An analysis of e-health level in Italy

Claudio Di Carlo
claudio.dicarlo@mise.gov.it

Elisabetta Santarelli
elisabetta.santarelli@mise.gov.it

Document available at

September 2012
ICT is increasingly spreading through the health system in Italy, with the consequences of improving quality and quantity of supplied services.

e-health tools and services include a wide variety of products, systems and solutions, including electronic bookings, payments and withdrawal of results, electronic health records (EHR), and telemedicine, etc. The implementation and development of e-health cannot be planned without adequate knowledge of the characteristics of the phenomenon, for which qualitative and quantitative analysis are needed.

The original contribution of the work consists in the proposal of a set of standard statistical indicators to evaluate the diffusion of e-health in the Italian health system. Such indicators are computed on data from a recent survey on e-health carried out in 2009 in Italy.

The content of this work reflects only the opinions of the authors, and not necessarily that of the Ministry.
1. Introduction

The application of ICT in health is known as e-health, i.e. “the use of emerging information and communication interactive technology, especially the Internet, to improve or enable health and health care” [1]. In a broader sense e-health “includes all ICT applications in the wide range of functions typical of a health system” [2], namely, doctors, hospital managers, nurses, data management specialists, social security administrators and, of course, the patients through better disease prevention and management.

Then e-health is a multidimensional concept involving different disciplines and areas of development. Two areas of e-health are the demand and supply of common services: appointments, tests, bookings, emergency medical services, first aid. A third aspect concerns the technical infrastructure and the ITC equipment required for the provision of these services. The final aspect is cultural, since the use and provision of e-health depends largely on health professionals having an adequate digital culture.

E-health tools and solutions adopted in Italy include instruments for administrative staff and health professionals (management information systems) as well as citizens (e.g. Electronic Health Record\(^1\), digital booking systems and access to medical reports). Also included are a wide range of telemedicine services (e.g. telemonitoring, teleconsultation, telerehabilitation).

E-health is a paradigm of innovation in different fields (computer science, medicine, business economics and statistics) [3], which cannot be properly developed without an adequate and updated knowledge of the phenomenon.

The technological innovation of the Italian National Health System is still in its infancy and is highly fragmented, largely because the initiatives undertaken lack coordination. This is reflected in the extremely heterogeneous data available, both at local than regional level, which makes it difficult to follow the progress of ICT technologies and compare the type and quality of digital services offered.

The limited statistical information is a major hurdle in the development of policies to promote e-health; standard statistical indicators would allow to evaluate e-health diffusion and adoption at different levels of geographical detail (both national and international) [4].

Up-to-date and comparable data allows to compare the policies of different countries, to assess how effective they are, to examine the relationship between the incentives promoted and the results obtained, and to reduce costs.

---

\(^1\) The Electronic Health Record (EHR) contains information on patient from medical records (of different health organizations, hospitals, doctors, general practitioners and paediatricians), such as: diagnosis, admission and discharge, specialist examinations, test results and reports and X-ray-like images.
Since the data and statistics are so fragmented, we need to develop a single tool to measure e-health and analyse the evolution of the phenomenon in time and space. In this paper we illustrate an assessment model for e-health based on the four areas described above. Then, we use a set of statistical indices, established on the basis of the model, to analyze both the supply of ICT tools in Italian health care organizations and the extent to which they are used by citizens.

2. The e-health assessment model

In this paragraph we present a model for assessing e-health by analyzing the different domains of the concept. The indices used in the model were constructed in accordance with the guidelines on the measurement of e-health defined by the OECD, which put forward a reference framework for the development of a set of internationally comparable indicators [6,7].

The theoretical model was defined after an extensive study of literature on e-health tools adopted by international health systems for citizens (online bookings, payment, results), for offices (archive and data exchange tools) and for health professionals (distance learning, EHR).

As already pointed out, technological development in health care affects different areas, which represent the dimensions of the concept of e-health in its broadest sense [2]. Each dimension expresses different aspects of technological progress and consists of several sub-dimensions, which in turn focus on a single aspect of innovation. The analysis of all the areas of ICT development in health care has led to the definition of four basic dimensions: the supply of e-health services, the use of e-health services, the e-health network and the know-how of health personnel [5]. The first two dimensions concern the use and supply of common e-health services: medical appointments, tests, bookings, emergencies, first aid. The third dimension concerns the technical infrastructure and the ITC equipment required for the provision of these services. The final aspect is cultural, since the use and provision of e-health depends largely on health professionals having an adequate technological and ITC culture oriented towards digital health policy planning.

