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Developing health centres and hospitals indices for Syria

Based on HeRAMS dataset 2014

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The HeRAMS data used in this study are a product of joint collaboration between the World Health Organization, Ministry of Health and Ministry of Higher Education in the Syrian Arab Republic, during 2014.

[1] See: http://scpr-syria.org/

Contents

Abbreviations

BEmOC	Basic Emergency essential Obstetric Care
ERM	Department of Emergency Risk Management and Humanitarian Response (WHO)
HCI	HeRAMS Centre Index
HeRAMS	Health Resources and services Availability Mapping System
HHI	HeRAMS Hospital Index
ICT	Information and Communication Technology
IIM	Intelligence, Information and Monitoring unit
INGOs	International Nongovernmental Organizations
MoH	Ministry of Health
MoHE	Ministry of Higher Education
NGOs	Nongovernmental Organizations
SCPR	Syrian Centre for Policy Research
WHO	World Health Organization

Executive summary

Building indices

This research paper uses the Health Resources and services Availability Mapping System (HeRAMS) database to develop two composite indices – one for health centres and one for hospitals – in order to analyse and assess the health facilities' performance across time and to evaluate the disparities among regions in the Syrian Arab Republic. The indices will provide an evidence-based tool for the main actors in the health sector to identify gaps, to intervene accordingly and to assess the impact of their interventions on the health system. The process of constructing the indices includes description and selection of variables, application of normalization techniques and weighting methods, and sensitivity analysis. A literature review, analysis of the scope of the HeRAMS database, analysis of the crisis situation, data limitation and expert consultations were the main aspects of the construction process of the indices.

The composite indices of the centres and hospitals consist of three dimensions – (i) accessibility and equity; (ii) readiness; and (iii) efficiency – that are equally weighted and comprise different indicators. The research encompassed HeRAMS data collected in 2014 on a monthly basis for hospitals and on a quarterly basis for health centres. The sensitivity analysis shows that the main contributor to the variance of the composite indices is variance of the accessibility dimension, followed by readiness and efficiency. This reflects the crisis situation facing the population: the accessibility dimension varies greatly between regions due to the varying impact of the conflict.

HeRAMS health centres index results

In terms of the health centres composite index (HCI), the results show that the overall performance of health centres in Syria is weak but that it improved during 2014, scoring an average of 0.51 (out of 1) in 2014, which indicates that the average performance of health centres in Syria was 51 per cent of the optimal "best performance". The improvement is mainly correlated to accessibility, which improved notably during 2014. The HCI shows that Aleppo witnessed the worst performance, followed by Ar-Raqqa, Quneitra, Al-Hasakeh, Deir-ez-Zor and Rural Damascus. The best performer was Tartous, followed by Lattakia, As-Sweida and Damascus.

The accessibility and equity dimension for the HCI includes one indicator, physical accessibility to health centres. The accessibility dimension is the best performer in comparison with the other two dimensions.

The readiness dimension for centres, *which represents the availability of infrastructure, human resources, services, equipment and medicines,* has also improved during 2014. The reported improvement was found in all governorates, except for Quneitra in which the readiness dimension was generally constant throughout 2014. Additionally, the readiness dimension demonstrates that health centres in 2014 were suffering from huge shortages of medicines, equipment and services.

The results in regard to the efficiency dimension for centres show weak performance yet a slight improvement during 2014. Among this dimension's components, services efficiency was the weakest performer by far compared to the performance of functionality, equipment and human resources. The dimension varies across governorates. In 2014, Tartous, Lattakia, Damascus and Hama were the best performers, while Aleppo, Ar-Raqqa, Quneitra and Deir-ez-Zor were the worst performers.

HeRAMS hospitals index results

The hospitals composite index (HHI) witnessed gradual improvement during 2014, and the main contributor to the performance of this index was the accessibility dimension followed by readiness and then efficiency, the latter showing a modest performance compared to other dimensions. The performance of this index differed among governorates: Quneitra had the best performance in 2014, followed by As-Sweida, whereas the worse performance was Dar'a followed by Aleppo.

The accessibility dimension in the HHI reflects the physical accessibility of public hospitals. This dimension is the main contributor to the HHI. The results reflect inequalities among governorates in accessibility of public hospitals, mainly as a result of armed conflict and hospital damage in some governorates.

The readiness dimension for hospitals represents the availability of: infrastructure, human resources, health services, equipment and medicines. This dimension has witnessed gradual improvement during 2014 at the national level. However, there was huge inequality among governorates, whereby some governorates, such as Quneitra, As-Sweida, Tartous, Lattakia and Damascus, had a relatively good performance, while others, such as Aleppo, Dar'a, Rural Damascus, Deir-ez-Zor and Homs, performed weakly.

The five components of the readiness dimension for hospitals differed across time and governorates; the results at national level in 2014 showed that infrastructure scored the highest value followed by human resources, equipment, health services and medicine. These components were directly affected by the conflict, through the destruction of public hospital infrastructure, migration and displacement of medical staff, pillaging and destruction of medical equipment, in addition to the destruction of national pharmaceutical industries that had a negative impact on medicine availability.

The efficiency dimension for hospitals includes four indicators, on the efficiency of: functionality, human resources, health services and equipment. This dimension witnessed gradual improvement during 2014. However, it showed a notable inequality among governorates, although the score for this dimension was relatively low in all governorates. The weakest performances among governorates were Dar'a, Rural Damascus, Aleppo and Homs, respectively; whereas, Quneitra, Tartous, As-Sweida and Lattakia had the best performances.

The four components of the efficiency dimension for hospitals differed across time and governorates; the results at national level in 2014 showed that functionality scored the highest value followed by equipment, human resources and services. The four indicators were greatly affected by the continuation of the armed conflict; functionality was very much related to the security situation, and human resources efficiency was low mainly due to the migration and displacement of medical staff. The efficiency of health services reached a very low level, reflecting the lack of efficient health services in most hospitals, and the efficiency of equipment was affected during the conflict as a result of pillaging and poor maintenance.

The two composite indices (HCI and HHI) are useful tools for assessing the performance of health centres and hospitals over time and for evaluating inequality across regions; moreover, these indices identify gaps and bottlenecks in the health system that need to be addressed. However, more efforts are required to overcome the gaps in data collection with a more participatory approach, such as conducting population health surveys and opinion surveys to measure health outcomes and to understand the needs from the beneficiaries' point of view.

Introduction

Since March 2011, Syria has faced one of the most severe humanitarian disasters in modern history as a result of the armed conflict, which emerged from a longstanding and deep political, social and economic crisis in the country and the region. It is very challenging to estimate the human, social, cultural and economic capital losses the country has suffered due to the conflict. The loss of lives remains the most tragic aspect. Mortality and morbidity directly and indirectly caused by the conflict are becoming a blind spot for all parties to the conflict. It is estimated that by the end of 2014, 210 000 people had lost their lives, and 840 000 people had been injured directly as a result of the conflict (SCPR, 2015). The Syrian Centre for Policy Research (SCPR) has estimated the long-term impact of the conflict on population health by calculating the loss in life expectancy at birth: they estimate this loss at about 20 years.

The ongoing conflict has also caused a major deterioration of the national health system and health equity in the country. Destruction of infrastructure, the spread of violations against health facilities, workers and patients, disruption of production and imports of pharmaceuticals, flight of the health workforce and military operations are all factors leading to system collapse and health inequalities and disparities.

With the continuation and intensification of the Syrian crisis, the need for systematic analysis of the health system indicators using comprehensive indices becomes crucial to an understanding of the dynamics of the crisis affecting population health, and to developing alternative strategies and immediate interventions to mitigate and overcome the impact of the current crisis.

In this context, this research paper constructs two composite indices, the first for public health centres and the second for public hospitals. These indices are based on the Syrian Health Resources and services Availability Mapping System (HeRAMS) dataset that is managed by WHO in cooperation with the Ministry of Health (MoH) and the Ministry of Higher Education (MoHE), and which collects data on the responsive capacity of centres and hospitals. These indices provide a map of the responsiveness capacity of health facilities based on three dimensions: accessibility, readiness and efficiency. The analysis of these indices provides an in-depth understanding of trends in the health system and services by regions and the three dimensions. The analysis in this research paper is on a quarterly basis for health centres, covering the four quarters of 2014, whereas it is on a monthly basis for hospitals, covering the 12 months of 2014. The framework of this research is designed to be used in the analysis of data collected in the future, and it also highlights the gaps in data collection that need to be addressed.

Literature review

In times of crisis, health systems adjust and cope in different ways – even if unprompted by leadership – driven by the nature and complexity of the crisis, the status of the system before the crisis, the economic and social settings, and the type and level of political and humanitarian response. The primary coping response by the health system is usually to react to short-term impacts.

"Action is always ahead of understanding" (Pain and Goodhand, 2002) is the general trend throughout a political and humanitarian crisis response. This action is traditionally dominated by politics and ideologies, causing a loss of lessons learnt and preventing a needs-driven response. Knowledge and evidence are crucial and only a comprehensive understanding of the general country-level situation is able to provide the needed knowledge. However, this is very unlikely to be obtained. For understandable reasons, political parties and humanitarian organizations tend to narrow down their analysis to specific measurable and manageable aspects of health systems. Such a narrowly defined approach provides little understanding of a complex situation and is not context-specific; it also suggest that there will be lost opportunities for exploring lessons learnt, community resilience and response mechanisms and choices, and health system spontaneous adaptation. In addition, a lack of understanding increases the risk of inefficient distribution and expenditure of scarce resources.

a) Health system performance

The continuous challenges to health and other social services, and multiple waves of reforms, led to a late agreement on the values and goals influencing the governance, function and assessment of health systems globally (WHO, 2008a). This agreement includes the following:

1. Equity is a central value, not only in how health systems are managed, function and provide services, but in how health systems can provide socially common and universal population benefit. A health system can be a vehicle of social justice and greater equality in a society (CSDH, 2007). An equal health system will not only be universal in its services and functionality to protect everyone against the vulnerabilities of sickness and ill-health; it will also guarantee the participation and inclusion of all population groups in the governance process and achievements of social and economic development. Two functions identified here to achieve health equity are: guaranteeing equitable health systems through universality, and addressing health inequalities caused by social inequalities.
2. Health care that puts "people first": Health systems, through planning, finance, service provision and health workers, should be designed according to people's needs and expectations. However, across the world, providers design services and systems according to what they see as priorities (WHO, 2008b). This approach has caused low responsiveness and failure to cope with changes of an epidemiological and social nature. An earlier diagnosis of the Syrian health system prior to the crisis illustrates institutional failure in achieving reforms that reflect a changing epidemiological transition and changing expectations of the population (SPC, 2009).
3. Securing the health of communities: the State, as part of the social contract with the population, has the obligation to provide protection from public health hazards. Different communities have and perceive public health hazards and risks differently. This might be conceptualized politically,

socially or culturally, but whatever the construction is, a functional health system should have the capacity to protect, and to respond to health risks in communities, whether related to factors such as the environment, food security, or collective living and socializing. In order to fulfil this function, the health system should be constructed in close connection with the population and communities, and information and knowledge systems should be well coordinated and easy to access. Services should be provided by primary health and social workers who can communicate communities' needs to institutions and health professionals.

4. Participation: populations, including patients, families, communities, unions and civil society organizations, should have their voices heard. Participation should be institutionalized to guarantee that people's expectations, needs and aspirations are met in policy agendas. Participation ensures transparency and accountability, and prevents the dominance of interest groups' agendas. Communities' participation and self-determination, and people-centred health systems are core values of the primary health care movement (WHO, 2008b); participation is not only a condition, it can also be an innovative solution to democratization of services and outreach to non-urban and deprived communities.
5. Reliable and responsive health authorities: as health is considered to be a public good and common interest across the world, health services are seen as a public responsibility of the State (Davis, 1999). In war or peace, social trust in institutions is vital to their functionality, legitimacy and continuity. Fragmented stewardship, and decreasing and fluctuating public finances are often seen as the State withdrawing from these responsibilities and are the main drivers of popular disappointment, loss of trust, scepticism and instability.

Four agreed functions of health system are usually assessed (WHO, 2000):

1. Stewardship: the term stewardship was used in health system literature instead of governance to describe the wide range of functions carried out by governments as they seek to achieve national health policy objectives, and the national policy may also define the roles and responsibilities of the public and private sectors, and civil society. Stewardship is similar to the notion of public governance but emphasizes the State's leadership role in the health system, however the system is organized.
2. Financing: financing involves three functions (WHO, 2010): (a) revenue collection (sources vary among tax payers, households, and external funding); (b) pooling – as an accumulation and management of financial resources, the main aim of pooling should be to spread the financial risk of illness among the population; and (c) purchasing, i.e., paying for health services (integration of purchasing where the government pays providers, or through the insurance sector, or directly through households and individuals). Equitable financing is essential to achieving equitable health systems, and financing should be built to provide universal access for the entire all population to all services of an acceptable quality, and without going into financial risk or hardship.
3. Resource generation: includes a wide range of inputs, such as human resources, knowledge and intellect, technologies and physical resources. It involves universities and research institutions, training institutions, the pharmaceutical sector, regulators, and the industrial sector (Murray and Evans, 2003). Autonomy and good governance are main issues in determining the fairness, performance and responsiveness of health resources.

4. Providing services: many classifications are available for health services, the most common one being based on the level and type of care. Health care is also divided by users: individual level health services and population-level services as in public health interventions (Goodwin, 2008). Health services are composed of: primary care (general practitioners, family physicians, therapists, community health workers, etc.); secondary care (hospitals, outpatient clinics, treatment centres); and tertiary care (specialist units, rehabilitation centres, inpatient wards)[2] (WHO, 2000; Goodwin, 2008). Primary health care is the first contact for individuals, families and communities; it is the "gate keeper" of the health system, and the referral system for the population into other services.

More recently, assessments of health systems have started to focus on dimensions of equity, performance, quality and efficiency, after two decades of a narrow focus on financial and services efficiency by the international funders of structural adjustments in developing countries. Maxwell (1992) presented six dimensions for assessing health care quality, including:

1. Access to services
2. Relevance to needs (for the whole population)
3. Effectiveness (at individual patient level)
4. Equity (fairness)
5. Social acceptability
6. Efficiency and economy

The literature on assessing health systems in times of conflict is fragmented and case specific, dominated by international nongovernmental organizations (INGOs) and with an orientation towards specific interventions. Ratnayake et al. (2014) found that only 11 per cent of the published material included multiple countries, and that 6 per cent was not specific to any country. The same study also found that the subjects of the published material were mainly infectious diseases (26 per cent), mental health (20 per cent), and gender-based violence (10 per cent). Only 2 per cent of published material was on the social determinants of health, and the same percentage of material was on human rights, ethics, noncommunicable diseases, education, surgery and injuries.

Scholars argue that issues related to limited knowledge of research approaches, access, ethical constraints, funding limitations and politicization of conflicts are the main drivers of lack of research frameworks and references in assessing health systems in times of conflict (Panter-Brick, 2009; Howard, Sondorp, and ter Veen, 2012; Ratnayake et. al, 2014). Panter-Brick (2009) argues for revisiting approaches to research and enquiry, and for adopting broader conceptual frameworks for both health and conflict, and refers to the work of the Commission on Social Determinants of Health (CSDH, 2008) as a guiding framework for conceptualizing health in times of conflict. References to the social determinants of health and interdisciplinary approaches of enquiry were, according to the author, in response to: poor and fragmented evidence, political blind spots, scarcity of critical resources and fragile governance (Panter-Brick, 2009).

This study is guided by the vision and goals of a health care system that is universal, equitable (financially and socially), based on strengthened and people-centred primary health care, that is responsive to people's expectations and has participatory, efficient institutions. It attempts to establish

[2] Differences in the services provided at each level of care vary among countries.

a group of indicators that can be used to reflect these goals in time of conflict. There are certain dimensions that should be added or emphasized in conflict situations. These include: readiness of health systems to adapt to dramatic, constantly changing circumstances; equitable access to health services; and social acceptance. The literature indicates the importance of focusing on access and utility, driven by the broader determinants of health. The necessity of applying a "comprehensive" approach to analyse and assess health systems and health situations in conflict-affected areas is mainly driven by the fact that conflict becomes a social determinant of health. Even in the case of areas minimally affected by military operations, health systems and population health are affected by the decrease of public expenditure on social sectors, the compromising of public health through destruction of infrastructure, and the different social dynamics of power.

The changing social dynamics of power through militarization, and the creation of deprivation and a war economy redefine status, power, agency, perceptions and expectations. They change dynamics within families and communities, and the literature shows that children, women and the elderly are the most affected by this new distribution of power. However, given that militarization and a war economy change gender roles and expectations, men are also dramatically affected. Therefore, everyone is considered vulnerable in conflict (Cohn, 2013). Data focusing on the supply side for health care services can be helpful in providing an initial needs assessment and a prioritization agenda for the humanitarian response. However, supply side data only, are inadequate for assessing the response by health care services and institutional preparedness.

b) Composite index construction

Assessing the health system's performance is a multidimensional task that requires analysis of various indicators and comparison of performance across regions and over time. The composite index is an aggregated measure of different sub indicators related to health facilities' (health centres or hospitals) performance, which summarizes the responsive capacity of the health system. Such an index is a useful instrument for policy-makers, specialists and other key players in the health system, giving a rich yet concise picture of the health system situation to support evidence-based policies and interventions, as well as identifying strengths, weaknesses, challenges and trends in the performance of health facilities at the macro level. The decomposability of the index helps in diagnosing key bottlenecks in each area and analysing the challenges at micro level over time, and in disseminating information in a simple manner to the public. A composite index covers many different aspects of health systems, such as efficiency, equity, responsiveness, quality, health outcomes and access (Papanicolas et al., 2008; Metge et al., 2009).

