Background Information

Background	
Name	
Email address	
Your position in your institution/organization/ department/center:	
Position if not listed:	
Date you held this position:	
Highest academic degree that you hold:	
Your overall years of experience:	

Section 2 Institutional Characteristics

Institutional characteristics	
Institution name	
Website	
Type of the institution	
Type of organization	
Country	
If other is selected please specify Type/sector	
Year established	
Years of experience in research for health	

Section 3 Scope of Research (Please check all that apply)

	Type(s) of research your institution mainly undertakes	Please specify other types (if not listed)
Biomedical /Basic Sciences Research	Anatomy Bacteriology Biochemistry Biology Botany To make multiple selections, press the «Ctrl key» and click on the items to choose. Click to Select / unselect all	
Clinical / Experimental Research	Cardiology Chest medicine Clinical Health Dermatology Emergency medicine To make multiple selections, press the «Ctrl key» and click on the items to choose. Click to Select / unselect all	
Social / Behavioral Research	Abuse and violence Alcohol Diet and nutritional Elicit substances and drugs Injury and accident To make multiple selections, press the «Ctrl key» and click on the items to choose. Click to Select / unselect all	
Population / Public Health Research	Behavioral sciences Biostatistics Communicable diseases Community medicine Demography To make multiple selections, press the «Ctrl key» and click on the items to choose. Click to Select / unselect all	
Health Policy / Systems Research	Delivery Arrangements Financial Arrangements Governance Arrangements Health services/ management/ administration Health Systems Strengthening To make multiple selections, press the «Ctrl key» and click on the items to choose. Click to Select / unselect all	

Please indicate how much research for health did your institution produce in selected field/topic during the past 5 years

Institutional characteristics	
Institution name	
Website	
Type of the institution	
Type of organization	
Country	
Years of experience in research for health	

Section 4 Training and Capacity Building

What type of training/capacity building -if any- does your institution provide for students in research for health? *

Type «N/A» if not applicable

How often does your institution provide capacity building/ training opportunities for the researchers / staff? *

Always ○ Frequently ○ Occasionally ○ Rarely ○ Never ○

What other incentives does your institution offer to staff to engage in research for health? *

Type «N/A» if not applicable

How frequent -if any- does your institution announce for Calls for Proposals to provide research grants? *

Bi-annual ○ Annual ○ Never ○ Other ○

Please specify if other frequency for Call for Proposals is selected

Please indicate how much research for health did your institution produce in selected field/topic during the past 5 years

If applicable, please specify the topics of the last three capacity building/training workshops conducted by your institution	
First Capacity building/training topic	
Second capacity building/training topic	
Third capacity building/training topic	
Other not listed topics	

Section 5 Ethics, Leadership and Governance

Advisory Board representatives

	Does your institution have an advisory board that helps in establishing the institution's overall direction and priorities?	Advisory board Representatives	Other not listed representatives (separated by semicolon [;])
Advisory board Representatives (Please check all that apply)	Yes ○ No ◉	General public or service recipients (e.g., citizens, patients, clients) Other academic faculties/schools/ research institutes Policymakers in the government To make multiple selections, press the «Ctrl key» and click on the items to choose. Click to Select / unselect all	

Collaborating Research Partners

	Does your institution/ department have collaborating research partners?	Type(s) of collaborating research partners	Other not listed types (separated by semicolon [;])
Types of collaborating research partners (please check all that apply)	Yes ○ No ○	International partners National partners To make multiple selections, press the «Ctrl key» and click on the items to choose. Click to Select / unselect all	

Ethics

	Does your institution have an Ethics Review Committee, Research Ethics committee and/or Institutional Review Board?	Experts areas represented in the boards (Ethics Review Committee, Research Ethics committee and/or Institutional Review Board)	Other not listed expert areas (separated by semicolon [;])
Ethics review committee (please check all that apply)	Yes ○ No ○	Allied health sciences Dentistry Health Systems To make multiple selections, press the «Ctrl key» and click on the items to choose. Click to Select / unselect all	

Policies and Enabling Settings

Does the Ethics Review Committee/ Research Ethics Committee / Institutional Review Board have a policy which outlines its structure / functions? * Yes ○ No ○