Figure 1 shows the relationships between the dimensions: the health facility network and health personnel know-how form the background on which e-health services are implemented, while supply and use indicate the exchange of services between health centres and citizens [5].
The model involves the use of statistical indices to measure the dimensions, which are based on a series of sub-indicators. In this paper the term *indicator* is used to measure a single dimension, while the term *sub-indicator* is used for single aspects of technological innovation within each dimension.

The supply of e-health services is part of the health service’s institutional role to provide increasingly more effective and efficient services to citizens through the adoption of ICT. This dimension is measured using the *eSupply* indicator, which examines the level of technological services provided to citizens through the following sub-indicators: booking appointments (S1), medical reports (S2), payment of fees (S3), electronic health record (S4), online communication (S5) and telemedicine services (S6) (see Table 1). This indicator assesses both the type of ICT services provided (bookings, EHR) and the technological level of implemented services (CUP2 bookings, web)3.

The *use of e-health services* includes aspects regarding the use of technological services by citizens. The simpler the services are to use, the more common, inexpensive, and tailored to the needs of citizens, the more they are used. The *eUse* indicator measures the level of use of technological services and has the same sub-indicators as *eSupply* from the viewpoint of users: booking appointments (U1), medical reports (U2), payment of fees (U3), electronic health records (U4), online communications (U5) and telemedicine services (U6). The indicator gives a percentage of the use of major e-health services, such as getting results online, searching for information on diagnoses, illnesses, waiting lists, bookings and telemedicine services on the corporate website.

The *e-health network* dimension includes aspects regarding the basic infrastructure required for the provision of digital health services and consists of regional networks that link up different local health care facilities, doctors, general practitioners (GPs) and paediatricians. The network is

---

2 CUP is the Italian acronym of Centro Unico di Prenotazione, that stands for Single Booking Centre.

3 For more details on the indices, please refer to methodological appendix A2.
An analysis of e-health level in Italy

essential for the provision of quality digital services accessible to all citizens, such as a single booking system operating throughout the country and valid for all healthcare facilities.

This dimension is quantified with the $eNet$ indicator, which assesses the degree to which health facilities are networked, namely if they can communicate in a single standard language, and includes the following sub-indicators: local health facilities (N1), pharmacies (N2), networked GPs and paediatricians (N3), Regional Health Register (N4). The $eNet$ indicator measures the "network effect", that is, the systematic nature of the health system and its capacity to provide standard integrated services to all citizens. This also includes the regional health register, i.e. the availability online of essential information\(^4\) on all residents in the region, an important element in terms of networking.

The last aspect is that concerning the technological know-how of medical staff, which measures the degree of technological expertise. If health professionals have an adequate amount of know-how the potential of technological services can be fully exploited. This dimension is assessed through the $eKnow-How$ indicator, which includes the following aspects: digital signature (K1), digital certificates (K2) and prescriptions (K3), electronic reports (K4), training (K5) and possession of ECDL Health (K6).

\textbf{Table 1: Dimension indicators}

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Indicator</th>
<th>Sub-indicators</th>
</tr>
</thead>
</table>
| Supply          | eSupply    | S1 – Booking appointments  
|                 |            | S2 – Medical reports  
|                 |            | S3 – Payment of fees  
|                 |            | S4 – Electronic Health Record  
|                 |            | S5 – Online communication  
|                 |            | S6 – Telemedicine services  |
| Use             | eUse       | U1 – Booking appointments  
|                 |            | U2 – Medical reports  
|                 |            | U3 – Payment of fees  
|                 |            | U4 – Electronic Health Record  
|                 |            | U5 – Online communication  
|                 |            | U6 – Telemedicine services  |
| Network         | eNet       | N1 – Local health facilities  
|                 |            | N2 – Pharmacies  
|                 |            | N3 – GPs and Paediatricians  
|                 |            | N4 – Regional Health Registry  |
| Technological know-how | eKnowHow  | K1 – Digital signature  
|                 |            | K2 – Digital certificates  
|                 |            | K3 – Digital prescriptions  
|                 |            | K4 – Electronic reports  
|                 |            | K5 – Distance learning  
|                 |            | K6 – ECDL Health  |

\(^4\) The most important information is: name, sex, date of birth, tax number, address, social security number, health centre, doctor's name.
Finally, the general indicator, *eHealth*, measures the overall level of e-health in health facilities, that is, the amount of digital services that have been adopted, the extent to which they are used by citizens and the degree of integration of health facilities. The *eHealth* indicator is a synthesis of eSupply, eUse, eNet and eKnowHow indicators.