In a conflict context, the need for a composite index is essential for understanding the dynamics of the crisis and its impact on the health system, which usually witnesses dramatic deterioration during an armed conflict and requires direct interventions (Nardo et al., 2005). There are several stages to constructing a composite index, including the identification of health facilities that need to be assessed, the selection of indicators that reflect the key functions and status of these facilities, and the methods of normalization, weighting and aggregation of the selected indicators; the last stage tests for robustness and sensitivity (Jacobs, Goddard, & Smith, 2007). It is necessary to normalize different types of indicators with different measurement units before aggregation. There are several methods of normalization, such as ranking of indicators, standardization (z-score), rescaling, distance to reference country, and categorical scales (Nardo et al., 2005).

The process of developing composite indices includes numerous methodological challenges that may substantially affect the final results, and should be reported. These challenges include the dependency on the judgement of experts, which could be accompanied with uncertainties. Assigning weights to the individual indicators is another key challenge in constructing a composite index. There are different methods for assigning weights, including multiple regression, stakeholders' preferences and experts' judgement. Sophisticated methodologies have not been widely applied to the construction of composite indicators of health system performance (Papanicolas, 2009).

Assessing health facilities' performance in Syria

HeRAMS is a World Health Organization (WHO) project that aims at strengthening the collection and analysis of information on the availability of health resources and services in Syria at health facility level. A team of national health staff from all governorates was formulated for HeRAMS reporting, and different data collection mechanisms were introduced to address the shortage of timely and relevant information. The main HeRAMS tool for collecting data is a questionnaire that assesses the functionality status, accessibility, health infrastructure, human resources, availability of health services, equipment and medicines at primary and secondary care level.

The HeRAMS project in Syria

HeRAMS is a global health information management tool (for mapping, collection, collation and analysis of information on health resources and services) that aims to provide timely, relevant and reliable information for decision-making. It is used to guide interventions at the primary and secondary care levels, measure gaps and improve resource planning, ensure that actions are evidence-based, and enhance the coordination and accountability of WHO and other health sector partners.

HeRAMS was adapted for use in Syria in 2013, based on consultative meetings and the endorsement of the MoH and health sector partners. Despite the challenging security situation and protracted crisis, in addition to the wide disruption of the Health System, the implementation of HeRAMS has been successfully institutionalized and strengthened in public health facilities using standard data collection tools, systematic methodologies and reporting channels, trained data collectors, agreed protocols and an operational framework with key stakeholders (including comprehensive training programmes and provision of information and communication technology (ICT) to improve timeliness and completeness of reporting).
HeRAMS encompasses public hospitals (under the MoH and MoHE), public health centres, and selected clinics operated by international and national NGOs in the 14 governorates of Syria.

The implementation of HeRAMS in the Syrian crisis has been solidly institutionalized nationwide, systematically assessing health facilities' functionality status, infrastructure, and accessibility, and the availability of resources, services, equipment and medicines. The information generated has had a significant impact on strategic planning, allocation of resources and identification of needs and gaps, in turn improving the targeted response.

Source: WHO (2015): HeRAMS project in Damascus, Syria

This research uses the HeRAMS database to develop two composite indices for health centres and hospitals in order to analyse and assess their performance and dynamics across time and to evaluate the disparities among regions. Moreover, these indices are important and simple tools for policy-makers and the other main players in the health sector for identifying gaps, intervening accordingly and assessing the impact of their interventions on the health system.

a) Assessing HeRAMS data

The HeRAMS database was assessed by checking the descriptive measures of variables, missing values, outliers and consistency of results across indicators. This analysis was applied to all variables across centres and hospitals, in addition to time and location. The data were further scrutinized and adjusted through a consultative approach by WHO technical experts, data managers and data collectors.

The HeRAMS dataset is comprised of two categories of variables:

- Quantitative variables: to count the number of available human resources, health consultations provided and existing equipment.
- Qualitative variables: to measure functionality status, accessibility, infrastructure, availability of services and availability of medicines.

All variables are collected on a monthly basis for hospitals, and on a quarterly basis for health centres. Most of the questions were designed with predefined answers to ensure high quality, measurable analysis, and comparability of results.

The following verifications and validation mechanisms are regularly followed to guarantee quality data collection:

- Values should be restricted to the question choices/predefined answers.
- Validation rules are applied in the data entry tools.
- A time trend comparison is performed for each variable, for the months and quarters of the collected data, to identify variations. In case of an identified variation, justifications are registered to explain the exceptions, such as data with big variations or cases that do not match validation rules.
- A feedback system was developed to verify and triangulate data at all levels, ranging from data collectors to verifiers, information producers and other partners including focal persons in health facilities, health districts, and governorates, and staff of the MoH, MoHE, NGOs and WHO.
- Regular visits to health facilities at central and governorate level, in collaboration with different partners.

In addition to the above, training workshops for data collectors are conducted at different levels (health facility, governorate, and country). These had a remarkable impact on the quality of data, while contracting focal points in hard-to-reach areas resulted in improved completeness of the dataset. Moreover, supplying of ICT support to reporting staff resulted in improved timeliness and completeness of reporting, quality of data, flow of information and dissemination. HeRAMS regularly published reports are available online[3].

b) Composite index methods

Taking into consideration the related literature review, scope of this research, the conflict situation, data limitations and expert consultations, the research constructed two composite indices (HeRAMS Hospital

[3] HeRAMS published reports are available online: http://www.emro.who.int/syr/herams/herams.html

Index, henceforth HHI and HeRAMS Centre Index, henceforth HCI) that summarizes the performance of public health facilities.

Selecting variables for composite indices

For the HCI, the unit of analysis is the centre, and the results were aggregated at the national and governorate levels throughout the four quarters of 2014. Based on the HeRAMS health centres standard questionnaire, 94 variables were used to construct the centres' index. Table 1 shows the number of centres included in the data sets of each quarter across the governorates, noting that the number of centres incorporated during the third and fourth quarter data sets varied. The variation in the number of assessed health centres was mainly due to newly established or re-accredited health centres, or permanently closed health centres.

Table 1: Number of health centres included in the HCI by governorates and quarters (2014)

Governorate	Q1	Q2	Q3	Q4
Damascus	61	61	61	61
Rural Damascus	169	169	175	178
Aleppo	226	226	226	227
Idleb	118	118	116	114
Lattakia	117	117	119	116
Tartous	164	164	165	165
Homs	216	216	216	221
Hama	161	161	148	167
Al-Hasakeh	91	91	96	97
Deir-ez-Zor	95	95	101	103
Ar-Raqqa	72	72	73	73
Dar'a	104	104	103	103
As-Sweida	92	92	92	93
Quneitra	58	58	59	58
Total	**1744**	**1744**	**1750**	**1776**

Source: HeRAMS datasets 2014.

For the HHI, the unit of analysis is the hospital, and the results were aggregated at the national and governorate levels for each month in 2014. Based on the HeRAMS hospitals' standard questionnaire, 167 variables were used in building the hospital index. Table 2 shows the number of hospitals included in the datasets across governorates per month; in 2014, the HeRAMS system was expanded to include all MoH and MoHE affiliated hospitals.

Table 2: Number of hospitals included in the HHI by governorates and months (2014)

Governorate	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Damascus	8	8	8	13	13	13	13	13	13	15	15	15
Rural Damascus	13	13	13	14	14	14	14	14	14	14	14	14
Aleppo	11	11	11	15	15	15	15	15	15	15	15	15
Idleb	4	4	4	4	4	4	4	4	4	4	4	4
Lattakia	6	6	6	8	8	8	8	8	8	8	8	8
Tartous	6	6	6	6	6	6	6	6	6	6	6	6
Homs	14	14	14	14	14	14	14	14	14	16	16	16
Hama	6	6	6	6	6	6	6	6	6	6	6	6
Al-Hasakeh	5	5	5	5	5	5	5	5	5	5	5	5
Deir-ez-Zor	7	7	7	7	7	7	7	7	7	7	7	7
Ar-Raqqa	4	4	4	4	4	4	4	4	4	4	4	4
Dar'a	9	9	9	9	9	9	9	9	9	9	9	9
As-Sweida	3	3	3	3	3	3	3	3	3	3	3	3
Quneitra	1	1	1	1	1	1	1	1	1	1	1	1
Total	**97**	**97**	**97**	**109**	**109**	**109**	**109**	**109**	**109**	**113**	**113**	**113**

Source: HeRAMS datasets 2014.

Most of the variables in the questionnaires were used to build the HeRAMS indices. The crisis context imposed dramatic and unpredictable changes on normal relations among health factors, and their significance. Moreover, all variables in the questionnaire are designed to give important information about the health system's performance in Syria during the crisis. Using the available indicators provided the ability to identify any shortages in any aspect directly. Thus, the research did not use factor analysis or principal component analysis, as these methods mask the detailed changes in each indicator, which can be crucial during crisis situations.

Missing values and outliers

The missing values were treated as an absence of the services/elements, in all indicators, since the missing values mostly reflected non-reporting health facilities in conflict zones. It is worth mentioning that non-reported cases decreased substantially during 2014.

Regarding outliers, the team checked for the accuracy of cases and adjusted the imprecise cases accordingly. The accurate outliers remain in the analysis as a reflection of the impact of the crisis on the health system.

Normalization method

The score of each index ranges between 0 and 1; where 0 reflects the absence of health services, while 1 reflects an ideal performance of a health unit. The research normalized all indicators, constructing the composite indices using a rescaling method, where the indicator x_c^t for health facility c and time t (quarter for centres and month for hospitals) is rescaled in $I_c^t \in (0, 1)$ as follows:

$$I_c^t = \frac{x_c^t - min_{t \in \mathrm{T}} min_c(x^t)}{max_{t \in \mathrm{T}} max_c(x^t) - min_{t \in \mathrm{T}}\, min_c(x^t)}$$

Where $max_{t \in \mathrm{T}}\, max_c(x^t)$ and $min_{t \in \mathrm{T}}\, min_c(x^t)$ are the maximum and the minimum value of x_c^t across all health facilities across the whole time range T.

Weighting method

The three dimensions of which the composite indices consist (accessibility and equity, readiness, and efficiency) are equally weighted; furthermore, the aggregation is conducted using simple weighted average. The weighting methodology is based on the Analytic Hierarchy Process which is a participatory approach (OECD, 2008). The process was conducted by senior experts from WHO and independent researchers;[4] they participated in five roundtables to identify the weighting values for the dimensions, and indicators and sub indicators. Instead of averaging the expert weighting values, the team continued discussion with the experts to reach a consensus.

i. HCI structure

The first composite index is the HCI, which reflects the performance of public health centres (see Annex 1a). The HCI consists of three dimensions – accessibility and equity, readiness and efficiency – that are equally weighted. Each of the three dimensions consists of different indicators as follows:

1- HCI accessibility and equity:

The indicator for this dimension is physical accessibility to health centres. Physical accessibility is a crucial element to be analysed during armed conflicts like that in Syria. The research highlights some data gaps, like financial accessibility, accessibility for all people, equity of health outcomes, and equality of health services. These data gaps need different tools to be assessed, such as population health surveys and public opinion surveys.

2- HCI readiness:

This dimension is constructed from five indicators (infrastructure, human resources, health services, available equipment, and medicines) that are equally weighted; each of them consists of sub indicators as follows:

2-1- HCI infrastructure:

This indicator includes the following sub indicators:

- Damage to infrastructure, weighed 0.8
- Water source functionality, weighted 0.1
- Electricity generator availability, weighted 0.05
- Refrigerator availability, weighted 0.05

2-2- HCI human resources:

This indicator includes the following sub indicators:

- Doctor availability, weighted 0.45

[4] From WHO: Ms Fatma Giha: International technical officer (Information Management Specialist); Dr Aicha Aljaber: National technical officer (Primary Health Care and Polio), a former MoH technical staff member; Dr Ghazal Faris: National fficer (Secondary and Tertiary Heath Care), a former MoH technical staff member; Ms Hala Khudari: National technical officer (Nutrition Specialist); Eng. Ayman Mobayed: GIS (Health Information System), a former Central Bureau of Statistics technical staff member; Eng. Mutasem Mohammad: Data Management (Health Information System), a former Central Bureau of Statistics technical staff member. From the Syrian Centre for Policy Research: Mr Zaki Mehchy; Mr Rabie Nasser; and Dr Khuloud Saba.

- Number of nurses and midwives for each doctor, given that the benchmark is at least 2 nurses and midwives for each doctor (MoH, 2011), weighted 0.30
- Support staff to medical staff ratio, given that the benchmark is 0.54 (MoH, 2011); medical staff includes doctors, nurses and midwives, while support staff includes the rest of the human resources, such as administrative staff and technicians; weighted 0.25

2-3- HCI health services:

This indicator includes the following sub indicators:

- General services, weighted 0.125; it includes:
    - Outpatient services, weighed 0.45
    - Basic laboratory services, weighted 0.3
    - Referral capacity, weighted 0.25
- Emergency services, weighted 0.125
- Child health care services, weighted 0.125; it includes three equally weighted services
- Nutrition (screening for malnutrition and lactating women), weighted 0.125
- Communicable diseases (regular reporting to the national surveillance system), weighted 0.125
- Sexual and reproductive health, weighted 0.125; it includes the following services:
    - Management of sexual transmitted infections, weighted 0.08
    - Standard precautions, weighted 0.16
    - Prophylaxis and treatment of opportunistic infections, weighted 0.08
    - Antenatal care, weighted 0.16
    - Skilled care during childbirth, weighted 0.12
    - Essential newborn care, weighted 0.12
    - Basic Emergency essential Obstetric Care (BEmOC), weighted 0.12
    - Tetanus vaccination, weighted 0.12
    - Emergency contraception, weighted 0.04
- Noncommunicable diseases, weighted 0.125; it includes the following services:
    - Surgical care, weighted 0.08
    - Cardiovascular services, weighted 0.23
    - Hypertension management, weighted 0.23
    - Diabetes management, weighted 0.31
    - Mental health care, weighted 0.15
- Environmental health (safe waste disposal and management), weighted 0.125

2-4- HCI equipment:

This indicator includes the availability of 15 equally weighted pieces of basic equipment.

2-5- HCI medicine:

This indicator includes the availability of six equally weighted essential types of medicine.

HCI efficiency:

Efficiency applied in this dimension is defined as the ability to accomplish activities with the least waste of resources. The dimension is constructed from four indicators (functionality, human resources efficiency, health services efficiency, and equipment efficiency) that are equally weighted; each of them consists of sub indicators as follows:

3-1- HCI functionality:

This indicator includes one sub indicator regarding the status of health centres in terms of overall functionality.

3-2- HCI human resources efficiency:

This indicator includes the following equally weighted sub indicators:

- Burden (the ratio of visitors over doctors); the benchmark (12) is based on the national average ratio and its standard deviation of 2010 (pre-crisis). It indicates whether staff are overloaded.
- Underuse (the ratio of visitors over doctors) the benchmark (6) is based on the national average ratio and its standard deviation of 2010 (pre-crisis). It indicates whether staff are underused.

3-3- HCI health services efficiency:

This indicator includes the following two equally weighted sub indicators:

- Emergency and surgical care efficiency
- General health services efficiency, which includes four equally weighted elements:
    - Cardiovascular services efficiency
    - Hypertension management efficiency
    - Diabetes management efficiency
    - Mental health care efficiency

3-4- HCI Equipment efficiency:

This indicator reflects the ratio of functioning equipment to available equipment; it includes the efficiency of 15 equally weighted types of basic equipment.

ii. HHI structure

The second composite index is the HHI, which reflects the performance of public hospitals (see Annex 1b). HHI consists of three dimensions – accessibility and equity, readiness and efficiency – that are equally weighted. Each of the three dimensions consists of different indicators as follows:

1- HHI accessibility and equity:

The indicator for this dimension is physical accessibility to hospitals. Physical accessibility is a crucial element to be analysed during the armed conflicts like that in Syria. The research highlights some data gaps, like financial accessibility, accessibility for all people, equity of health outcomes and equality of health services. These gaps need different tools to be assessed, such as population health surveys and public opinion surveys.