Does your institution provide physical facilities to Ethics Review Committee/ Research Ethics committee / Institutional Review Board that will allow confidentiality to be achieved? (e.g. office space; meeting room; telecommunications; PC/printer/copier; storage facilities, etc.) * Yes ○ No ○

	Does your institution provide training or CME training to scientists / researchers / new members on research on health ethics?	Please specify the modality of training	Other not listed modalities (separated by semicolon;
Training Facilities: (please check all that apply)	Yes ○ No ○	Web-based Lecture based Other To make multiple selections, press the «Ctrl key» and click on the items to choose. Click to Select / unselect all	

Verification and Auditing

	Yes	No
Does your institution have policy for conducting on-site audits to ensure researchers' compliance to Research Ethics Committee rules? *	○	○
Does your institution have conflict of interest policies for research? *	○	○
Does your institution provide information to research participants on publicly accessible website? *	○	○
Does your institution conduct internal / external assessment of Research Ethics Committee functioning as part of its QI (Quality Improvement) program? *	○	○

If assessments are conducted, please specify number / description

Section 6 Resources

Human Resources

	Number of male researchers	Number of female researchers
Gender profile	*	*

Please estimate number of full-time equivalent (FTE) staff employed *

The input is of type «number»

	Holder of PHD degree	Holders of Master degree	Holders of other degrees (Degree / Number; Degree / Number, ..)
Qualification profile			

	Does your institution provide research management services (include staff involved in financial management and control of research funds)?	Does your institution provide research on health proposal writing services?	Does your institution have other support staff in research on health (i.e., data collection, data management, analysis, etc.)?	Does your institution have Information Technology (IT) support staff?
Specialty profile	Yes ○ No ○ *	Yes ○ No ○ *	Yes ○ No ○ *	Yes ○ No ○ *

Financial Resources

	Please indicate type of funding sources for your institution during the past five year? Please check all that apply	Please list other UN organizations if any, [separated by semicolon [;]	Please list other sources if any, [separated by semicolon [;]	Percentage of private funding Private +public=100%):	Percentage of public funding (Private +public=100%):
Funding profile	Own institution funds/budget Local Private Institution Local Public Institution Regional Private Institution Regional Public Institution Pharmaceutical companies International aid programs World Health Organization Other UN agencies To make multiple selections, press the «Ctrl key» and click on the items to choose. Click to Select / unselect all				

Please indicate the amount and the duration of the last five grants your institution has received:

	Fund source	Amount (US$)	Duration (months)
First grant			
Second grant			
Third grant			
Fourth grant			
Fifth grant			

Technical resources

Please assess researchers accessibility in your institution to the following resources

	Always	Frequently	Occasionally	Rarely	Never
Computers *	○	○	○	○	○
Internet connection *	○	○	○	○	○
National databases *	○	○	○	○	○
International databases *	○	○	○	○	○
Scanners *	○	○	○	○	○
Printers *	○	○	○	○	○
Telephones *	○	○	○	○	○

Please list any other resources accessible to researchers in your institution

Does your institution have research laboratories?

Types of Research laboratories available at your institution (if any) *

None
Biotechnical labs
Tropical labs
Clinical labs

To make multiple selections, press the «Ctrl key» and click on the items to choose.
Click to Select / unselect all

Section 7 Institutional planning of Research for Health

Please indicate the number of research proposals that were submitted by your institution during the past five years (2014-2010) to

	Number of research proposals Submitted	Number of research proposals funded	Number of research proposals initiated in response to calls for proposals by funder
National funders			
Regional funders			
International funders			

Priority setting

Did your institution conduct a priority-setting exercise for Research for Health during thepast 5 years (2014-2010)?

Did your institution conduct a priority-setting exercise for research on health during the past 5 years (2014-2010)? * Yes No

If priority-setting exercise exists, did your institution follow a standardized priority-setting methodology? Yes No

please describe the methodology including who was involved (policymakers, stakeholders, researchers etc.)