3. The methodology

This section illustrates the methodology used to build the indices, and then presents the results of the quantitative analysis. Data come from the LITIS project (Levels of Technological Innovation in Healthcare), a 2010 census survey on Italian ASLs (local health trusts), AOs (hospitals), PUs (university hospitals) and IRCCSs (research hospitals) [8].

The aim of the LITIS project was to identify initiatives across the Italian health system to see how they could be guided at the national level; in particular, data were collected on to the use and dissemination of e-health technologies, as well as information on number of inhabitants, number of beds, number of outpatients, total annual expenditure, spending on ICT equipment and spending on ICT employees.

The survey involved almost 60% of national health facilities (147 organizations out of 254) of various sizes (number of employees, turnover, beds) and different types of advanced technological services. The distribution of health centres is fairly homogeneous within the 5 major geographical areas (northwest, northeast, centre, south and islands). Some regions are not well represented (only one ASL in Puglia), while others are completely absent (Basilicata, Molise, Valle d’Aosta and Marche). There are a large number of ASLs and AOs, but very few PUs and IRCCSs.

To date, the LITIS project is one of the most comprehensive and detailed dataset on e-health, and, thus, represents an important source of knowledge, considering the relatively sparse data on e-health in Italy. This survey is a precious source to compute the indicators and to validate the multidimensional model previously illustrated. We should point out that the LITIS survey is not based on the multi-dimensional model defined above and for this reason it has not been possible to calculate all the sub-indicators of the four dimensions. We are able to compute all the supply and use sub-indicators, but as regards the network dimension we are not been able to calculate indicator N4 concerning the regional health register, nor, as regards know-how, indicators K1 and K4 on electronic reports and digital signature. At present, no region has activated the regional health register, so the lack of this indicator (N4) do not influence the findings based on the *eNet* indicator.

All indices are calculated using techniques that synthesize the sub-indicators in a single value and produce pure numerical values, that is, independent of the unit of measurement so that comparisons
over time and space can be made. The indicators are computed for different territorial levels: health trust, type of health trust, region, geographical area.

In particular, to calculate the indices we used two methods: weighted average (MP) [9] and coefficient of variation penalty (MPcv) [10].

The two methods have both advantages and disadvantages. The weighted average provides an indicator with values of between 0 and 100 and assesses the relative importance of each sub-indicator by attributing each a weight. The subjective evaluation of the weight for each sub-indicator is crucial: the final results are conditioned by the value of these weights. Using the classical approach, adopted in this study, they are quantified by determining the absolute importance of one indicator compared to the others. The weights are attributed after an extensive review of the literature and thanks to the cooperation of e-health experts and researchers, who gave a weight between 0 and 100 for each technological innovation.

The MPcv method gives an indicator with values ranging approximately between 70 and 130, and does not require the individual sub-indicators to be weighted. The advantage of this method is that the values are not conditioned by the weights attributed to individual sub-indicators.

All the synthetic indicators are to some extent subjective and can be biased towards one element or another in the various stages of calculation, which give them a certain range of variation. For this reason a sensitivity analysis of the values of the indicators was carried out for both methods. In particular, the sensitivity analysis on the variations of the weights and measurement scales adopted for the sub-indicators confirmed a certain level of variability, especially for the MP indicator.

These considerations show that the MPcv method is more stable or, at any rate, less subjective than the weighted average.

4. Results

In this section we present the results of the calculation of the eUse, eSupply, eNet, and eKnowHow indicators, as well as the general eHealth indicator for all levels of analysis and for both methods.

A comparison of the results shows that MP and MPcv provide similar findings for facility typology, region and geographic area, but different values for some ASLs. Thus, for regions and especially geographic area the two methods can be considered equivalent and therefore can be used interchangeably.