2- HHI Readiness:

This dimension is constructed from five indicators (infrastructure, human resources, health services, equipment and medicines) that are equally weighted; each of them consists of the following sub indicators:

2-1- HHI Infrastructure:

This indicator includes the following sub indicators:

- Damage to infrastructure, weighed 0.8
- Water source functionality, weighted 0.1
- Electricity generator availability, weighted 0.05
- Refrigerator availability, weighted 0.05

2-2- HHI Human resources:

This indicator includes the following sub indicators:

- Doctor availability, weighted 0.45
- Number of nurses and midwives for each doctor, given that the benchmark is at least 2 nurses and midwives for each doctor (MoH, 2011); weighted 0.30
- Support staff to medical staff ratio, given that the benchmark of this ratio is 0.54 (MoH, 2011); medical staff includes doctors, nurses and midwives, while support staff includes the rest of the human resources, such as administrative staff; weighted 0.25

2-3- HHI Health services:

This indicator includes 12 equally weighted sub indicators:

- General services, which includes 3 equally weighted services:
    - Outpatient services
    - Laboratory services
    - Imaging services
- Inpatient services
- Emergency surgery services
- Elective surgery services
- Blood bank services
- Intensive Care Unit (ICU) services
- Emergency services, which includes two equally weighted services:
    - Emergency services
    - Mass causality management
- Child health care services
- Nutrition (management of severe acute malnutrition)
- Reproductive health (including BEmOC)
- Noncommunicable diseases, which includes the following services:
    - Diabetes management, weighted 0.125
    - Hypertension management, weighted 0.125
    - Mental health outpatient, weighted 0.125
    - Mental health inpatient, weighted 0.125

    - Kidney disease, weighted 0.25
    - Cancer treatment services, weighted 0.25

- Environmental health (safe waste disposal and management)

2-4- HHI equipment:

This indicator includes two equally weighted groups of equipment:

- Basic equipment, which includes the availability of 19 equally weighted pieces of equipment.
- Special equipment, which includes the availability of 13 equally weighted pieces of equipment.

2-5- HHI medicine:

This indicator includes the availability of 21 equally weighted types of medicine.

3- HHI efficiency:

The efficiency applied in this dimension is defined as the ability to accomplish activities with the least waste of resources. The dimension is constructed from four indicators (functionality, human resources efficiency, health services efficiency, and equipment efficiency) that are equally weighted, and each of which consists of sub indicators:

3-1- HHI functionality:

This indicator includes two sub indicators:

- Overall functionality, weighted 0.8
- Inpatient capacity (the ratio of actual number of beds to the planned number of beds), weighted 0.2

3-2- HHI human resources efficiency:

This indicator includes the following equally weighted sub indicators:

- Burden (the ratio of visitors to doctors); the benchmark (12) is based on the national average ratio and its standard deviation of 2010 (pre-crisis).
- Underuse (the ratio of visitors to doctors); the benchmark (6) is based on the national average ratio and its standard deviation of 2010 (pre-crisis).

3-3- HHI Health services efficiency:

This indicator includes 11 equally weighted sub indicators:

- General services efficiency, which includes 3 equally weighted services:
    - Outpatient services efficiency
    - Laboratory services efficiency
    - Imaging services efficiency
- Inpatient services efficiency
- Emergency surgery services efficiency
- Elective surgery services efficiency
- Blood bank services efficiency
- ICU services efficiency

- Emergency services efficiency, which includes two equally weighted services:
    - Emergency services efficiency
    - Mass casualty management efficiency
- Child health care services efficiency
- Nutrition efficiency (management of severe acute malnutrition)
- Reproductive health efficiency (including BEmOC)
- Noncommunicable diseases efficiency, which includes the following services:
    - Diabetes management efficiency, weighted 0.125
    - Hypertension management efficiency, weighted 0.125
    - Mental health outpatient efficiency, weighted 0.125
    - Mental health inpatient efficiency, weighted 0.125
    - Kidney disease treatment efficiency, weighted 0.25
    - Cancer treatment services efficiency, weighted 0.25

3-4- HHI equipment efficiency:

This indicator reflects the ratio of functioning equipment to available equipment; it includes two equally weighted groups:

- Basic equipment efficiency, which includes 19 equally weighted equipment ratios.
- Specialized equipment efficiency, which includes 13 equally weighted equipment ratios.

c) Sensitivity analysis

A global sensitivity analysis was conducted, which applies variance-based approaches to examine the importance of the dimensions and indicators used in the composite indices and to analyse the contribution of input variances to the total variance of the composite indices (OECD, 2008; Baptista, 2014; Saltelli et al., 2004). The Sobol method was used to analyse the sensitivity of the results, based on a Monte Carlo simulation and using Simlab2.2.1 software (EC-JRC, 2011).

In term of centres, the results of the sensitivity analysis show that the main contributor to the variance of the HCI is the variance of the accessibility dimension followed by readiness and efficiency. The main contributor to the readiness dimension variance is the variance of human resources readiness, followed by infrastructure, equipment, services and medicine. The efficiency dimension variance is mainly affected by the variance of functionality, followed by human resources and equipment.

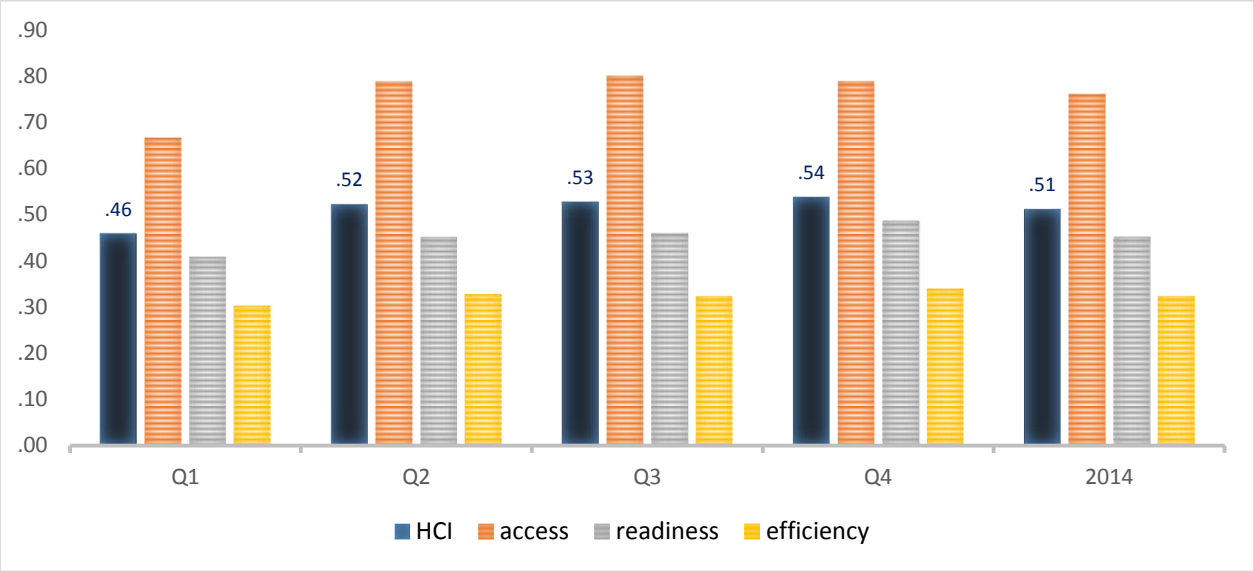
For hospitals, the main contributor to the variance of HHI is the variance of the accessibility dimension followed by readiness and efficiency. The readiness dimension variance is mainly affected by the variance of human resources readiness, followed by medicine, services, equipment and infrastructure readiness. The main contributor to the efficiency dimension variance is the variance of functionality efficiency, followed by equipment and human resources (see Annex 2).

d) Main results

i. HCI results

The HeRAMS dataset for health centres that was used in this research covered 2014. The number of centres included in the first and second quarters was 1744, while in the third quarter the number increased to 1750 and in the fourth quarter to 1776. The data improved in terms of the reduction of non-reporting centres for the accessibility question, from 21.4 per cent in 2014Q1 to 1.8 per cent in 2014Q4. The analysis using the HCI measured the difference in performance among health centres over time and across regions, covering the HCI's dimensions and indicators.

Figure 1: The HCI and its dimensions by quarter (2014)



Sources: HeRAMS dataset 2014 and authors' calculations.

Figure 1 shows that the overall performance of health centres measured by the HCI in Syria improved from 0.46 in 2014Q1 to 0.54 in 2014Q4, and that the index has an average of 0.51 in 2014, meaning that the average performance of health centres in Syria in 2014 is 51 per cent of the standard and comprehensive centre. It is worth mentioning that the only statistically significant improvement of the HCI and the accessibility dimension were between 2014Q1 and 2014Q2, while the readiness and efficiency dimensions improved significantly between 2014Q1 and 2014Q2, and between 2014Q3 and 2014Q4 (see Annex 3).

The dimensions of the HCI improved between 2014Q1 and 2014Q4 mainly due to improvement in the accessibility dimension and enhancement of the reporting process. The readiness and efficiency dimensions improved slightly during the same period. Since all centres are public and provide free services, accessibility was not a constraint before the crisis, but during the crisis the violence prevented many people from accessing health centres due to insecurity and the damage to, or destruction of, many health centres.

Additionally, the readiness of health centres was negatively affected by the destruction of infrastructure, lack of fuel and medical logistics, reduction of public expenditure on health, displacement and migration of medical and support staff, and a drop in medicine and equipment availability.

The insecure environment, deterioration of rule of law, the enormous increase in injuries and diseases due to the armed conflict, and polarization within society, all negatively affected the efficiency of the remaining resources within the health centres.

The crisis aggravated the inequality of health centres' performance among geographical regions. Map 1 and Figure 2 shows the huge differences among governorates. Aleppo witnessed the worst performance according to the HCI, followed by Ar-Raqqa, Quneitra, Al-Hasakeh, Deir-ez-Zor and Rural Damascus. The best performer was Tartous, followed by Lattakia, As-Sweida and Damascus; the HCI score of Tartous is around three times that of Aleppo.

Map 1: Performance of public Health Centres per governorate, based on HeRAMS Centres Index (HCI)

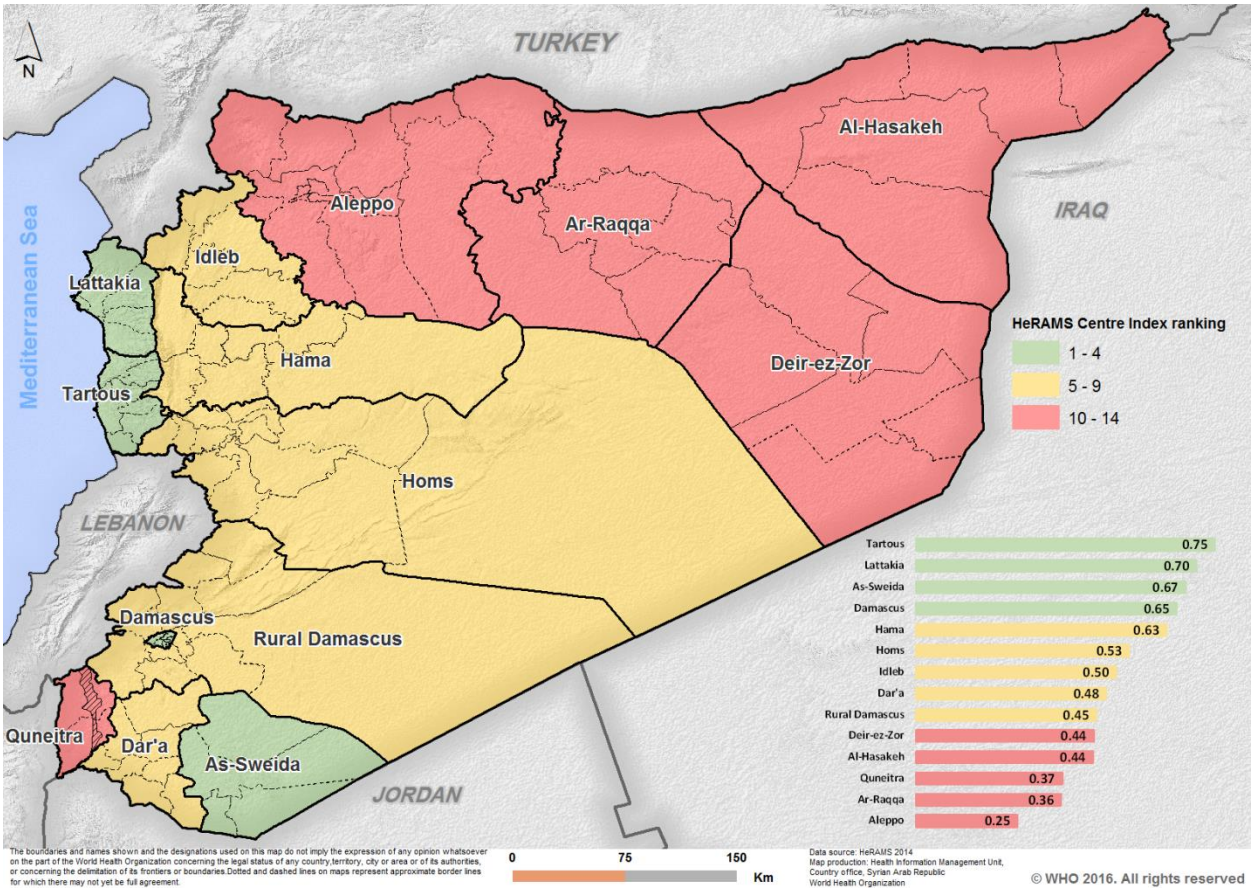
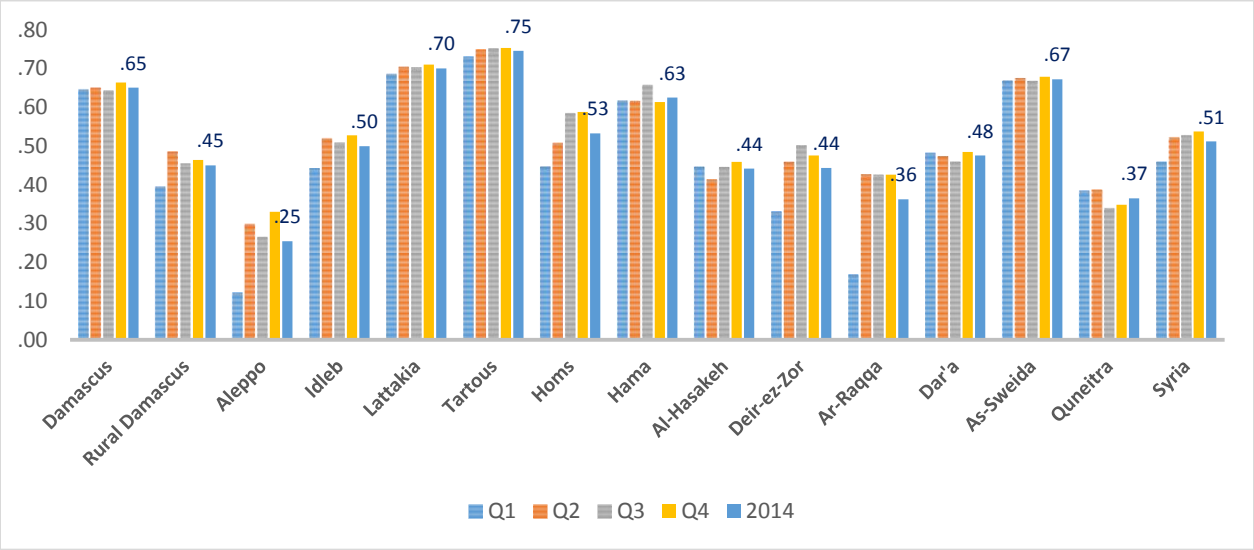


Figure 2: The HCI across time and governorates, 2014



Sources: HeRAMS dataset 2014 and authors' calculations.

All governorates witnessed improvement in the HCI between 2014Q1 and 2014Q4 except Quneitra and Hama, where the index decreased slightly. The improvement is mainly due to better reporting in Aleppo, Ar-Raqqa, Rural Damascus, Deir-ez-Zor and Homs. Deterioration in the HCI is associated with intensification of the armed conflict.

Table 3 shows that some governorates have a better relative performance in one dimension compared to their performance in the other two dimensions. For example, Ar-Raqqa is ranked 8th in terms of accessibility while it is ranked 13th (rank 14th is the worst) in terms of readiness and efficiency. The same applies to Deir-ez-Zor. On the other hand, the relative performance of Damascus and Rural Damascus compared to other governorates in terms of accessibility is worse than their relative performance in terms of readiness and efficiency. Thus any analysis of the results with a view to understanding the situation and the key challenges should not focus on the HCI composite index alone but should deepen the analysis to include the dimensions and indicators. This will improve the ability to choose the right policies and interventions.