How often does your institution involve policymakers and stakeholders in setting priorities for the institution's research on health? * Always Frequently Occasionally Rarely Never

How often does your institution translate high priority policy concerns into priority research on health themes and/or questions? * Always Frequently Occasionally Rarely Never

How often does your institution make available an up-to-date list of the country's research on health priorities to the institution's researchers / scientists? * Always Frequently Occasionally Rarely Never

How often does your institution involve policymakers and stakeholders in its research projects (in the development of joint proposals/ research methodology and tools/ analysis & write-up/ publications?) * Always Frequently Occasionally Rarely Never

Section 8 National planning of Research for Health

Does your country have national research on health priorities? *

No ○ Do not know ○ Yes ○

if yes how many proposals of last 5 years' proposals (2014-2010) addressed national Research on Health priorities?

Number of proposals that addressed national health research Priorities *

Enter 0 if not applicable

The input is of type «number»

	Priority 1	Priority 2	Priority 3	Priority 4	Priority 5
Please list the top five priorities					

Recognition and coordination of national health priorities

How often do funders formulate their priorities and calls for proposals for research for health in response to national/regional needs? *

Always ○ Frequently ○ Occasionally ○ Rarely ○ Never ○

If priority-setting exercise exists, did your institution follow a standardized priority-setting methodology?

No ○ Don't know ○ Yes ○

Was your institution institutions involved in a priority-setting exercise for health research at the national level during thepast five years (2014-2010)? *

Yes ○ No ○

if yes who conducted it?

Does the Ministry of Health have a directorate/ department that especially deals with and coordinates health research in your country? *

No ○ Don't know ○ Yes ○

Does your country have a National Health or Health Sector strategy? *

No ○ Don't know ○ Yes ○

If yes please attach

File size is limited to 10MB.

Is there any legislation in your country that deals specifically with health research? *

No ○ Don't know ○ Yes ○

If yes please attach

File size is limited to 10MB.

Does your country have a National Ethics Review Committee? *

No ○ Don't know ○ Yes ●

Section 9 Knowledge Management, Translation & Dissemination

Please indicate how often does your institution disseminate its health research findings through the following means:

	Always	Frequently	Occasionally	Rarely	Never
Institution own peer-reviewed scientific journal *	○	○	○	○	○
Other peer-reviewed scientific journals *	○	○	○	○	○
Seminars/conferences *	○	○	○	○	○
Press releases to the media *	○	○	○	○	○
Institution/researchers' Social Media *	○	○	○	○	○
Institution's website *	○	○	○	○	○
Newsletters/emails/printed reports toresearch networks within your institution *	○	○	○	○	○
Newsletters/emails/printed reports to research networks outside your institution *	○	○	○	○	○
Letters/briefs/tailored messages to policymakers/ stakeholders *	○	○	○	○	○
Policy briefs *	○	○	○	○	○
Policy dialogues *	○	○	○	○	○

If applicable, please indicate any other way you use to disseminate your health research findings:

Do you disseminate health research findings within your institution? *

Yes ○ No ○

if yes how?

Please indicate how often your institution transfer/translate knowledge to each of the following categories of potential users of health research.

	Always	Frequently	Occasionally	Rarely	Never
Policymakers in the government (e.g., Ministry of Health, Ministry of Social Affairs, Ministry of Education, etc...) *	○	○	○	○	○
Directors in Non-Governmental Organizations (NGOs) *	○	○	○	○	○
Directors in international agencies (e.g., United States Agency for International Development [USAID], World Bank, WHO, etc...) *	○	○	○	○	○
Directors in donor agencies *	○	○	○	○	○
Directors in health care facilities (e.g. PHCCs, hospitals, etc...) *	○	○	○	○	○
Directors in a health professional association or group (e.g., Syndicate of Hospitals, Order of Physicians, Order of Nurses, etc...) *	○	○	○	○	○
Healthcare providers (e. g. clinicians, nurses, pharmacists, etc...) *	○	○	○	○	○
Other academic faculties/schools/institutes/ departments *	○	○	○	○	○
General public or healthcare recipients (e.g., citizens, patients, clients, etc...) *	○	○	○	○	○

	Yes	No
Do researchers in your institution have skills on how to disseminate research results to policymakers and stakeholders? *	○	○
Does your institution aim to influence health policymakers and stakeholders as part of its vision/ mandates/ objectives/strategies? *	○	○

	Always	Frequently	Occasionally	Rarely	Never
How often do you examine the extent to which health policymakers utilize your institution's health research results? *	○	○	○	○	○
How often do you measure the impact of your health research outcomes (did it influence policymaking)? *	○	○	○	○	○

If applicable, what methods do you use to measure your health research outcomes' impact?