---

5 For more details on the methodology used to build the indices, see Methodological Appendix A1.
A first look at the results shows that all indicators give similar results, i.e. high values for eSupply correspond to high values for eUse, eNet, and eKnow-how, and vice versa. A high value in the general eHealth indicator is obtained by a high supply of ICT services in a geographical context where health centres benefit from a strong network effect, health professionals have good digital knowledge and integrated easily accessible services are provided for citizens-patients. Moreover, there seem to be no significant differences in supply and use of digital services between ASLs and AOs, while the ASLs benefit from a higher degree of networking and digital knowledge (Tables 2 and 3). It must be remembered that the indices regarding PUs and IRCCSs are not significant, because they concern only a few structures (4 PUs and 5 IRCCS).

Table 2: Indices by facility typology (MP method)

<table>
<thead>
<tr>
<th></th>
<th>eSupply</th>
<th>eUse</th>
<th>eNet</th>
<th>eKnowHow</th>
<th>eHealth</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASL</td>
<td>22.8</td>
<td>12.7</td>
<td>14.1</td>
<td>33.6</td>
<td>20.8</td>
</tr>
<tr>
<td>AO</td>
<td>22.6</td>
<td>12.2</td>
<td>7.2</td>
<td>24.1</td>
<td>16.6</td>
</tr>
<tr>
<td>IRCCS</td>
<td>21.6</td>
<td>9.5</td>
<td>5.0</td>
<td>30.0</td>
<td>16.5</td>
</tr>
<tr>
<td>PU</td>
<td>18.8</td>
<td>11.0</td>
<td>17.2</td>
<td>26.8</td>
<td>18.4</td>
</tr>
</tbody>
</table>

Source: authors’ elaboration on LITIS data.

Table 3: Indicators by facility typology (MPcv method)

<table>
<thead>
<tr>
<th></th>
<th>eSupply</th>
<th>eUse</th>
<th>eNet</th>
<th>eKnowHow</th>
<th>eHealth</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASL</td>
<td>99.2</td>
<td>99.1</td>
<td>99.7</td>
<td>100.6</td>
<td>99.6</td>
</tr>
<tr>
<td>AO</td>
<td>99.2</td>
<td>99.1</td>
<td>98.2</td>
<td>97.2</td>
<td>98.5</td>
</tr>
<tr>
<td>IRCCS</td>
<td>99.6</td>
<td>98.6</td>
<td>97.2</td>
<td>98.5</td>
<td>98.5</td>
</tr>
<tr>
<td>PU</td>
<td>98.2</td>
<td>99.5</td>
<td>102.9</td>
<td>97.5</td>
<td>99.6</td>
</tr>
</tbody>
</table>

Source: authors’ elaboration on LITIS data.

Tables 4 and 5 highlight the differences among the five geographical areas. The North-East comes out best in all indicators, while the North-West comes a close second; the Centre-South and the islands lag a little behind. The indicators by geographical area seem to follow the level of infrastructural, technological and economic development of the country.
Table 4: Indicators by geographic area (MP Method)

<table>
<thead>
<tr>
<th>Region</th>
<th>eSupply</th>
<th>eUse</th>
<th>eNet</th>
<th>eKnowHo</th>
<th>eHealth</th>
</tr>
</thead>
<tbody>
<tr>
<td>North West</td>
<td>24.6</td>
<td>12.7</td>
<td>17.4</td>
<td>33.4</td>
<td>22.0</td>
</tr>
<tr>
<td>North East</td>
<td>35.1</td>
<td>16.3</td>
<td>15.7</td>
<td>35.8</td>
<td>25.7</td>
</tr>
<tr>
<td>Centre</td>
<td>20.6</td>
<td>11.1</td>
<td>11.9</td>
<td>30.4</td>
<td>18.5</td>
</tr>
<tr>
<td>South</td>
<td>10.2</td>
<td>8.6</td>
<td>4.3</td>
<td>20.3</td>
<td>10.9</td>
</tr>
<tr>
<td>Islands</td>
<td>20.5</td>
<td>12.4</td>
<td>4.0</td>
<td>28.2</td>
<td>16.3</td>
</tr>
</tbody>
</table>

Source: authors’ elaboration on LITIS data.