Table 3: HCI ranking and dimensions across governorates in 2014

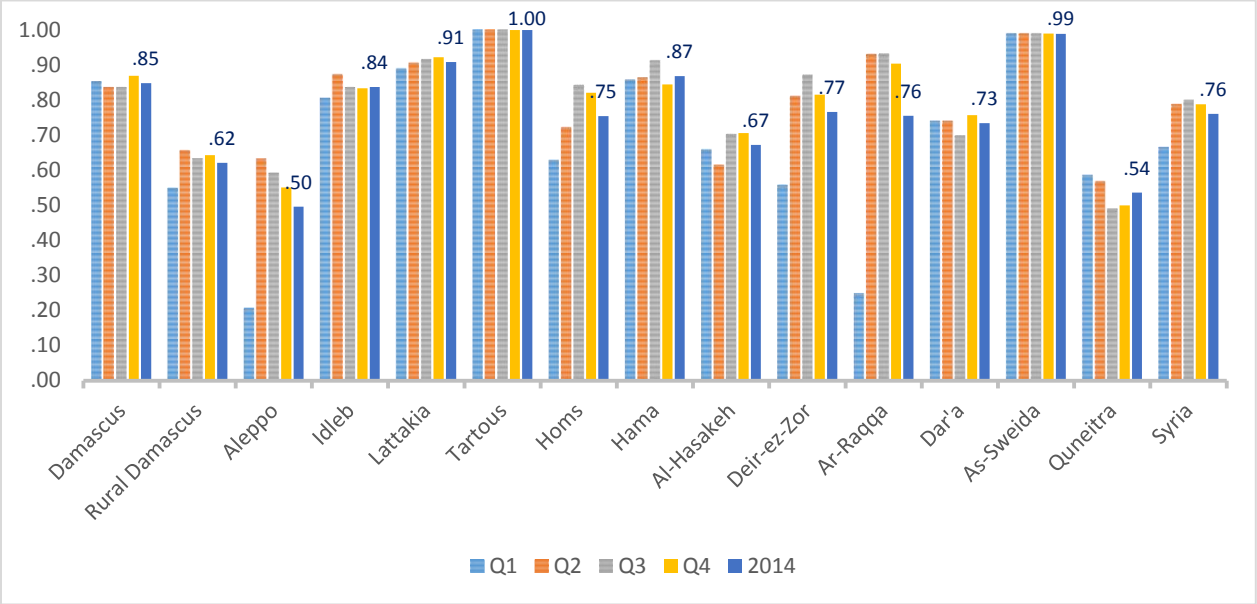
Governorate	HCI	Accessibility	Readiness	Efficiency
Damascus	4	5	3	3
Rural Damascus	9	12	7	7
Aleppo	14	14	14	14
Idleb	7	6	9	10
Lattakia	2	3	2	2
Tartous	1	1	1	1
Homs	6	9	6	6
Hama	5	4	5	4
Al-Hasakeh	11	11	10	9
Deir-ez-Zor	10	7	11	12
Ar-Raqqa	13	8	13	13
Dar'a	8	10	8	8
As-Sweida	3	2	4	5
Quneitra	12	13	12	11

Sources: HeRAMS dataset 2014 and authors' calculations.
Red colour indicates governorates ranked 10–14, orange colour indicates governorates ranked 5–9, and green colour indicates governorates ranked 1–4 (rank 14 is the worst).

HCI Accessibility

The accessibility dimension is the best performer compared to the other two dimensions. However, the crisis dramatically affected accessibility, as people were prevented from physically reaching health centres, in addition to the fact that some health centres were damaged or destroyed. For example, in 2014 around 50 per cent of the health centres in Aleppo were not accessible, while this indictor was 46 per cent, 38 per cent, and 33 per cent in Quneitra, Rural Damascus and Al-Hasakeh, respectively. This reflects the uneven nature of the deterioration of the public health care system in terms of accessibility during the crisis (Figure 3).

Figure 3: HCI accessibility dimension across time and governorates in 2014



Sources: HeRAMS dataset 2014 and authors' calculations.

Nevertheless, some governorates, like Tartous, As-Sweida, Lattakia and Hama, witnessed a relatively better performance in terms of accessibility. This does not, however, necessarily reflect a better overall performance because some health centres are accessible but suffer in terms of the readiness and efficiency dimensions.

HCI Readiness

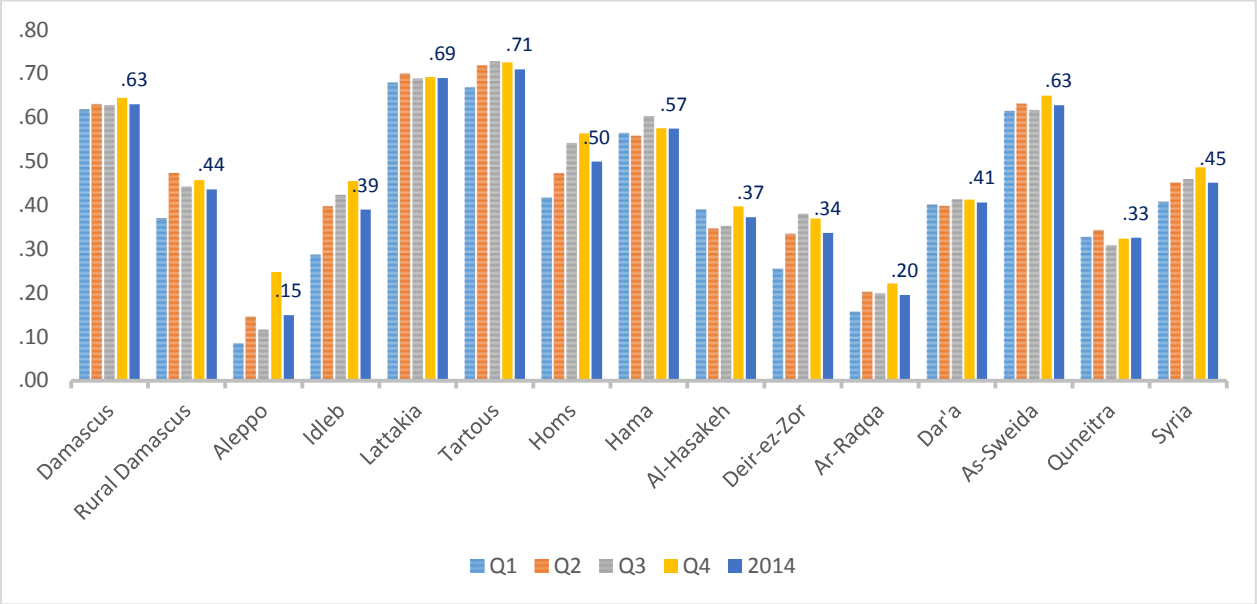
This dimension represents the availability of infrastructure, human resources, services, equipment and medicines. Figure 4 shows that the readiness index for Syria was below 0.5 during 2014, even though there were improvements between 2014Q1 and 2014Q4 from 0.41 to 0.49. These improvements occurred in all governorates, at different levels, except for Quneitra where the readiness index was almost stable during this period.

There are large inequalities among regions. For instance, in 2014 the readiness index scored 0.71 in Tartous which is about 4.7 times Aleppo's score (0.15). Ar-Raqqa, Quneitra, Deir-ez-Zor, and Al-Hasakeh in addition to Aleppo suffered from poor performance in this index; Tartous, Lattakia, Damascus and As-Sweida were the best performers.

The readiness index components shown in Figure 5 indicate an improvement in all components between 2014Q1 and 2014Q4. However, it is clear that health centres were suffering from huge shortages in terms of medicine, equipment and services.

Moreover, the infrastructure indicator reflects a huge amount of destruction of the physical buildings of the health centres and a lack of utility. In this regard, 16 per cent of health centres were fully damaged or did not report while around 18 per cent were partially damaged at the national level in 2014Q4. The picture is gloomier in some governorates: in 2014Q4, 45 per cent of health centres in Aleppo were fully damaged or did not report and 28 per cent were damaged; in Ar-Raqqa 7 per cent of health centres were fully damaged or did not report and 78 per cent were partially damaged; and in Quneitra 50 per cent of health centres were fully damaged or did not report and 7 per cent were partially damaged.

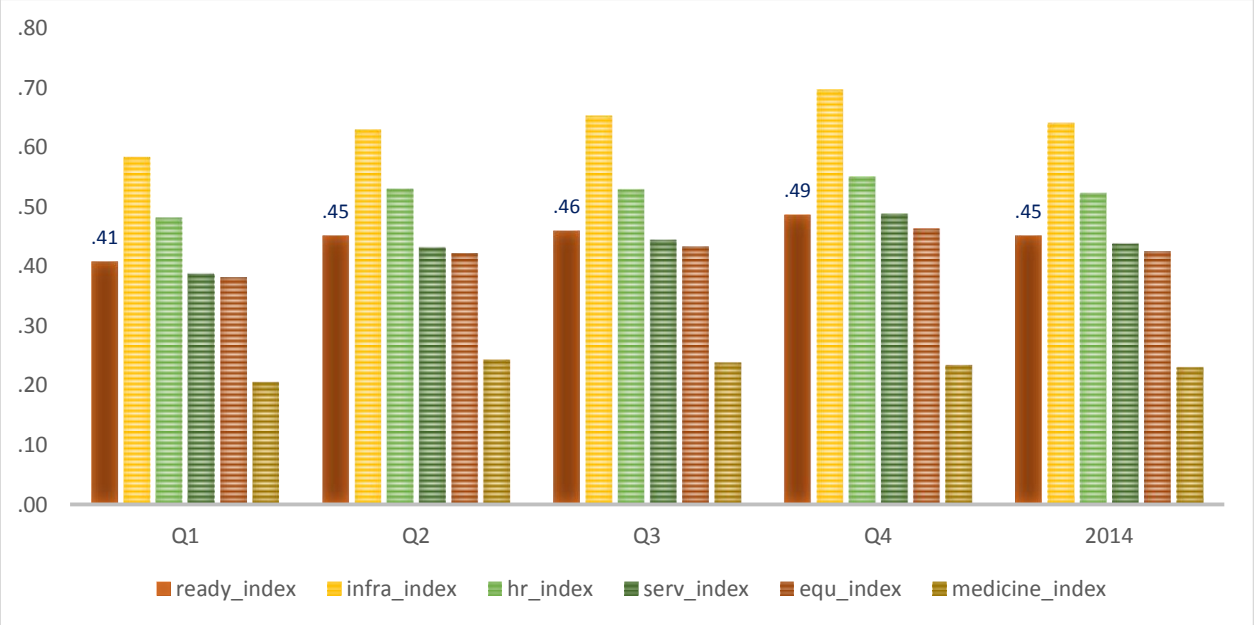
Figure 4: HCI Readiness dimension across time and governorates in 2014



Sources: HeRAMS dataset 2014 and authors' calculations.

Human resources, as a major pillar of the health system, have witnessed huge challenges. Many medical and technical staff were forced to flee the conflict regions or the country as a result of the protracted crisis. For example, 41 per cent of health centres in 2014Q4 had no doctor or did not report any doctors; this indicator reached 66 per cent, 59 per cent, 55 per cent in Aleppo, Ar-Raqqa and Al-Hasakeh, respectively.

Figure 5: Readiness and its main indicators across time in 2014



Sources: HeRAMS dataset 2014 and authors' calculations.

The health services indicator improved notably from 0.39 in 2014Q1 to 0.49 in 2014Q4. The key challenges within this indicator, which contains eight sub indicators, were the availability of reproductive health, noncommunicable diseases management, child nutrition, and outpatient services.

Ar-Raqqa, Aleppo, Deir-ez-Zor and Al-Hasakeh were the worst performers in terms of the services readiness indicator, while Tartous, Lattakia, As-Sweida and Hama were the best performers. The score of the services indicator in Tartous was almost nine times that of Ar-Raqqa in 2014. The inequalities in the provision of services deepened the differences in health outcomes faced by populations across the country.

The indicator of equipment availability improved from 0.38 in 2014Q1 to 0.46 in 2014Q4. This indicator reflects the poor availability of pulse oximeters, safe and clean delivery kits, and oxygen cylinders. The disparities among regions were enormous. The worst performers in 2014 were Ar-Raqqa, Aleppo, Quneitra, Deir-ez-Zor and Al-Hasakeh, while the best performers were Lattakia, Tartous, As-Sweida, Damascus and Hama. The availability of equipment was affected by factors like damage and pillaging during the conflict, the reduction of expenditure on health, and the difficulties of importing and maintenance.

The performance of the medicines' availability indicator was the worst compared to the other components of the readiness dimension. The destruction of the pharmaceutical industry and difficulties in importing medicines negatively affected the availability of medicines in health centres. The medicines' availability indicator consists of six groups of medicines, of which the scarcest were the delivery-related medicines, followed by anti-diabetic preparations, and cardiac and/or vascular drugs.

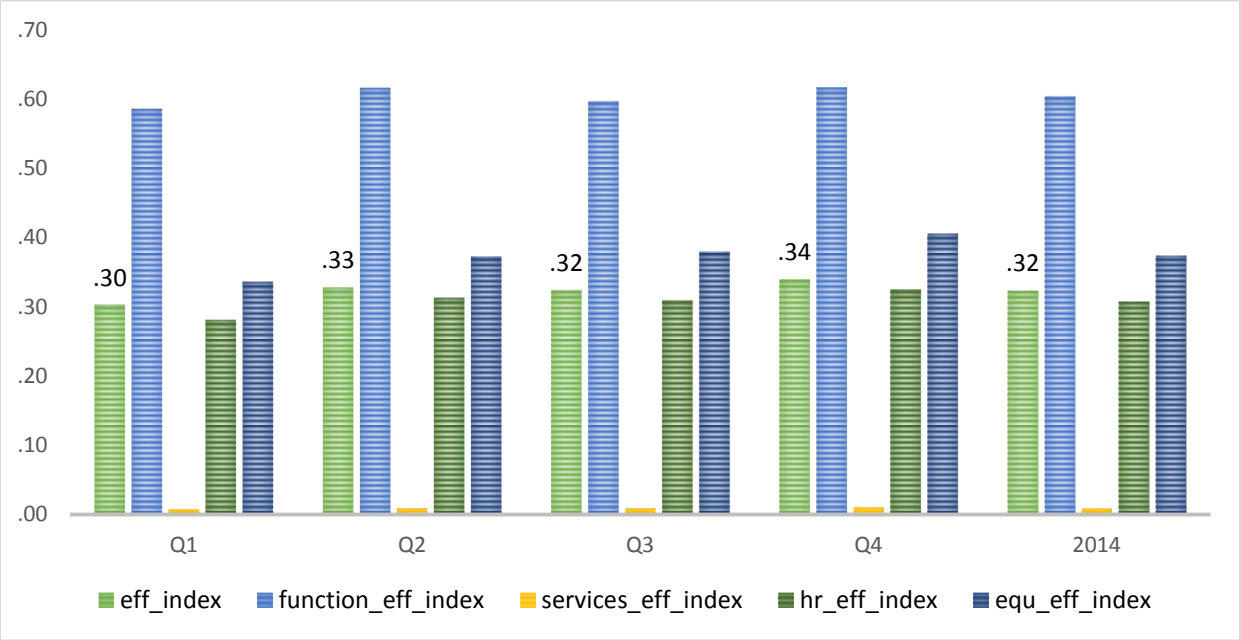
The disparities among governorates were enormous; in 2014 the worst performers were Ar-Raqqa, Aleppo, Deir-ez-Zor, Idleb and Al-Hasakeh, while the best performers were As-Sweida, Damascus, Lattakia, Tartous and Homs. In 2014, the medicine score of As-Sweida was almost 20 times that of the worst performer Ar-Raqqa.

HCI Efficiency

The Accessibility and Readiness dimensions within the HCI are important but they do not provide information on how efficient the use of resources was. Therefore, this research adopted an efficiency dimension using the available data in HeRAMS. The efficiency dimension consists of four main indicators: functionality, human resources, health services and equipment efficiency. One limitation that affects this dimension is the use of the number of visitors to each service compared to the highest number of visitors, to measure the level of use of resources. This method was chosen due to the lack of information concerning the capacity of the health centres to receive visitors with regard to each service.

The result of the efficiency dimension was 0.3 in 2014Q1, increasing to 0.34 in 2014Q4. Figure 6 shows the main components of the efficiency dimension; services efficiency was the weakest performer by far compared to the performances of functionality, equipment and human resources efficiency. During 2014, the functionality indicator improved from 0.59 in 2014Q1 to 0.62 in 2014Q4. Similarly, the human resources indicator and the equipment indicator increased from 0.28 and 0.34 in 2014Q1 to 0.33 and 0.40 in 2014Q4, respectively.

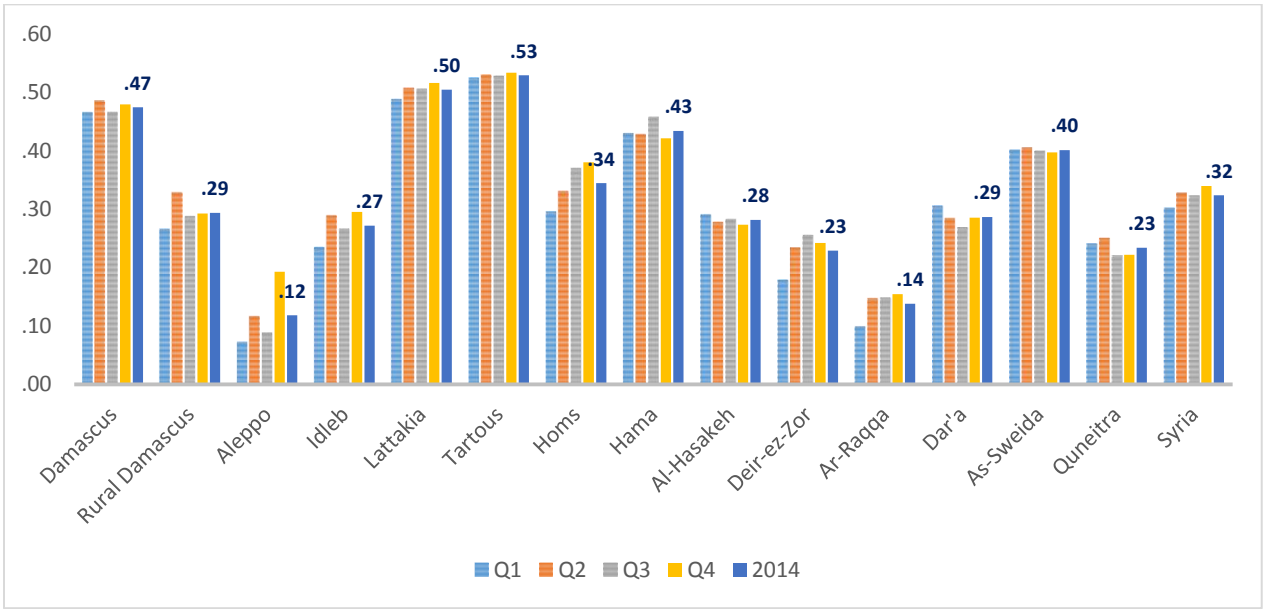
Figure 6: HCI Efficiency dimension and its indicators across time in 2014



Sources: HeRAMS dataset 2014 and authors' calculations.