Do you believe health research produced by your institution has impacted health policymaking? *

Yes ○ No ○

If yes please give a brief example of a success story where evidence generated from health research in your own institution had an impact on health policy making (e.g. community based studies on goiter in Egypt has identified areas with iodine deficient underground water used for drinking, which has eventually resulted in a legislation for nationwide salt iodization):

Section 10 Open Ended Questions

What are the challenges your institution faces in conducting Research for Health?

Click this URL to emphasize obstacles that your institution faces: Challenges

Please confirm that all challenges were submitted * ☐ Yes, all submitted

Feedback on the survey

If you have any comments regarding issues raised in particular questions, kindly identify section and the question number and add your comments in the box below:

Annex 2
Medical subject headings (MeSH) for bibliometrics: PubMed search queries pertaining to Eastern Mediterranean Region countries

Country	Search strategy/query
Afghanistan	Afghanistan*[AD] NOT ("Afghanistan and Pakistan Programs"[AD] OR Lelystad[AD])
Bahrain	Bahrain*[AD] NOT ("Bahraini nh"[author] OR bahrainstephen[AD] OR "Bahrainwala j"[author] OR "Bahrainy m"[author] OR Nazanin[AD] OR Sharif[AD])
Djibouti	Djibout*[AD]
Egypt	Egypt*[AD] NOT Egyptology[AD]
Iran (Islamic Republic of)	Iran*[AD] NOT ("alarcon iranzo m"[author] OR "Bar-Iran University"[AD] OR "Department of Iranian Languages"[AD] OR "Iran caddesi"[AD] OR "Iranian Hospital"[AD] OR Iranyitastechnika[AD] OR "Adel.I.Irani@uth.tmc.edu"[AD] OR "airanzo@clinic.ub.es"[AD] OR "Amir.Iranpour@med.lu.se"[AD] OR "castro i"[AD] OR "esperanza.iranzo@uam.es"[AD] OR "iran.correa@ufrgs.br"[AD] OR "iran@ncc.re.kr"[AD] OR "iranah p"[author] OR "iranetealmeida@hotmail.com"[AD] OR "iranfar n"[author] OR "irani j"[author] OR "irani k"[author] OR "irani m"[author] OR "irani r"[author] OR "irani s"[author] OR "irani.ratnam@mh.org.au"[AD] OR "iranica@yahoo.com"[AD] OR "iranifontova@yandex.ru"[AD] OR "iranirm@uol.com.br"[AD] OR "iranlacerda@gmail.com"[AD] OR "iranmahboob a"[author] OR "iranmalavazi@bol.com.br"[AD] OR "irantzu.barrio@ehu.es"[AD] OR "irantzu.izco@thomsonreuters.com"[AD] OR "irantzu.martinez@ehu.es"[AD] OR "Iranyi Daniel u. 4."[AD] OR "iranzo j"[author] OR "iranzo m"[author] OR "iranzo-cortes j"[author] OR "iranzo-tatay c"[author] OR "iranzosj@cab.inta-csic.es"[AD] OR "kristina.irander@telia.com"[AD] OR "lim ir"[author] OR "moe@iran.usc.edu"[AD] OR "mugueta-aguinaga i"[author] OR "pallares i"[author] OR "perez-ruiz i"[author] OR "piltan f"[author] OR "pouya.iranmanesh@hcuge.ch"[AD] OR "quagio-grassiotto i"[author] OR "ramos-prieto i"[author] OR "randall i"[author] OR "Reza.Iranpour@lacity.org"[AD] OR "sedigheh.iranmanesh@ltu.se"[AD] OR "shahrzad.irannejad@mcgill.ca"[AD] OR "silva.iran@ig.com.br"[AD] OR "yves.irani@gmail.com"[AD] OR "yves_irani@hotmail.com"[AD])
Iraq	(Iraq*[AD] OR Irak[AD]) NOT ("International Society of Iraqi Scientists"[AD] OR metehan[AD] OR meryem[AD] OR "Rua Republica do Iraque"[AD] OR "World Health Organization Iraq Office"[AD])