Table 5: Indicators by geographic area (MPcv method)

<table>
<thead>
<tr>
<th>Region</th>
<th>eSupply</th>
<th>eUse</th>
<th>eNet</th>
<th>eKnowHo</th>
<th>eHealth</th>
</tr>
</thead>
<tbody>
<tr>
<td>North West</td>
<td>99.8</td>
<td>99.1</td>
<td>101.6</td>
<td>100.6</td>
<td>100.0</td>
</tr>
<tr>
<td>North East</td>
<td>103.3</td>
<td>100.7</td>
<td>100.4</td>
<td>100.6</td>
<td>101.1</td>
</tr>
<tr>
<td>Centre</td>
<td>98.8</td>
<td>98.8</td>
<td>99.3</td>
<td>99.3</td>
<td>98.9</td>
</tr>
<tr>
<td>South</td>
<td>95.1</td>
<td>97.5</td>
<td>96.8</td>
<td>96.3</td>
<td>96.3</td>
</tr>
<tr>
<td>Islands</td>
<td>98.1</td>
<td>98.9</td>
<td>96.3</td>
<td>98.8</td>
<td>97.8</td>
</tr>
</tbody>
</table>

Source: authors’ elaboration on LITIS data.

Furthermore, the data show that the North and Centre have a greater number of healthcare organizations with high levels of technological innovation, while in the South healthcare organizations have medium to low levels of innovation, although there are some exceptions. Figure 2 shows that regions with the highest global eHealth indicator are Emilia Romagna, Trentino Alto Adige, Liguria and Veneto, while those with the lowest levels of innovation are Calabria and Campania. The regional values are in line with those of geographical area, with the exception of Abruzzo (4 local health centres) where values in all indicators are similar to those of the North-East. It must be remembered that regional data are scarcely indicative for regions with few health trusts (Puglia, Trentino Alto Adige and Umbria).

Analyses of the indicators based on the MP and MPcv methods come to the same conclusions about the dissemination and use of ICT in the Italian health system and therefore confirms the assumption that the two methods that can be used in the same way.
Central and northern regions seem to have adopted effective e-health policies, implemented plans aiming at integrating the services provided by local health centres and launched campaigns to raise awareness and a digital culture among professionals and citizens. Strategies that involve health professionals and citizens should encourage the use of innovative systems over the more traditional ones.

5. Conclusions

From this study emerge a heterogeneous picture of supply and use of ICT health services in the Italy with big differences between the North, Centre and South. The North seems to benefit from a greater degree of integrated governance in health centres and appear to be ahead in the use of
electronic services. This may be due to awareness of the innovative potential of ICT and a culture among health decision makers oriented towards programmes to integrate local systems. 

Greater growth in the overall level of e-health and the development of digital health can be achieved in different ways: rationalizing the provision of ICT services, increasing the network effects (e.g. by activating the EHR for patients in all health centres and GPs), encouraging the use of the Internet (for example: for bookings and payment of fees, medical report in digital format) and boosting advanced telemedicine systems, such as teleconsultations between remote facilities and specialized centres.

Timely and reliable e-health indicators can support policy towards the integration of the different levels of the health system, which are often fragmented. Common and shared policies to adopt ICT tools and solutions, combined with organizational changes and the acquisition of new skills, generate savings and greater productivity (fewer medical errors, reduction of unnecessary hospitalization, shorter waiting lists, less paperwork) that can have a positive effect on the increasingly tight regional budgets. Investing in ICT in health care also produces great benefits for the country’s economy, boosting productivity through incentives and the creation of new jobs [11,12].

Given the limited amount of official, up-to-date and comprehensive statistics on e-health in Italy, policy makers clearly need a unequivocal tool, such as the one proposed in this paper, to measure the level of e-health by means of statistical indices that are easy to interpret.

The analysis carried out in this work confirms the validity of the multidimensional approach adopted for the study of e-health and allow to evaluate whether the supply of ICT services meets the specific requirements of the patient or whether it responds to the needs of the market.

In this perspective, the eSupply, eUse, eNet, eKnow-how and eHealth indices could be used to better understand, compare and monitor the strategies of local and central health centres (also in an international perspective), supporting the design of quality services that address the needs of the citizen/patient.

In addition, the indices can be used to measure over time the dissemination and improvement of ICT services for citizens and can trigger a virtuous circle of competiveness among healthcare organizations for the provision of efficient and high quality services.