The efficiency index varies across governorates. In 2014, Tartous, Lattakia, Damascus and Hama were ranked as the best performers, while Aleppo, Ar-Raqqa, Quneitra and Deir-ez-Zor were ranked as the worst performers. The efficiency score of Tartous was around 4.5 times that of Aleppo (Figure 7).

Figure 7: HCI Efficiency dimension across time and governorates in 2014



Sources: HeRAMS dataset 2014 and authors' calculations.

The first indicator of the efficiency dimension is the functionality status of health centres. This indicator shows that in 2014Q4 almost 25 per cent of health centres were not functioning at all or did not report;

around 26 per cent were partially functioning, and the rest were fully functioning. This reflects the distortion in the public health care system. Inequalities among governorates were huge; for example, in 2014Q4, only 1.4 per cent, 6.6 per cent, and 6.8 per cent of health centres in Ar-Raqqa, Aleppo and Deir-ez-Zor, respectively, were fully functioning; while 99 per cent, 95 per cent, and 91 per cent of health centres in Tartous, As-Sweida and Lattakia, respectively, were fully functioning.

Utilizing human capital, as measured through the burden or underuse of human resources, shows that some health centres suffered from a heavy burden of visitors compared to doctors, while others suffered from underuse of the available doctors. In this indicator, the absence of a doctor in the health centre is considered as the worst efficiency performance. The human resource efficiency indicator improved from 0.28 in 2014Q1 to 0.33 in 2014Q4. In terms of burden, Aleppo and Idleb are among the worst performance in 2014; while the worst performance in terms of underuse occurred in As-Sweida, Al-Hasakeh, and Deir-ez-Zor. These results show the disparity of efficiency in terms of human resources even within the same governorates.

The indicator of health services' efficiency includes emergency and surgical care efficiency and general health services efficiency. The latter includes cardiovascular services, hypertension management, diabetes management and mental health care efficiency. Efficiency is measured by comparing the number of visitors to each service with the best health centre in the country in terms of total number of visitors who received a consultation in the centre.

The results show that the services' efficiency indicator improved gradually over the 2014 quarters. The sub indicators reflect different performances among services; at the national level in 2014Q4, emergency and surgical care, were more efficient than other services. The weakest performer was mental health care efficiency. In 2014, there were large inequalities among governorates: Ar-Raqqa, Aleppo, Deir-ez-Zor and Al-Hasakeh were the weakest performers, while Damascus, Homs and Tartous were the best performers.

The indicator of equipment efficiency uses the ratio of functional equipment to existing equipment. This indicator includes 15 equally weighted sub indicators. The performance of this indicator improved during 2014. The worst performing sub indicators were pulse oximeters, safe and clean delivery kits, and oxygen cylinders. Among governorates in 2014, the best performers were Lattakia, Tartous, As-Sweida and Hama, while the worst performers were Ar-Raqqa, Aleppo, Quneitra and Deir-ez-Zor.

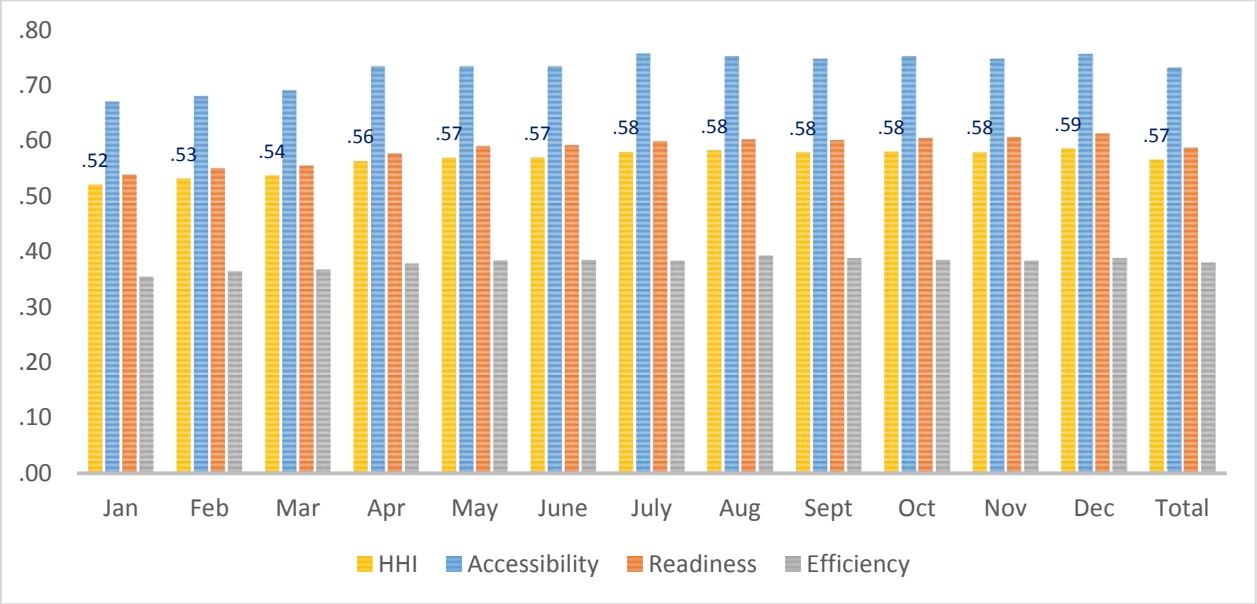
ii. HHI results

The HeRAMS data for hospitals were obtained on a monthly basis and covered the whole of 2014. The total number of hospitals included in the HeRAMS database increased from 97 during the months of the first quarter to 109 hospitals in the second and third quarters, to reach 113 hospitals in the fourth quarter of 2014. This increase slightly affected the indices and indicators at national and governorates levels, but had no impact on the results at hospital level.

The results show that for the HHI the overall composite index for hospitals at national level witnessed a continuous increase during 2014, with an average value of 0.57 for the year. The result reflects the fact that the average performance of public hospitals (included in HeRAMS) in Syria is 57 per cent of the performance of the standard and comprehensive hospital.

Figure 8 shows the gradual improvement of the HHI from 0.52 in January 2014 to 0.59 in December of the same year. During that period, the three dimensions of accessibility, readiness and efficiency increased by 12.9 per cent, 13.7 per cent, and 10.3 per cent, respectively. The main contributor to HHI performance was accessibility followed by readiness and then efficiency; the latter showed a modest performance compared to the other dimensions.

Figure 8: The HHI and its dimensions across time in 2014



Sources: HeRAMS dataset 2014 and authors' calculations.

The HHI performance differed among governorates. Map 2 and Figure 9 shows that Quneitra was the best performer followed by As-Sweida, whereas, the worst performers were Dar'a followed by Aleppo. There is only one public hospital in Quneitra and there are only three public hospitals in As-Sweida. Thus, the relatively good performances in these two governorates are vulnerable.

The performance of hospitals in Damascus is relatively good, with an HHI value of 0.74 (which is above the national average) together with Idleb, Lattakia, Tartous, Hama, Al-Hasakeh, Ar-Raqqa, Quneitra and As-Sweida. The performances of Rural Damascus, Homs, Deir-ez-Zor, Aleppo and Dar'a governorates were below the national average.

Map 2: Performance of public hospitals per governorate, based on HeRAMS Hospitals Index (HHI)

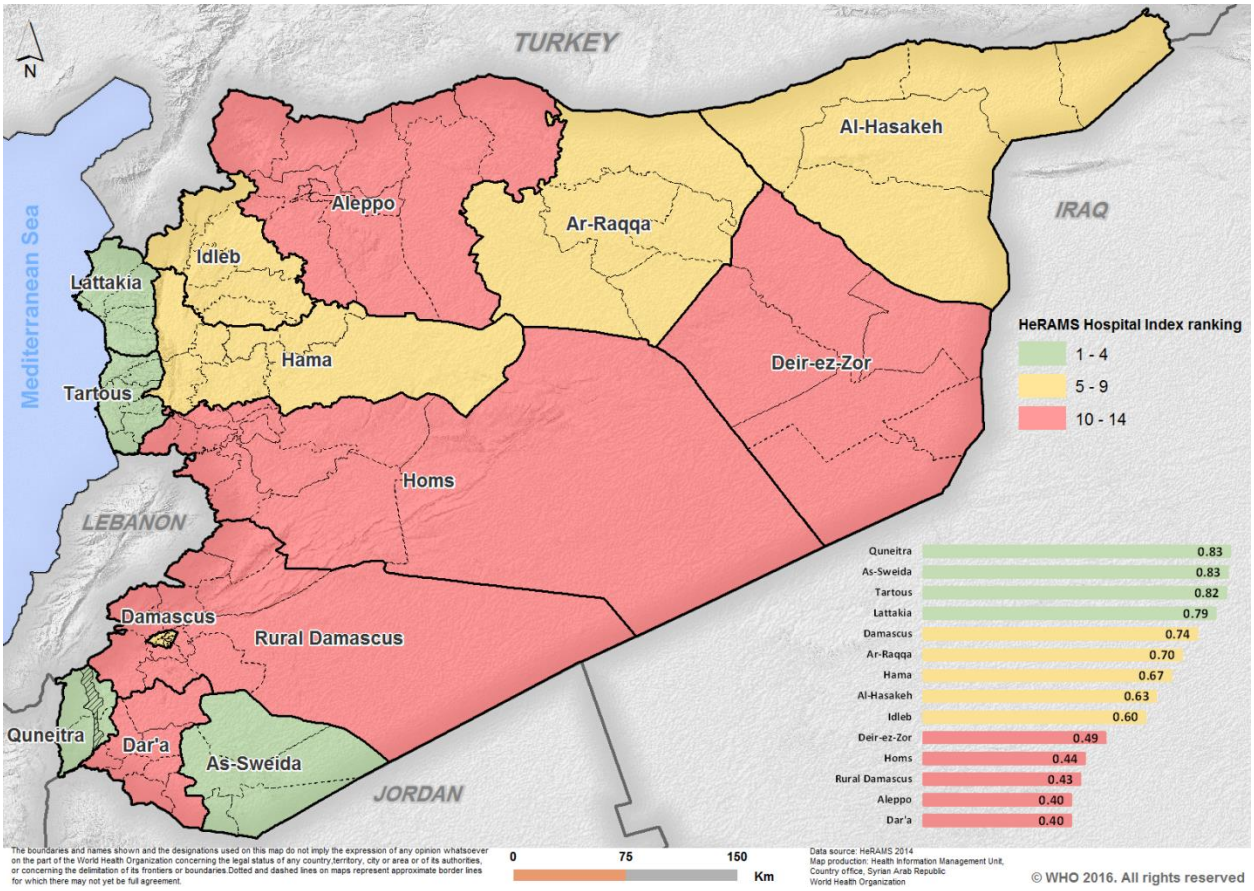
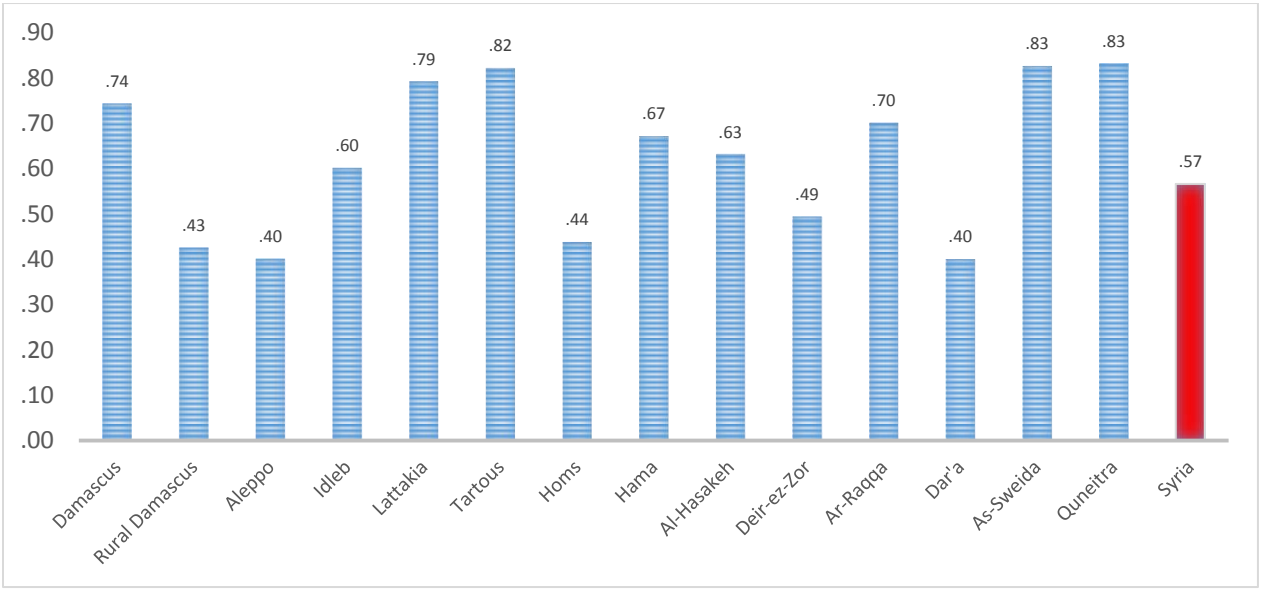


Figure 9: HHI across governorates in 2014



Sources: HeRAMS dataset 2014 and authors' calculations.

Table 4 shows that most governorates have a similar relative performance in one dimension compared to their relative performance in the other two dimensions, with some exceptions like Ar-Raqqa which is ranked 1st in terms of accessibility, while it is ranked 7th in terms of readiness and 6th in terms of efficiency. Nevertheless, the analysis should be careful not to concentrate only on the HHI composite index without deepening the analysis to include the dimensions and indicators in order to obtain a better understanding of the situation and the key challenges. This will improve the ability of decision-makers to choose the right policies and interventions.

Table 4: HHI ranking and dimensions across governorates in 2014

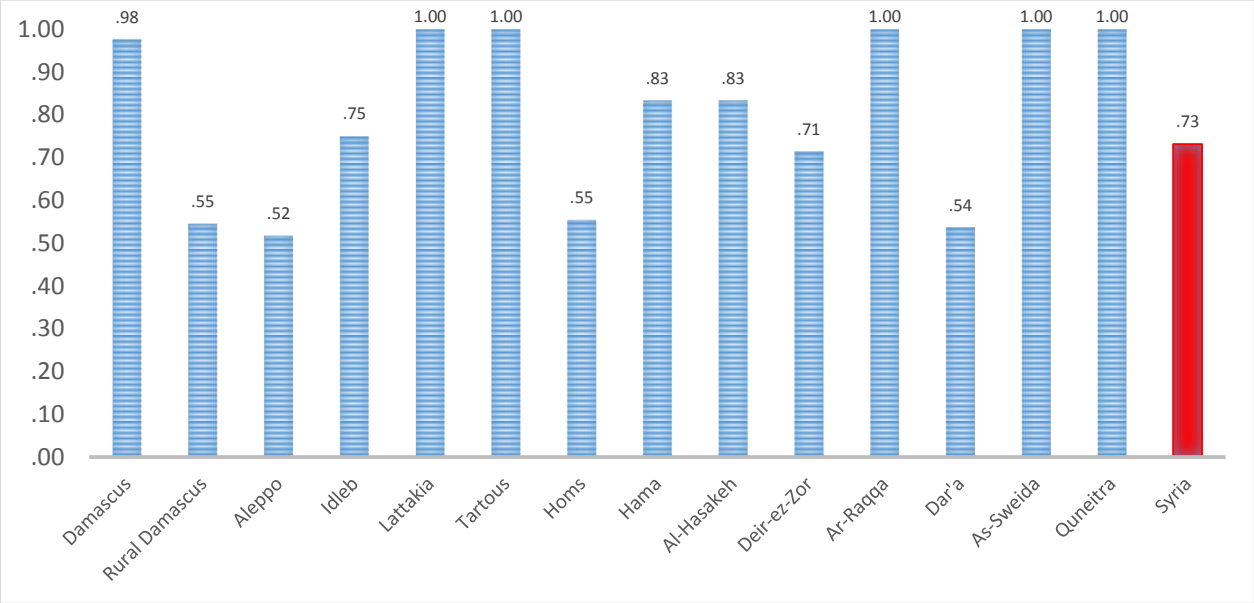
Governorate	HHI	Accessibility	Readiness	Efficiency
Damascus	5	6	5	5
Rural Damascus	12	12	12	13
Aleppo	13	14	14	11
Idleb	9	9	8	9
Lattakia	4	1	4	4
Tartous	3	1	3	2
Homs	11	11	10	12
Hama	7	7	6	8
Al-Hasakeh	8	8	9	7
Deir-ez-Zor	10	10	11	10
Ar-Raqqa	6	1	7	6
Dar'a	14	13	13	14
As-Sweida	2	1	1	3
Quneitra	1	1	2	1

Sources: HeRAMS dataset 2014 and authors' calculations.
Red colour indicates governorates ranked 10–14, orange colour indicates governorates ranked 5–9, and green colour indicates the governorates ranked 1–4 (rank 14 is the worst).