Country	Search strategy/query
Jordan	Jordan[AD] NOT ("3A Kapetan Kotta str"[AD] OR "200 S. Jordan"[AD] OR "425 Jordan"[AD] OR "4248 Jordan Hall"[AD] OR "ailsa.jordan@hnehealth.nsw.gov.au"[AD] OR "albritton j"[author] OR "amar jy"[author] OR "andrea.hayes-jordan@uth.tmc.edu"[AD] OR "anne.lynch-jordan@cchmc.org"[AD] OR "axelrad j"[author] OR "Barbara Jordan-Mickey Leland School of Public Affairs"[AD] OR "Beth.Jackson-Jordan@carolinashealth care.org"[AD] OR "blacktop j"[author] OR "BOKU-University"[AD] OR "Bryan Jordan"[AD] OR "Camille Jordan Institute"[AD] OR "chenkin j"[author] OR "cloyd j"[author] OR Cupecoy[AD] OR "Devine-Jordan Center for Reconstructive surgery and Pelvic Health"[AD] OR "dr.jordan.lewis@gmail.com"[AD] OR "dunlap j"[author] OR "etkin j"[author] OR "facey j"[author] OR "feld jj"[author] OR "greenbaum vj"[author] OR "guenette ja"[author] OR "Institut Camille Jordan"[AD] OR Jordan[author] OR "Jordan 1240"[AD] OR "Jordan 866"[AD] OR "Jordan Bldg"[AD] OR "jordan b"[author] OR "Jordan Building"[AD] OR "jordan c"[author] OR "jordan d"[author] OR "Jordan Family Center"[AD] OR "Jordan Hall"[AD] OR "Jordan Health Center"[AD] OR "jordan i"[author] OR "Jordan Institute for Families"[AD] OR "jordan j"[author] OR "jordan k"[author] OR "Jordan Laboratory"[AD] OR "jordan m"[author] OR "jordan p"[author] OR "jordan r"[author] OR "Jordan Road"[AD] OR "Jordan Str"[AD] OR "jordan v"[author] OR "Jordan Valley"[AD] OR "Jordan Valley Dermatology and Research Center"[AD] OR "Jordan Valley Innovation Center"[AD] OR "Jordan Valley Medical Center"[AD] OR "jordan.angell@osumc.edu"[AD] OR "jordan.beck@cuw.edu"[AD] OR "Jordan.Berg@ttu.edu"[AD] OR "jordan.berlin@Vanderbilt.Edu"[AD] OR "jordan.brown@abbvie.com"[AD] OR "Jordan.Chill@biu.ac.il"[AD] OR "jordan.chill@weizmann.ac.il"[AD] OR "jordan.cohen@calgaryhealthregion.ca"[AD] OR "jordan.covvey@gmail.com"[AD] OR "Jordan.Dimitrakov@childrens.harvard.edu"[AD] OR "jordan.dimitrov@crc.jussieu.fr"[AD] OR "jordan.e.pinsker.mil@mail.mil"[AD] OR "jordan.farkas@utsouthwestern.edu"[AD] OR "jordan.fulcher@ctc.usyd.edu.au"[AD] OR "jordan.geller@cshs.org"[AD] OR "jordan.gilleland@choa.org"[AD] OR "Jordan.hall@lackland.af.mil"[AD] OR "jordan.jacobs@chw.edu"[AD] OR "Jordan k"[Author] OR "jordan.lancaster@va.gov"[AD] OR "jordan.li@health.sa.gov.au"[AD] OR "jordan.lodato@duke.edu"[AD] OR "Jordan.Louviere@uts.edu.au"[AD] OR "jordan.malof@duke.edu"[AD] OR "Jordan.Nguyen@uts.edu.au"[AD] OR "jordan.okie@asu.edu"[AD] OR "jordan.paradise@shu.edu"[AD] OR "Jordan.Peccia@yale.edu"[AD] OR "jordan.pinsker@na.amedd.army.mil"[AD] OR "jordan.pinsker@us.army.mil"[AD] OR "jordan.pober@yale.edu"[AD] OR "jordan.ramilowski@aggiemail.usu.edu"[AD] OR "jordan.ramilowski@riken.jp"[AD] OR "jordan.rechner@srrws.ch"[AD] OR "jordan.ringenberg@utoledo.edu"[AD] OR "jordan.rosenfeld@gov.bc.ca"[AD] OR "Jordan.Russell@albertahealthservices.ca"[AD] OR "Jordan.S.Nguyen@eng.uts.edu.au"[AD] OR "jordan.schneider@umontana.edu"[AD] OR "jordan.seira@ensiacet.fr"[AD] OR "jordan.smith@pnnl.gov"[AD] OR "jordan.smith@tiehh.ttu.edu"[AD] OR "jordan.smith@uon.edu.au"[AD] OR "jordan.stern@osumc.edu"[AD] OR "jordan.symons@seattlechildrens.org"[AD] OR "jordan.thurgood@monash.edu"[AD] OR "jordan.tompkins@uwo.ca"[AD] OR "Jordan.Trecki@Temple.edu"[AD] OR "jordan.vanlare@cms.hhs.gov"[AD] OR "jordan.wang@jefferson.edu"[AD] OR "jordan.warford@dal.ca"[AD] OR "Jordan.Wesolowski@Jefferson.edu"[AD] OR "jordan.winter@jefferson.edu"[AD] "jordan@musclepharm.com"[AD] OR "jordan@nucmed.rpa.cs.nsw.gov.au"[AD] OR "jordan@olemiss.edu"[AD] OR "jordan@tron-inter.net"[AD] OR "jordan_c_white@yahoo.com"[AD] OR "jordan_g_petrov@yahoo.com"[AD] OR "jordan_orl@hotmail.com"[AD] OR "jordan_renna@brown.edu"[AD] OR "jordan-cohen@uiowa.edu"[AD] OR "jordan-miller@uiowa.edu"[AD] OR "Jordan-Young Institute"[AD] OR "Jordan Medical Education Center"[AD] OR "k.jordan@dadlnet.dk"[AD] OR "kbonner@jordan-young.com"[AD] OR "Kinneret College in the Jordan Valley"[AD] OR "kofler j"[author] OR "MP Jordan Valley 15132"[AD] OR "miller.jordan@mayo.edu"[AD] OR "monnet j"[author] OR "N.Jordan-Mahy@shu.ac.uk"[AD] OR "navarro j"[author] OR "orr j"[author] OR "Peter-Jordan"[AD] OR "Peter Jordan Straße 82"[AD] OR "pierce j"[author] OR "Queen Elizabeth Hospital"[AD] OR "raf_jordan@inwind.it"[AD] OR "Ranken Jordan"[AD] OR "Roseman University of Health Sciences"[AD] OR "Samaria and Jordan Rift R&D Center"[AD] OR "schramm j"[author] OR "shapiro j"[Author] OR "smith j"[Author] OR "South Jordan"[AD] OR "The Jordan Valley"[AD] OR "troutman-jordan m"[Author] OR "v.craig.jordan@fccc.edu"[AD] OR "wang j"[Author] OR "West Jordan"[AD] OR Jordan*[author] OR "TX 78723"[AD] OR "TX, 78723"[AD] OR "University of Pennsylvania Jordan Medical Education Center"[AD] OR "UT 84095"[AD] OR "Utah 84095"[AD] OR "wang jv"[author] OR "West Jordan"[AD] OR "winter jm"[author] OR "wright jj"[author] OR "wright jl"[author])
Kuwait	Kuwait*[AD] NOT ("Al-Kuwait Teaching Hospital"[AD] OR "Kuwai t"[author] OR "Kuwait Hospital"[AD] OR "Kuwait University Hospital"[AD] OR "Sharjah-Kuwait Hospital"[AD])