Acknowledgements

We thank Dr. Angelo Rossi Mori and Dr. Oscar Tamburis of CNR (Italian National Research Council) for having given access to LITIS survey data and for their useful suggestions and comments on this work.
Methodological appendix

A1 – Methodology used for the indices

The methodology used in this paper to calculate the indicators involves the following phases: 1) basic indicators creation; 2) indicators’ standardization; 3) aggregation of standardized indicators into a single general indicator [13].

1) **Basic indicators.** Construction of matrix $X_{ij}$ of the basic indicators, where $i$ are the units surveyed (i.e. health care organizations) and $j$ are the different basic indicators;

2) **standardization.** Such indicators are not comparable, because they are expressed in different units of measurement. Standardization is used to produce indicators that are independent of specific units of measurement to obtain the standardized matrix $Z_{ij}$. In this work we have standardized the data using the Min-Max method, which means dividing the difference between each element $X_{ij}$ and its lowest value by the difference between the highest and the lowest:

$$Z_{ij} = \frac{(X_{ij} - \text{Min } X_{ij})}{(\text{Max } X_{ij} - \text{Min } X_{ij})}$$

This technique normalizes the values of $X_{ij}$ in the range 0 - 1.

3) **aggregation.** The most common procedure for the aggregation of indicators use methods based on averages, usually arithmetic weighed average. The weighted average requires vector $W$ of the weights of the basic indicators to identify the relative importance of each indicator compared to the others. In this work the methods we use are the *weighted average* (MP) and the *coefficient of variation penalty* (MPcv).

**Weighted average**

The MP method is the most straightforward to apply for the calculation of the indicators, generating indicators with values between 0 and 100. The next step is to calculate vector $MP$ of the indices of health trusts obtained by the matrix $Z$ multiplied by weight vector $W$:

$$MP = Z \cdot W \cdot 100$$

The MP indicator is easy to apply, but the final results are greatly affected by the subjectivity of the choice of weights, which means the method is not very stable.
Coefficient of variation penalty method

The MPcv method does not require the definition of a weight vector, since the mean values are used to calculate the indicators. The method is based on the standardization of matrix $X$ with the average and the standard deviation, so that the indicators all vary within the same scale, transforming each indicator into a standardized variable with mean $M = 100$ and standard deviation $S = 10$ [13]. The values thus obtained are roughly in the range of between 70 to 130. This means the indices are independent of both unit of measurement and variability. In this way, it is easy to identify the health organizations that have a level of equipment that is above or below the average (values higher/lower than 100).

The next step is to calculate vector MPcv of the indicators of health care organizations, given by the difference between two elements: the arithmetic mean $M_z$ of the standardized indicators and the penalty. The penalty is proportional to the mean square deviation $S_z$ and the coefficient of variation $cv$ (horizontal variability of the sub-indicators compared to the mean value).

$$MPcv = M_z - S_z \cdot cv$$

This method is additive and makes the MPcv easy to interpret, as it is possible to decompose the value of each organization into two components: mean effect and penalty effect. Corrections made penalize organizations which, having the same arithmetic average, have more imbalanced indicator values, while the coefficient of variation limits the bypass effect between two units with different arithmetic means only in cases where the unit with the highest arithmetic mean has a greater variability than the other.

In fact, an increase in the MPcv indicator (for example for the eSupply indicator) by a generic unit corresponds to an increase in infrastructure and/or a decrease in horizontal variability.

A2 - Calculation of the indices

eSupply indicator

The eSupply indicator assesses both the type of ICT services offered (booking of appointments, EHR) and the technological level of the services implemented (bookings on the web, mobile, etc).

The eSupply indicator is made up of the following subindicators.

Booking appointments ($S1$): gives the average of the values of the electronic modes of booking appointments out of the total. The electronic modes include: pharmacy, other desks, contact centre, website, portal and mobile.
Medical report (S2): is the average of the values of the electronic modes of getting results out of the total number in the survey. The electronic modes are: GPs and Web/Email.

Payment of fees (S3): is the average of the values of the electronic modes of paying fees out of the total methods in the survey. The electronic methods are: pharmacy, bank, post office, other networks, portal and mobile.

Electronic Health Record (S4): is a dichotomous indicator with a value of 1 if there is EHR infrastructure and 0 if there isn’t.