HHI Accessibility

The Accessibility dimension in the HHI concerns physical accessibility to the surveyed public hospitals. This dimension is the main contributor to the HHI, and it scored (1) in five governorates during 2014 (Figure 10). Aleppo had the worst performance in terms of accessibility with a value of 0.52, compared to the national average of 0.73. This reflects the inequalities among governorates in access to public hospitals, mainly a result of armed conflict and damage to hospitals in some governorates. About half of the public hospitals in Rural Damascus, Aleppo, Homs and Dar'a were not physically accessible during 2014.

Figure 10: Accessibility dimension across governorates in 2014



Sources: HeRAMS dataset 2014 and authors' calculations.

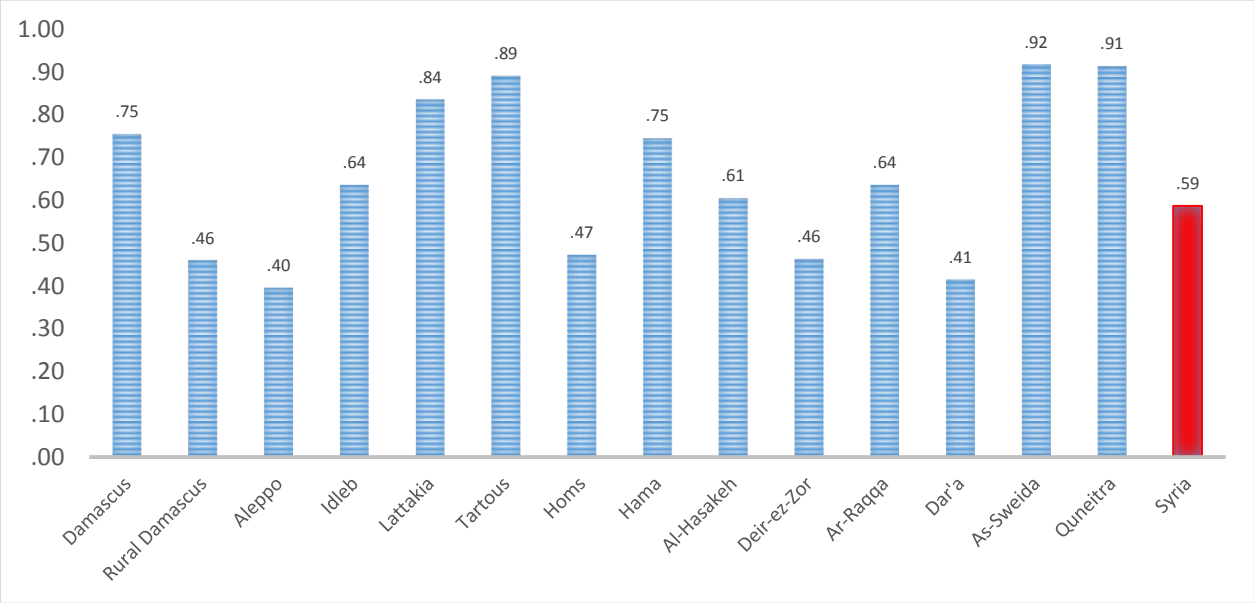
HHI Readiness

The Readiness dimension in HHI contains five groups of indicators: the availability of infrastructure, human resources, health services, equipment and medicines. Readiness was the second relative contributor to the HHI, and witnessed gradual improvement during 2014 at the national level from 0.54 in January to 0.61 in December. Moreover, the readiness dimension showed huge inequalities among governorates with some, such as Quneitra, As-Sweida, Tartous, Lattakia and Damascus, having relatively good performances compared to others such as Aleppo, Dar'a, Rural Damascus, Deir-ez-Zor and Homs (Figure 11).

The differences in the readiness dimension performance among governorates can be explained by analysing the performance of the group of indicators that compose the readiness dimension (Figure 12). The infrastructure indicator witnessed a slight improvement during 2014, from 0.69 in January to 0.72 in December. The infrastructure indicator had the best performances in Tartous, Quneitra, As-Sweida and Damascus, while the worst performances were in Aleppo, Deir-ez-Zor and Dar'a. The damage indicator was the main contributor to the infrastructure group of indicators. Thus, governorates with a relatively stable security situation had the best performance.

The human resources indicator improved during 2014 to increase from 0.62 in January to 0.72 in December. The results indicated that the best performances in regard to the human resources indicator were in As-Sweida, Tartous, Lattakia and Damascus, while the worst were in Aleppo, Dar'a and Rural Damascus. This reflects the low number of medical and support staff in the governorates that performed relatively poor in terms of human resources.

Figure 11: Readiness dimension across governorates in 2014



Sources: HeRAMS dataset 2014 and authors' calculations.

The health services indicator, which represents the availability of health services in hospitals, improved during 2014 to increase from 0.46 in January to 0.55 in December. The inequalities among governorates in terms of the availability of health services were huge. For instance, Aleppo scored 0.30, to have the worst performance, whereas Tartous scored 0.87, which was the best performance. Health services, such as noncommunicable diseases and child malnutrition management, were almost absent in the governorates with a low score in health services, such as Aleppo, Dar'a and Homs.

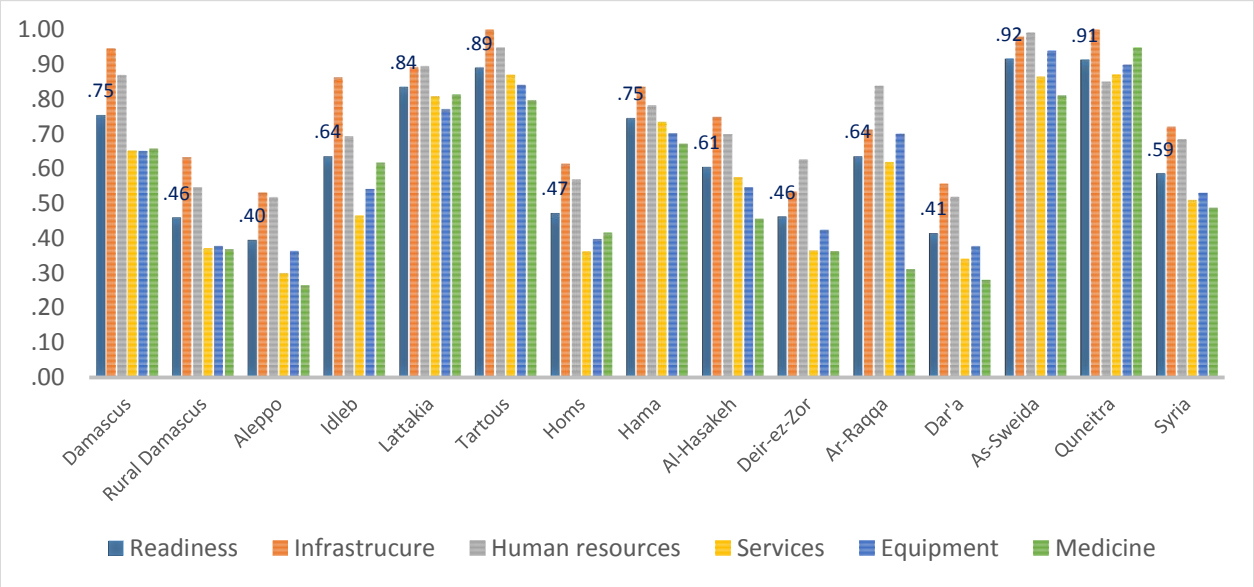
The equipment indicator, which includes the availability of basic and specialized health equipment in hospitals, improved during 2014 from 0.48 in January to 0.56 in December. The results showed that Quneitra, As-Sweida, Tartous and Lattakia governorates had the best performances in terms of equipment availability, while Aleppo, Dar'a and Rural Damascus were the worst performers. The weak performance of this indicator in those governorates is a result of the lack of specialized equipment such as MRI machines and ventilators for children.

The medicines indicator, which represents the availability of medicines in hospitals, improved gradually during 2014 from 0.44 in January to 0.50 in December. Similarly to the other indicators of the readiness dimension, the inequalities among governorates in terms of medicine availability were notable. Quneitra, As-Sweida and Tartous had the best performances, while Aleppo, Dar'a and Deir-ez-Zor had the worst. This indicator scored 0.27 in Aleppo compared to 0.95 in Quneitra. The weak performance of this indicator in some governorates reflected the absence or scarcity of some medicines, such as anti-poisoning and dermatological preparations.

The five components of the readiness dimension differed across time and governorates; the results at national level and for the whole of 2014 showed that infrastructure scored the highest value at 0.72, followed by human resources at 0.68. Equipment, health services and medicine scored 0.53, 0.51 and 0.49, respectively. These components were directly affected by the conflict through an increasing amount of damage to hospitals, deterioration of public infrastructure, such as water and electricity

networks, migration and displacement of medical staff, pillaging and destruction of medical equipment, in addition to the destruction of national pharmaceutical industries that had a negative impact on medicine availability.

Figure 12: Readiness dimension and its indicators across governorates in 2014

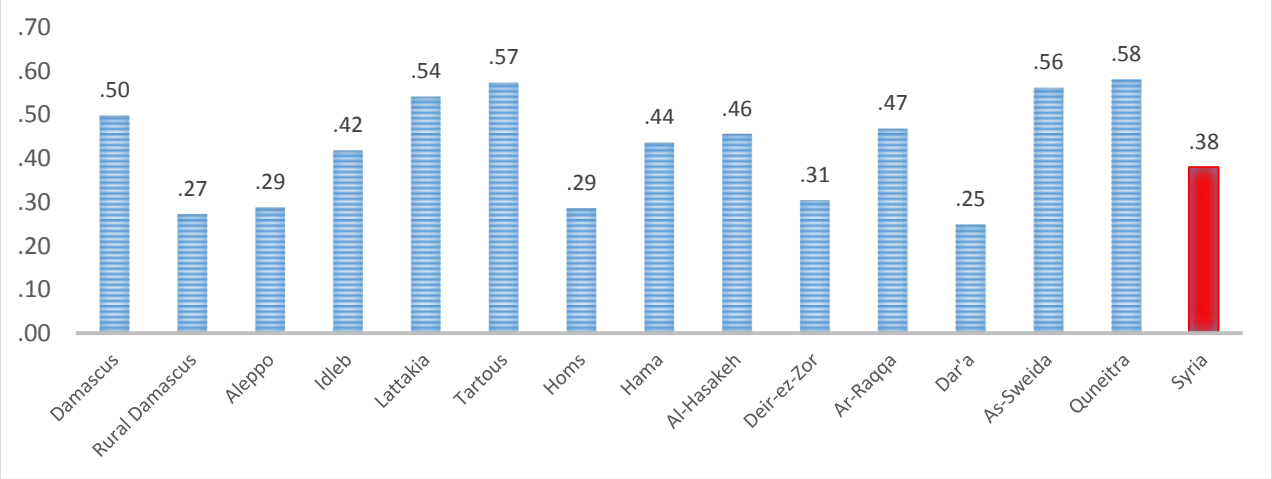


Sources: HeRAMS dataset 2014 and authors' calculations.

HHI Efficiency

The Efficiency dimension in the HHI includes four indicators: functionality, human resources, health services and equipment efficiency. Efficiency was the lowest relative contributor to the HHI, but it showed gradual improvement during 2014 at national level from 0.35 in January to 0.39 in December. Similarly to the other two dimensions, efficiency witnessed notable inequalities among governorates, although the score of this dimension is relatively low in all governorates. Figure 13 shows that the lowest performances in terms of efficiency among governorates were in Dar'a, Rural Damascus, Aleppo and Homs, whereas Quneitra, Tartous, As-Sweida and Lattakia had the best performances.

Figure 13: Efficiency dimension across governorates in 2014



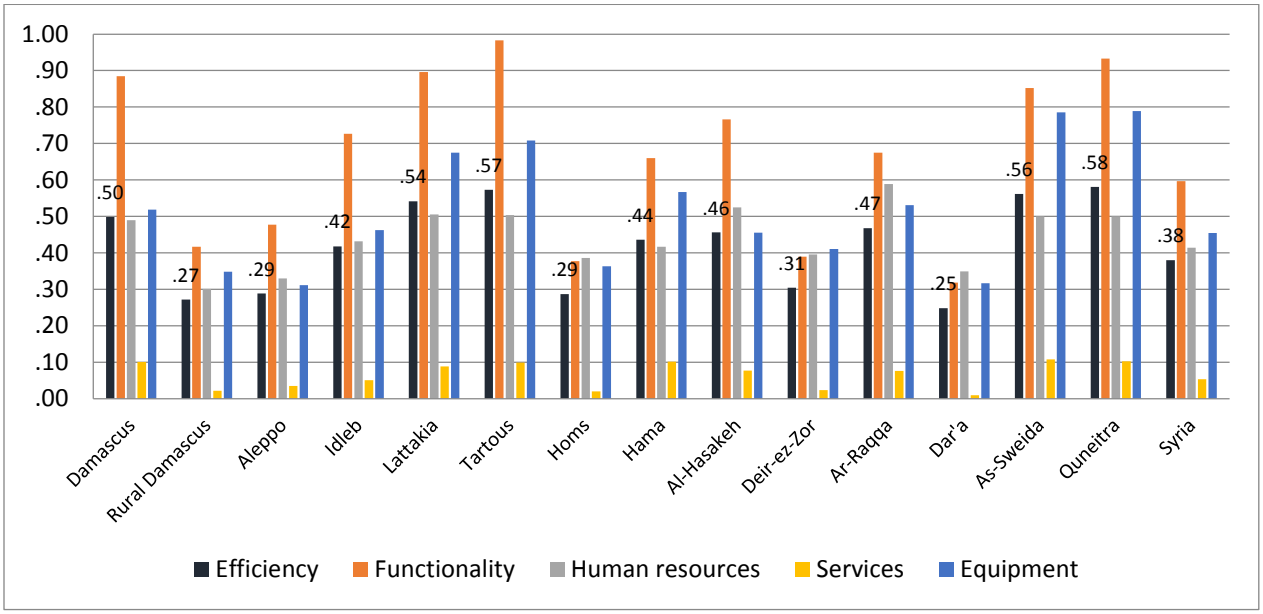
Sources: HeRAMS dataset 2014 and authors' calculations.

Analysing the performance of the indicators that composed the efficiency dimension clarifies the inequalities among governorates in terms of efficiency of hospitals (Figure 14). The functionality indicator showed a gradual improvement during 2014, from 0.57 in January to 0.61 in December. The results indicated that functionality had the best performance in Tartous, Quneitra, Lattakia and Damascus, while the worst performances were in Dar'a, Homs, Deir-ez-Zor and Rural Damascus. The functionality status sub indicator is the main contributor to the functionality indicator; thus, governorates with the relatively stable security situation show the best performance.

The human resources efficiency indicator slightly improved during 2014 from 0.38 in January to 0.42 in December. The results indicated that the best performances in regard to this indicator were in Ar-Raqqa, Al-Hasakeh and Lattakia and the worst performances were in Rural Damascus, Aleppo and Dar'a.

The health services indicator, which reflects the efficiency of services provided in public hospitals, witnessed no improvement during 2014, remaining almost stable at 0.05. There were large inequalities among governorates in terms of health services efficiency; for instance, Dar'a scored 0.01 to have the worst performance, compared to As-Sweida, which scored 0.11 to have the best performance. All health services had relatively low efficiency level. For instance, the results showed poor efficiency in terms of hypertension management and cancer treatment in several governorates.

Figure 14: Efficiency dimension and its indicators across governorates in 2014



Sources: HeRAMS dataset and authors' calculations

The equipment indicator, which includes the efficiency of basic and specialized health equipment in hospitals, improved during 2014 from 0.42 in January to 0.47 in December. This indicator reflected the functionality of medical equipment in hospitals. The results showed that Quneitra, As-Sweida, Tartous and Lattakia governorates had the best performances in terms of equipment efficiency, whereas Aleppo, Dar'a and Rural Damascus had the worst performances. The performance of this indicator varied among

governorates and type of equipment, but in general, low efficiency was observed more in the specialized equipment, particularly MRI machines and cardiotocography equipment.