Country	Search strategy/query
Lebanon	(Lebanon[AD] OR Liban[AD]) NOT ("1 MedSciCom LLC"[AD] OR "585 Lebanon Street"[AD] OR "a AirQuality Research & Logistics"[AD] OR "Behavioral health department of Lebanon VAMC in Wyomissing"[AD] OR "Bluegrass Eye Surgery"[AD] OR "Boone County Solid Waste Management District"[AD] OR "Bronx Lebanon"[AD] OR "Bronx-Lebanon"[AD] OR "C-Health"[AD] OR "Chaim Lebanon 30"[AD] OR "Children›s Hospital at Dartmouth"[AD] OR "Cumberland University"[AD] OR "Dartmouth College"[AD] OR "Dartmouth Hitchcock Medical Center"[AD] OR "Dartmouth Medical School"[AD] OR "Dartmouth-Hitchcock Medical Center"[AD] OR "Dartmouth Psychiatric Research Center"[AD] OR "Dartmouth University"[AD] OR "Franklin Pierce University in Lebanon"[AD] OR "Front Lebanon"[AD] OR "Geisel School of Medicine at Dartmouth"[AD] OR "Good Samaritan Hospital"[AD] OR "Institute for Quantitative Biomedical Sciences"[AD] OR "Lebanon Anesthesia Associates"[AD] OR "Lebanon Emergency Physicians"[AD] OR "Lebanon Magnetic Imaging"[AD] OR "Lebanon Pike"[AD] OR "Lebanon Square"[AD] OR "Lebanon Street"[AD] OR "Lebanon VA Medical Center"[AD] OR "Lebanon Valley College"[AD] OR "Lebanon Veterans Affairs Medical Center"[AD] OR "lebanon@stat.purdue.edu"[AD] OR "liban a"[author] OR "McKendree University in Lebanon"[AD] OR "Merck & Co."[AD] OR "Merck & Co. Inc."[AD] OR "New Hampshire"[AD] OR "New Haven, Conn."[AD] OR "Northwest Oregon Health"[AD] OR "Russell County Medical Center"[AD] OR "Skin Dermatology"[AD] OR "Tennessee Orthopedic"[AD] OR "The Dartmouth Centers for Health and Aging"[AD] OR "The Dartmouth Institute for Health Policy and Clinical Practice"[AD] OR "VA Medical Center"[AD] OR "Veterans Affairs Medical Center"[AD] OR "Warren County Drug Task Force"[AD] OR "Western University"[AD] OR "WesternU College of Osteopathic Medicine of the Pacific-Northwest"[AD] OR "Witham Health Services"[AD] OR "Witham Orthopaedic Associates"[AD] OR 03748[AD] OR 03756[AD] OR 03766[AD] OR 08833[AD] OR 17042[AD] OR 45036[AD] OR 65336[AD] OR 97355[AD] OR NH[AD] OR Permobil[AD] OR WellPoint[AD])
Libya	Liby*[AD] NOT (China[AD] OR Dartmouth[AD] OR Gothenburg[AD] OR "Liby kt"[author] OR LIByB[AD] OR Manhattan[AD])
Morocco	(Morocc*[AD] OR Maroc*[AD]) NOT ("angelo.marocco@upra.org"[AD] OR "aroca-peinado m"[author] OR "Chiara Marocco"[AD] OR "daniele.marocco@enea.it"[AD] OR "Lagoas-Marocosende"[AD] OR "marocchino@sbcglobal.net"[AD] OR "maroc@ipsogen.com"[AD] OR "marocen@fcien.edu.uy"[AD] OR "maroca80@hotmail.com"[AD] OR "marocco a"[author] OR "morocco@pobox.com"[AD] OR "roca-rodriguez m"[author] OR "rodriguez calvo de mora m"[author] OR "salazar.marocho@gmail.com"[AD] OR "San Marocs"[AD] OR "Spahis Marocain"[AD])
Occupied Palestinian territory	(Palesti*[AD] OR Gaza[AD] OR "West Bank"[AD]) NOT ("American Charities for Palestine"[AD] OR armitage[AD] OR "avenue Palestine"[AD] OR EAPPI[AD] OR Gaza[author] OR "Gaza Barracks"[AD] OR "Gaza-dong"[AD] OR Mozambique[AD] OR "New Palestine"[AD] OR "Palestine Hospital"[AD] OR "Palestine Refugees"[AD] OR "Palestine Street"[AD] OR Peterborough[AD] OR ramona[AD] OR "South Palestine St"[AD] OR "West Bank Drive"[AD] OR "West Bank Hospital"[AD] OR "West Bank Office Building"[AD])
Oman	Oman*[AD] NOT ("cecilia.oman@ifs.se"[AD] OR "kathy.oman@uch.edu"[AD] OR "kimberly.oman@jcu.edu.au"[AD] OR "manyuhina ov"[author] OR "mikael.oman@surgery.umu.se"[AD] OR "nicole_e_scangarella-oman@gsk.com"[AD] OR "oman kadunc n"[author] OR "Oman Sea"[AD] OR "oman t"[author] OR "oman@mscc.huji.ac.il"[AD] OR omana[AD] OR omanas[AD] OR "omand ja"[author] OR "omanga e"[author] OR Omanze[AD] OR omanovic[AD] OR omansoor[AD] OR omann[AD] OR omania[AD] OR "oman.huber@medizin.uni-ulm.de"[AD] OR "oman@salud.unm.edu"[AD] OR omanhijazi[AD] OR omangoush[AD] OR "pavol.omanik@gmail.com"[AD] OR "Roy-Oman"[AD])
Pakistan	Pakistan*[AD]