Online Communication (S5): measures the number of different types of information available on the institutional website, such as: services card, exemptions, methods and technologies, average access time, directions and transport, costs and how to apply.

Telemedicine services (S6): indicates the number of different types of telemedicine services offered. The telemedicine services in the LITIS survey include: telemonitoring, telecompany, telecheck-up, teleconsultation and telerehabilitation.

Finally, the eSupply indicator calculated using the MP method is given by the following formula:

\[ eSupply = (0,2 \cdot S1 + 0,2 \cdot S2 + 0,2 \cdot S3 + 0,15 \cdot S4 + 0,1 \cdot S5 + 0,15 \cdot S6) \cdot 100 \]

eUse indicator

The eUse indicator measures the level of use that citizens make of technological services and is made up of the following sub-indicators.

Booking appointments (U1): indicates the percentage of digital bookings of appointments (pharmacy, other desks, Contact Centre, website, portal and mobile) out of total bookings.

Medical report (U2): expresses the percentage of results obtained digitally (web portal, email and GPs) out of the total number of methods for getting results.

Payment of fees (U3): indicates the percentage of fee payments made digitally (pharmacy, bank, post office, other networks, portal and mobile) out of total payments.

Electronic Health Record (U4): indicates the percentage of patients with electronic health records.

Online Communication (U5): expresses the percentage of people looking for information on the web portal (exemptions, methods and technologies, waiting lists, directions and transport, costs and how to apply) out of total searches.

Telemedicine services (U6): measures the percentage of patients who benefited from telemedicine services out of total patients.

Generally, the eUse indicator calculated using the MP method is given by the following formula:

\[ eSupply = (0,2 \cdot U1 + 0,2 \cdot U2 + 0,2 \cdot U3 + 0,15 \cdot U4 + 0,1 \cdot U5 + 0,15 \cdot U6) \cdot 100 \]
**eNet indicator**

The *eNet* indicator assesses the extent to which health facilities are networked and is made up of the following sub-indicators.

*Local health facilities (N1)*: measures the number of different typologies that are integrated into the regional healthcare network, such as: sharing of clinical data, notification of significant events, consultation, and communication.

*Pharmacies (N2)*: measures the number of different types of technological infrastructures implemented in pharmacies for the exchange of data and information with other facilities. The typologies are: identification systems such as bar code, digital signature, single-dose administration and automatic medical dispensers.

*GPs and Paediatricians (N3)*: expresses the percentage of GPs and paediatricians connected to the regional network and/or other networks.

*Regional Health Register (N4)*: indicates whether or not there is a citizens' health register in the digital archives of the local health facility. The LITIS survey did not contain this information so we gave zero weight to this sub-indicator.

The eNet indicator calculated using the MP method, is given by the following formula:

\[ eNet = (0.25 \times N1 + 0.25 \times N2 + 0.50 \times N3 + 0 \times N4) \times 100 \]

**eKnowHow indicator**

The eKnowHow indicator measures the degree of technological expertise and knowledge of health personnel and is made up of the following sub-indicators:

*Digital Signature (K1)*: indicates the percentage of health workers that have a digital signature. The LITIS survey did not contain this information so we gave zero weight to this sub-indicator.

*Digital Certificates (K2)*: is the percentage of GPs and paediatricians who give out digital certificates.

*Digital prescriptions (K3)*: expresses the percentage of GPs and paediatricians who give out digital prescriptions.

*Electronic results (K4)*: is the percentage of health workers who provide electronic reports. The LITIS survey did not contain this information so we gave zero weight to this sub-indicator.

*Training (K5)*: measures the number of training methods implemented at a facility. The methods include: introduction to the use of ICT, management of individual applications, management of electronic health records, clinical data management and indicators.

*ECDL Health (K6)*: concerns the number of “computer driving licenses” in the health field.
The eKnowHow indicator calculated using the MP method is given by the following formula:

\[ e\text{KnowHow} = [0-K1+0.25-K2+0.25-K3+0-K4+0.50-(K5+K6)] \times 100 \]

**eHealth indicator**

The eHealth general indicators calculated using the MP method is given by the following formula:

\[ e\text{Health} = (0.25\times e\text{Supply}+0.25\times e\text{Use}+0.25\times e\text{Net}+0.25\times e\text{KnowHow}) \]
References