The four indicators of the efficiency dimension differed widely across time and governorates; the results at national level and for the whole of 2014 showed that functionality scored the highest value at 0.60 followed by equipment at 0.45, then human resources at 0.41. Health services efficiency scored the lowest among the four indicators with a value of 0.05. The four indicators were largely affected by the continuation of the armed conflict. Functionality was closely related to the security situation and the efficiency of general infrastructure. Human resources efficiency was low compared to the standard and comprehensive hospital mainly due to the migration and displacement of medical staff.

The efficiency of health services, which was affected by the availability and efficiency of the other three components, reached a very low level, reflecting the lack of efficient health services in most hospitals. Finally, the efficiency of equipment was affected during the conflict through pillaging and poor maintenance services.

Conclusion

This research has developed two composite indices to measure the performance of public health centres and hospitals using the rich HeRAMS datasets. These indices, HCI and HHI, summarize the main challenges facing, and strengths of, public health facilities over time, in addition to addressing the differences in performance among health facilities and regions. The HCI and HHI cover the multidimensional aspects of performance in health care systems, by visualizing the performance across accessibility and equity, readiness and efficiency dimensions. The bottlenecks can be traced through these indices from the national level to the indicators at health facility level.

During 2014, the crisis severely affected the population's ability to access health facilities, particularly in the conflict zones, due to the insecure conditions and the destruction of health facilities' infrastructure. Moreover, readiness and efficiency were catastrophically damaged/affected because of the direct and indirect loss of human capital, distortion in stewardship of the health sector, reduction in health resources and expenditure, loss of equipment and medicine, and difficulties of importing the necessary health materials and supplies.

Furthermore, the armed conflict aggravated the inequalities among regions, leaving many people deprived of the minimum level of health services. The results of the indices can help in directing the interventions of different players to the most vulnerable groups and those with the greatest needs, and in assessing the efficiency of interventions.

However, more efforts need to be made to overcome the gaps in data collection through a more participatory approach, such as conducting population health surveys and opinion surveys to measure health outcomes and understand the needs from the beneficiaries' point of view. In this regard, many aspects related to equity and equality, institutional performance, role of private sector and NGOs, and formal and informal health facilities' performance need to be covered in future research.

Using HeRAMS indices could be helpful for policy-makers and practitioners in many ways. For example, the HCI indicates the most deprived governorates or health centres and the best performers over time. In 2014, using the HCI ranking, Aleppo is clearly the worst performer compared to other governorates, thus the efforts should be focused on Aleppo as a first priority, in principle. Furthermore, tracing the dimensions and indicators in Aleppo shows that Aleppo is the worst performer in all three dimensions. Dar'a is middle-ranking performer according to the HCI, its accessibility is one of the worst performers; the focus in Dar'a should be on accessibility. Thereafter, each dimension can be traced in detail; the readiness dimension in Aleppo, for instance, is the worst or second worst performer in all its indicators, while Rural Damascus suffers the most from lack of availability of infrastructure within the readiness dimension.

Similarly, using the HHI ranking in 2014 shows that Dar'a is the worst performer compared to other governorates. Thus, in terms of hospitals, efforts should be focused on Dar'a; the most urgent dimension to work on in this governorate is efficiency. Aleppo shows the worst performance in terms of accessibility and readiness.

Finally, the judgements and assumptions of this research can be developed through an open dialogue with the stakeholders in the health sector in Syria to mitigate the impact of the crisis and to highlight the enormous challenges of the future.

References

Baptista S (2014): “Design and Use of Composite Indices in Assessments of Climate Change Vulnerability and Resilience”, Washington (DC), Tetra Tech International Development Services, U.S. Agency for International Development.

Cohn C (2013): “Women and War”, Cambridge, Polity Press.

Commission on Social Determinants of Health (CSDH) (2007): “A Conceptual Framework for Action on the Social Determinants of Health”, Discussion paper, Geneva, WHO.

Davis H (1999): “Falling public trust in health services: Implications for accountability”, Journal of Health Services Research and Policy, 4:193–194.

Gilson L (2003): “Trust and the development of health care as a social institution”, Social Science and Medicine, 56:1453–1468.

Goodwin DN, (2008): “Managing for Health”, Edited by David J. Hunter. Health & Social Care in the Community, 16: 208–209.

Howard N, Sondorp E, and ter Veen A (2012): “Conflict and Health Priorities”, Open University Press.

IBM Corp. Released (2012): IBM SPSS Statistics for Windows, Version 21.0, Armonk NY, IBM Corp.

Maxwell R (1992): “Dimensions of quality revisited: from thought to action”, Quality Health Care, 1(3): 171–177, September.

Metge C, Chateau D, Prior H, Soodeen R, De Coster C, Barre L. (2009): “Composite Measures/Indices of Health and Health System Performance”, Winnipeg, Manitoba Centre for Health Policy.

Ministry of Health (2011): “Guide for Health Units”, Damascus (in Arabic).

Nardo M, Saisana M, Saltelli A, Tarantola S (2005): “Tools for composite indicators building”, Ispra, Joint Research Centre of the European Commission (EUR 21682 EN).

Organization for Economic Cooperation and Development (OECD) (2008): “Handbook on Constructing Composite Indicators: Methodology and Users Guide”, Paris.

Pain A, Goodhand J (2002): “Afghanistan: current employment and socioeconomic situation and prospects”, Geneva, International Labour Organization.

Panter-Brick. C, (2014): “Health, Risk, and Resilience: Interdisciplinary Concepts and Applications”, Annual Review of Anthropology 43: 431-448.

Papanicolas I, Smith P, Mossialos, E (2008): “What are the methodological issues related to measuring health care performance?”, Brussels, European Commission.

Ratnayake R, Degomme O, Roberts B, Spiegel P (2014): “Conflict and Health: seven years of advancing science in humanitarian crises”, Conflict and Health, Vol. 8

Saltelli A, Tarantola S, Campolongo F, Ratto M (2004): “Sensitivity Analysis in Practice: A Guide to Assessing Scientific Models”, Ispra, Joint Research Centre of the European Commission.

SimLab 2.2.1 software (2011), Ispra, Joint Research Centre of the European Commission.

StataCorp (2013): Stata Statistical Software: Release 12.1. College Station (TX), StataCorp LP.

State Planning Commission (2009): “10th Five Year Plan mid Term Review”. SPC, Syria (unpublished).

Syrian Centre for Policy Research (SCPR) (2014): “Health, Health Systems, and Social and Political Change in Syria”, forthcoming.

SCPR (2015): “Alienation and Violence”, Damascus, UNRWA, UNDP, SCPR.

WHO (2000): “The World Health Report – Health Systems: Improving Performance”, Geneva.

WHO (2008a): “Social Determinants of Health in Countries of Conflict: A Perspective from the Eastern Mediterranean Region”, WHO Regional Publications, Eastern Mediterranean Series 32.

WHO (2008b): “The World Health Report – Primary Health Care: Now More than Ever”, Geneva.

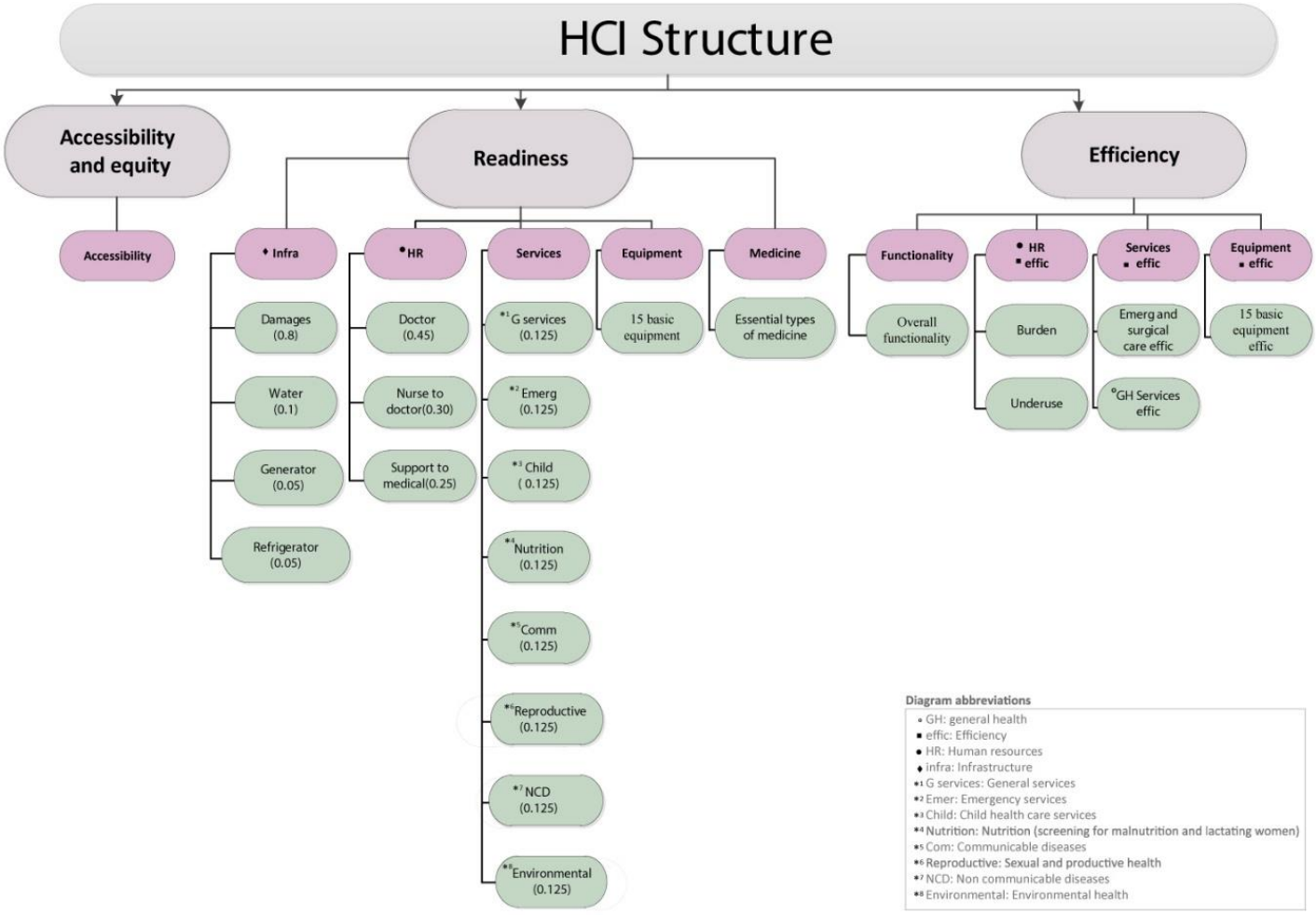
WHO (2010): “Health System Financing: the Path to Universal Coverage”, Geneva.

WHO (2014): “HeRAMS Summary”, Damascus, Health Information Management Unit.

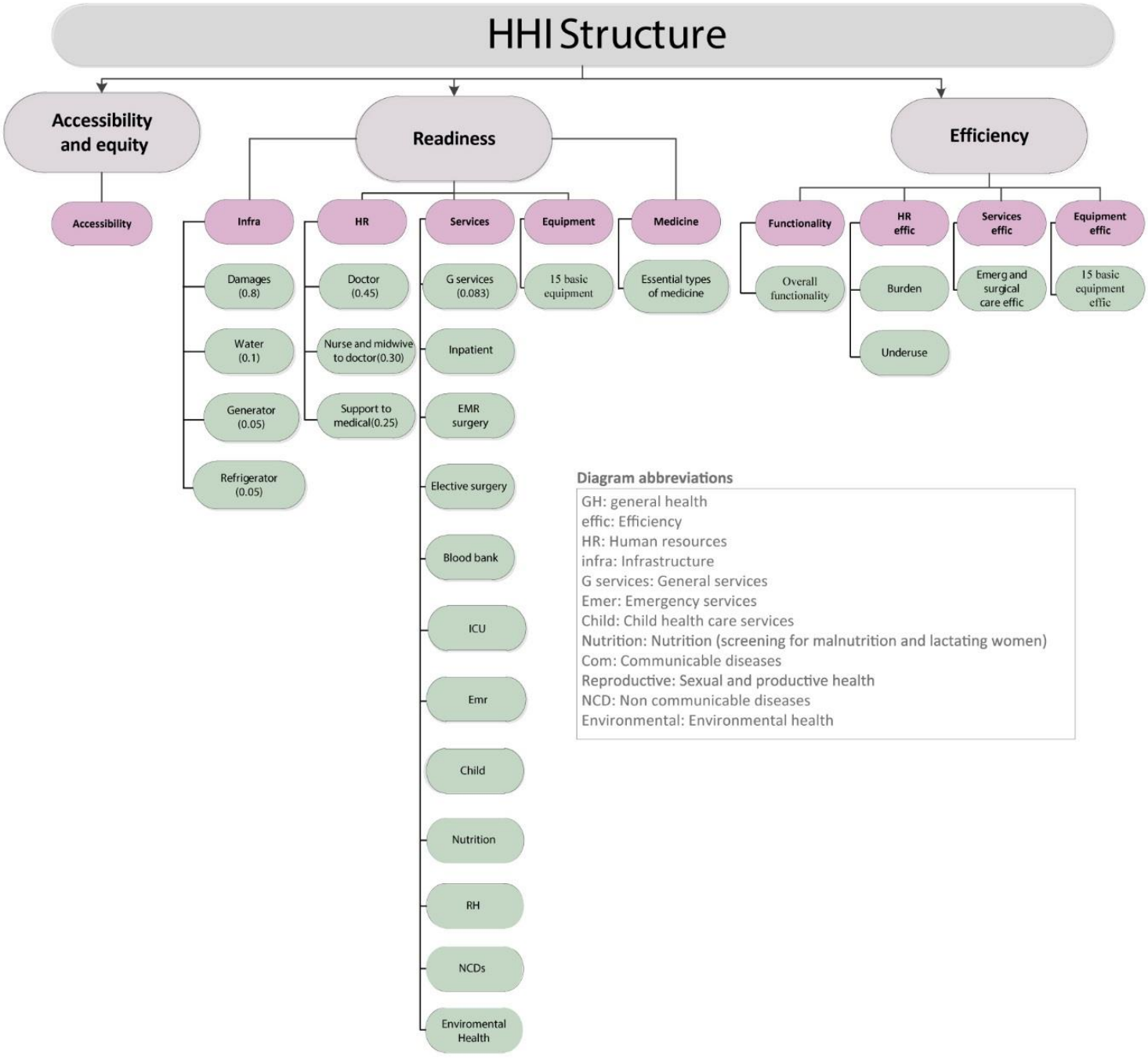
WHO (2014): HeRAMS Dataset, Syria.

ANNEXES

Annex 1a: the three dimensions of the Health Centre Index



Annex 1b: the three dimensions of the HeRAMS Hospitals Index



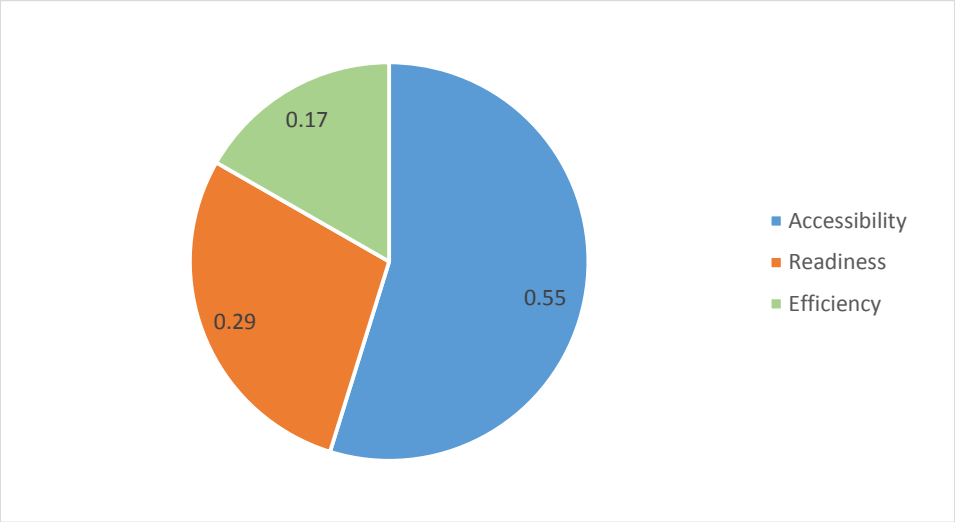
Annex 2: Sensitivity analysis

The research conducted a global sensitivity analysis, which applies variance-based approaches to examine the importance of the dimensions and indicators in the composite indices and to analyse the contribution of input variances in the total variance of the composite indices. The Sobol method was applied to analysing the sensitivity of the results, which is based on a Monte Carlo simulation.

a) Health centres' sensitivity analysis

The results of the centres' sensitivity analysis show that the main contributor to HCI variance is variance in the accessibility dimension, followed by readiness and efficiency (Figure 15). This reflects the fact that as a result of the crisis, the accessibility dimension varies greatly among regions.