Country	Search strategy/query
Qatar	Qatar*[AD] NOT ("Qatar Carbonates"[AD] OR rac2017[AD] OR "Qatar Street"[AD] OR "Sindh Government Qatar Hospital"[AD])
Saudi Arabia	(Saudi*[AD] OR Saoudite[AD] OR KSA[AD]) NOT ("Cantonal Hospital Aarau"[AD] OR "Kantonsspital Aarau"[AD] OR "Kantonsspital Aarau - KSA"[AD] OR "Kantonsspital Aarau (KSA)"[AD] OR "Kantonsspital Aarau AG"[AD] OR "Kantonsspital Graubunden"[AD] OR "Kantonsspital of Aarau"[AD] OR "mushkbar s"[author] OR "Saudi Arabian Cultural Bureau"[AD] OR Saudinger[AD] OR "Saudi Pak Tower"[AD] OR "University Hospital Basel"[AD] OR "ksa@elektro.dtu.dk"[AD] OR "ksa@yahoo.com"[AD] OR "saudiqbal200@yahoo.com"[AD])
Somalia	Somali*[AD] NOT (Andrioli[author] OR Darmstadt[AD] OR Djibouti[AD] OR Dritec[AD] OR "Erer District"[AD] OR Filtu[AD] Jigjiga[AD] OR Jijga[AD] OR Jijiga[AD] OR Minneapolis[AD] OR Nairobi[AD] OR Sapienza[AD] OR "Somali Health Board"[AD] OR Somalinga[author] OR Stockholm[AD] OR Tehran[AD] OR Thessaloniki[AD] OR Tucker[AD])
Sudan	(Sudan*[AD] OR Soudan[AD]) NOT ("Centro Studi Sudanesi"[AD] OR debra[AD] OR Huadong[AD] OR "jean-maik"[AD] OR "Lodge a"[author] OR "Neupane sp"[author] OR ranjan[AD] OR Solihull[AD] OR "Soudan m"[author] OR "Su d"[author] OR "Sudan v"[author] OR "Sudan Street"[AD] OR "WHO South Sudan"[AD])
Syrian Arab Republic	Syri*[AD] NOT ("Hospital de Alta Especialidad Syrio"[AD] OR Lancet[AD] OR Malankara[AD] OR Palimpsest[AD] OR "Syrian American Medical Society"[AD] OR "Syrian International Coalition for Health"[AD] OR "Syrian Lebanese Hospital"[AD] OR "Syrian-Lebanese Hospital"[AD] OR "Syrian-Lebanese Teaching"[AD] OR syriana[AD] OR syridou[AD] OR syrika[AD] OR Syril[author] OR syrina[AD] OR syrine*[AD] OR syring[author] OR Syringa[AD] OR syriopoulou[author] OR syriosi[AD] OR Syrit[AD] OR syriverama[AD])
Tunisia	Tunis*[AD] NOT ("Viale Tunisia"[AD] OR "tunis s"[author]" OR "Tunison Laboratory"[AD] OR "tunisona@yahoo.com"[AD])
United Arab Emirates	United Arab Emirates[AD] OR UAE[AD] OR "Emirats Arabes Unis"[AD]
Yemen	Yemen*[AD] NOT ("Al-Maisary s"[author] OR Jimma[AD] OR Ningbo[AD] OR Selangor[AD] OR "Shahid Beheshti University of Medical Sciences"[AD] OR Taleghani[AD] OR Velenjak[AD] OR "Yemen St"[AD] OR "Yemen Street"[AD] OR "yemenahmed2009@gmail.com"[AD])