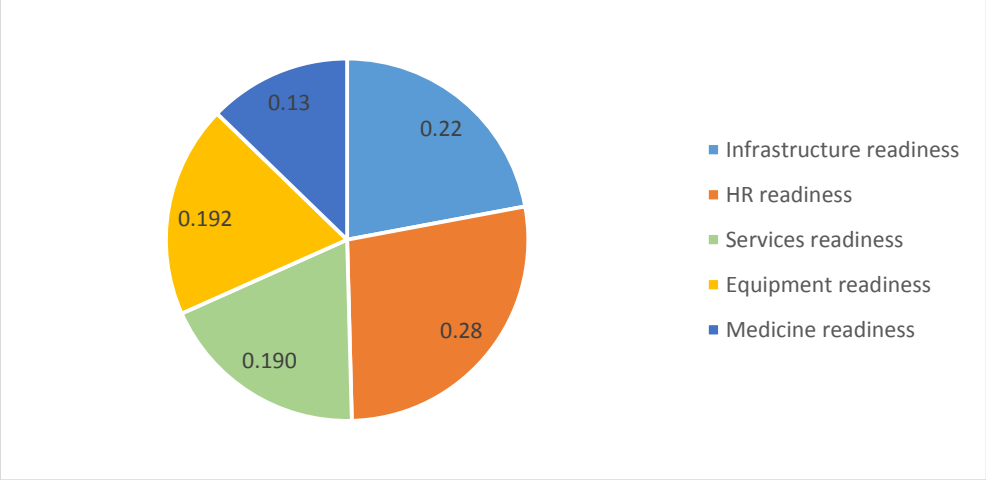
Figure 15: HCI: Sobol experiment first order effect results



Source: HeRAMS dataset 2014 and authors' calculations.

In the Sobol method, the results show that the main contributor to variance in the Readiness dimension in the HCI is the variance of Human Resources readiness, followed by Infrastructure, Equipment, Services and Medicine (Figure 16).

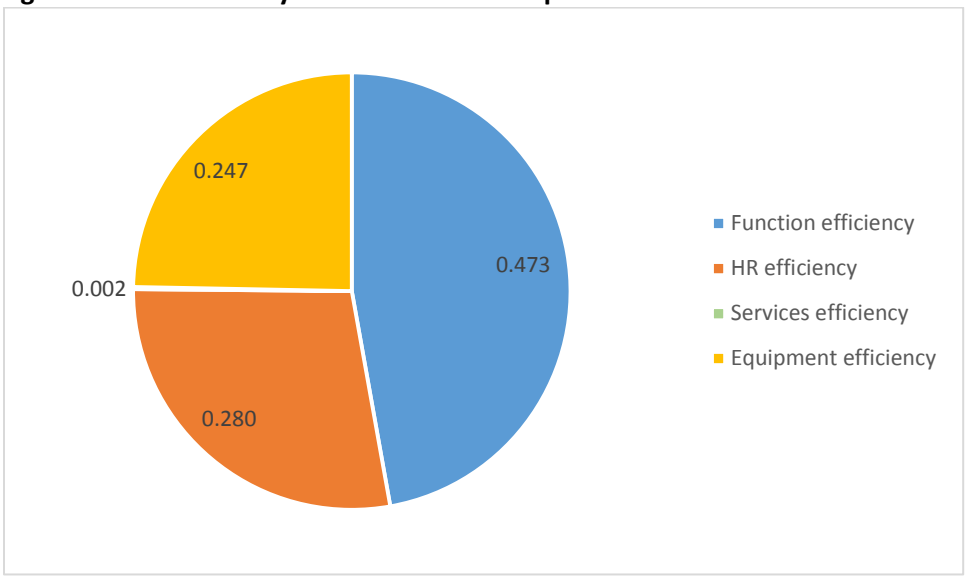
Figure 16: HCI Readiness dimension: Sobol experiment first order effect results



Source: HeRAMS dataset 2014 and authors' calculations.

In the Sobol method, the sensitivity analysis results show that the main contributor to variance in the Efficiency dimension in the HCI is variance in Functionality efficiency, followed by Human Resources and Equipment; however, the contribution of Services efficiency is very small due to the construction of the indicator, which requires more information about the capacity of centres (Figure 17).

Figure 17: HCI Efficiency dimension: Sobol experiment first order effect results

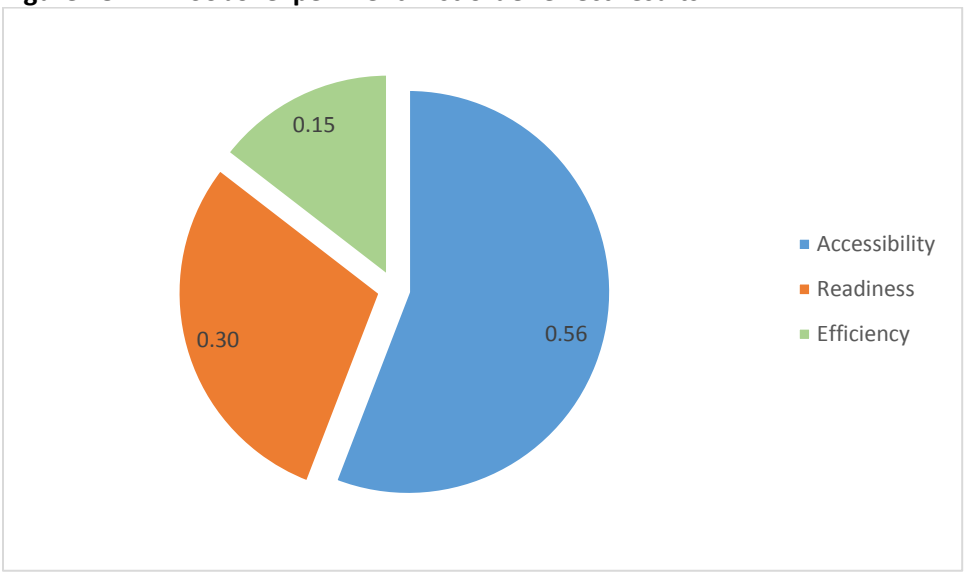


Source: HeRAMS dataset 2014 and authors' calculations.

b) Hospitals sensitivity analysis

The results of the hospitals' sensitivity analysis using the Sobol method show that the main contributor to HHI variance is variance in the Accessibility dimension, followed by Readiness and Efficiency (Figure 18). This reflects the crisis situation that accessibility dimension highly varies between regions due to the conflict.

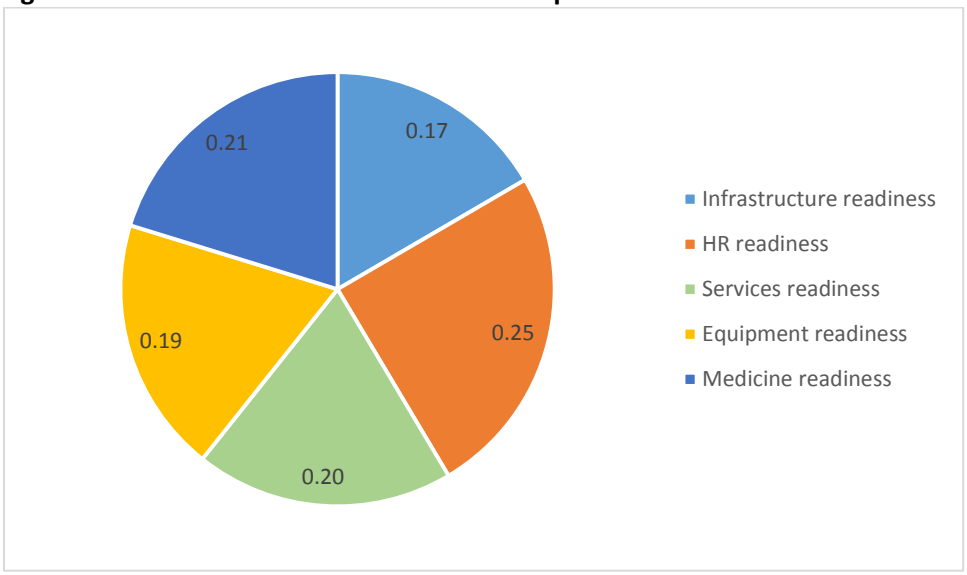
Figure 18: HHI: Sobol experiment first order effect results



Source: HeRAMS dataset 2014 and authors' calculations.

In terms of the readiness dimension, the results show that the main contributor to the variance of this dimension is the variance of human resources readiness; the contributions of variances in medicine, services and equipment are similar, and are followed by the contribution of infrastructure readiness (Figure 19).

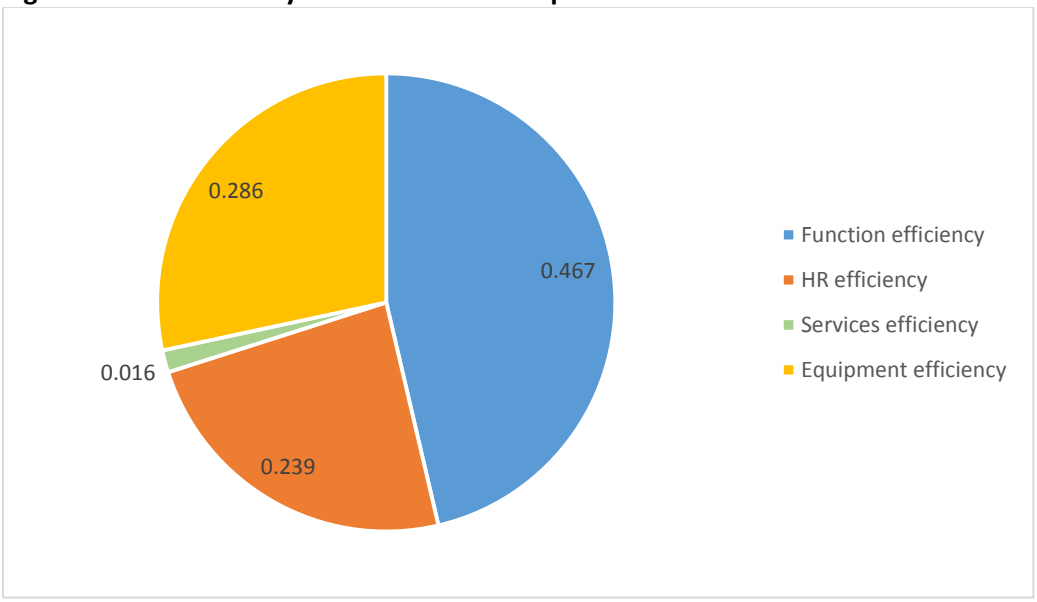
Figure 19: HHI Readiness dimension: Sobol experiment first order effect results



Source: HeRAMS dataset 2014 and authors' calculations.

In the Sobol method, the results show that the main contributor to variance of the Efficiency hospital dimension is the variance of functionality efficiency, followed by equipment and human resources; however, the contribution of Services efficiency is very small due to the construction of the indicator, which requires more information about the capacity of hospitals (Figure 20).

Figure 20: HHI efficiency dimension: Sobol experiment first order effect results



Source: HeRAMS dataset 2014 and authors' calculations.

Annex 3. Testing change significance of the HCI and its dimensions across time in 2014

HCI 2014		HCI_Total	Damas	Rural Damas	Aleppo	Idleb	Lattakia	Tartous	Homs	Hama	Hasakeh	Deir-Zor	Raqqa	Dar'a	Sweida	Quneitra
Q1_2	Coef	0.063***	0.005	0.090**	0.176***	0.077***	0.019	0.018*	0.061*	-0.001	-0.033	0.129***	0.258***	-0.008	0.007	0.003
	Se	(0.011)	(0.050)	(0.038)	(0.023)	(0.029)	(0.032)	(0.010)	(0.033)	(0.027)	(0.049)	(0.040)	(0.035)	(0.040)	(0.015)	(0.064)
Q2_3	Coef	0.005	-0.007	-0.031	-0.033	-0.011	-0.001	0.003	0.076***	0.042	0.033	0.043	-0.000	-0.014	-0.006	-0.047
	Se	(0.010)	(0.050)	(0.037)	(0.024)	(0.031)	(0.030)	(0.010)	(0.029)	(0.026)	(0.046)	(0.033)	(0.027)	(0.041)	(0.015)	(0.065)
Q3_4	Coef	0.010	0.021	0.009	0.064**	0.019	0.007	0.001	0.004	-0.044	0.013	-0.027	-0.000	0.025	0.010	0.008
	Se	(0.010)	(0.049)	(0.037)	(0.026)	(0.033)	(0.028)	(0.010)	(0.026)	(0.028)	(0.043)	(0.032)	(0.028)	(0.041)	(0.015)	(0.066)

Note: *** p<0.01, ** p<0.05, * p<0.1

HCI accessibility 2014		hcia_Total	Damas	Rural Damas	Aleppo	Idleb	Lattakia	Tartous	Homs	Hama	Hasakeh	Deir-Zor	Raqqa	Dar'a	Sweida	Quneitra
Q1_2	Coef	0.122***	-0.016	0.107**	0.425***	0.068	0.017		0.093**	0.006	-0.044	0.253***	0.681***	0.000	0.000	-0.017
	Se	(0.015)	(0.066)	(0.053)	(0.042)	(0.048)	(0.040)		(0.045)	(0.039)	(0.072)	(0.065)	(0.060)	(0.061)	(0.015)	(0.093)
Q2_3	Coef	0.012	-0.000	-0.023	-0.040	-0.037	0.010		0.120***	0.049	0.088	0.061	0.001	-0.041	0.000	-0.077
	Se	(0.014)	(0.068)	(0.052)	(0.046)	(0.046)	(0.037)		(0.039)	(0.036)	(0.069)	(0.052)	(0.042)	(0.063)	(0.015)	(0.093)
Q3_4	Coef	-0.012	0.033	0.009	-0.042	-0.003	0.006		-0.021	-0.068*	0.003	-0.056	-0.027	0.058	0.000	0.008
	Se	(0.014)	(0.065)	(0.051)	(0.047)	(0.049)	(0.036)		(0.035)	(0.037)	(0.065)	(0.051)	(0.046)	(0.062)	(0.015)	(0.093)

Note: *** p<0.01, ** p<0.05, * p<0.1

HCI readiness 2014		hcir_Total	Damas	Rural Damas	Aleppo	Idleb	Lattakia	Tartous	Homs	Hama	Hasakeh	Deir-Zor	Raqqa	Dar'a	Sweida	Quneitra
Q1_2	Coef	0.043***	0.012	0.103***	0.061***	0.110***	0.021	0.050***	0.055*	-0.006	-0.043	0.079**	0.045*	-0.003	0.016	0.016
	Se	(0.011)	(0.051)	(0.036)	(0.019)	(0.028)	(0.033)	(0.017)	(0.033)	(0.025)	(0.044)	(0.036)	(0.027)	(0.036)	(0.023)	(0.063)
Q2_3	Coef	0.008	-0.002	-0.031	-0.030	0.026	-0.011	0.010	0.069**	0.046*	0.006	0.046	-0.003	0.015	-0.014	-0.035
	Se	(0.011)	(0.050)	(0.037)	(0.020)	(0.033)	(0.032)	(0.018)	(0.031)	(0.026)	(0.040)	(0.030)	(0.027)	(0.037)	(0.023)	(0.063)
Q3_4	Coef	0.027***	0.017	0.015	0.131***	0.031	0.004	-0.002	0.022	-0.028	0.044	-0.010	0.022	-0.000	0.033	0.014
	Se	(0.010)	(0.051)	(0.037)	(0.022)	(0.035)	(0.030)	(0.017)	(0.027)	(0.028)	(0.037)	(0.028)	(0.029)	(0.038)	(0.024)	(0.065)

Note: *** p<0.01, ** p<0.05, * p<0.1

HCI efficiency 2014		hcie_Total	Damas	Rural Damas	Aleppo	Idleb	Lattakia	Tartous	Homs	Hama	Hasakeh	Deir-Zor	Raqqa	Dar'a	Sweida	Quneitra
Q1_2	Coef	0.025***	0.019	0.062**	0.044***	0.053**	0.019	0.004	0.034	-0.003	-0.013	0.054*	0.048	-0.021	0.003	0.009
	Se	(0.008)	(0.038)	(0.028)	(0.016)	(0.023)	(0.025)	(0.013)	(0.024)	(0.021)	(0.036)	(0.028)	(0.030)	(0.030)	(0.013)	(0.044)
Q2_3	Coef	-0.004	-0.019	-0.040	-0.028*	-0.022	-0.001	-0.001	0.040*	0.030	0.005	0.022	0.001	-0.016	-0.005	-0.029
	Se	(0.008)	(0.038)	(0.027)	(0.017)	(0.024)	(0.025)	(0.013)	(0.023)	(0.022)	(0.035)	(0.025)	(0.031)	(0.030)	(0.014)	(0.045)
Q3_4	Coef	0.016**	0.013	0.004	0.104***	0.028	0.010	0.005	0.010	-0.037	-0.010	-0.014	0.006	0.016	-0.003	0.001
	Se	(0.008)	(0.038)	(0.027)	(0.018)	(0.026)	(0.024)	(0.013)	(0.022)	(0.023)	(0.033)	(0.025)	(0.031)	(0.030)	(0.015)	(0.046)

Note: *** p<0.01, ** p<0.05, * p<0.1

Sources: HeRAMS dataset and authors' calculations.