Connecting the Electronic Medical Records in The European Union—Where Do We Stand and Where Does It Go?

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In this editorial, the author discusses the integration of eHealth systems in the European Union (EU) through the eHealth Digital Service Infrastructure (eHDSI) project. The EU's unique approach to integration involves overcoming language and system differences among its 27 member states. The European Directive 2011/24/EU emphasizes patients' rights in cross-border healthcare, pushing for interoperability in national eHealth systems (Note: Acronyms are defined in Appendix A after References.)

The eHDSI project aims to facilitate emergency cross-border healthcare. It involves National Contact Points for eHealth (NCPeH) in each country, connecting through standardized interfaces. The project covers Patient Summary (PS) exchange, electronic prescription (eP), electronic dispensation (eD), and Original Clinical Documents (OrCD) exchange.

Despite its progress, the eHDSI faces challenges, including language diversity and differences in national healthcare systems. Key performance indicators (KPIs) reveal operational details, with 11 NCPeHs established by 2023. While eP/eD services are more developed, PS exchange and OrCD usage remain limited.

Although eHDSI seems to be a viable project, its real-world usage is currently low. This can be attributed to technical complexities and incomplete implementation. Broader use should be pursued instead of expanding the system's capabilities. The complexity of the eHDSI and its implementation could pose additional challenges, and widespread use may not be achieved before 2030.

Integration in the European Union and the eHealth Interoperability

The EU embodies a distinctive approach to integrating various domains typically reserved for individual countries. Currently, the EU consists of almost 450 million inhabitants living in 27 different national states using 24 official languages, all of which are deemed equivalent. EU law is given precedence over national laws, and there is a growing tendency toward further integrating individual national states. However, each country has decades or even centuries of independent evolution, resulting in distinct customs and perspectives in every EU member state. Laws and procedures evolved autonomously and most likely will remain different even in the future. The same applies to diverse eHealth systems that were introduced way before the current unifying activities were started.

Generally, the EU insists on the concept of an "EU citizen," which means that a national of one EU country, when residing or being active in another EU country, is subject to the same handling as a primal citizen of that later country. This approach is applied in various scenarios, including work conditions, property acquisition, tuition fees, and healthcare. However, this unifying attitude should also encompass situations where the EU citizen is temporarily in another EU country or even chooses another EU country to provide them with a specific service. In healthcare, this is reflected by the European Directive 2011/24/EU on patients' rights in cross-border healthcare,[1] which, among other provisions, also recognizes the necessity to introduce interoperability in the

national eHealth systems. However, on the national level, these should remain the sole responsibility of the particular country. In the future, voluntary involvement in the exchange of health data between countries might even become mandatory due to the proposed Regulation of the European Parliament and the Council on the European Health Data Space.

The first pilot project covering the cross-border exchange of patient data between various Electronic Medication Records (EMR) in the EU was introduced in 2008 under the name of European Patient Smart Open Services (epSOS).[2] Under this project, two different services were launched—the exchange of PS (PS: a standardized limited set of patient health information to enable treatment by another physician) and the dispensation of medication using national electronic prescription systems (EPS). During the project, which ran until 2014, no live data were ever exchanged. Still, important fundamentals were laid out—both in the technological sense and in understanding the issues when connecting dissimilar national systems. This project then transformed into the eHDSI project that, at present, should run until 2027. Starting in 2019, this evolving service (also known under the MyHealth@ EU name) enables PS exchange, dispensation of medication, and also exchange of original clinical documentation. This service was launched gradually by connecting national EMR systems one by one. This editorial describes the current state of the eHDSI project and explores its future progress.

Description of the eHDSI Project
Information about the eHDSI project is documented on the eHDSI confluence pages across three distinct domains: Operations, Semantic, and Technical. This documentation is freely accessible to anyone using the European Commission's multifactorial user authentication services (EU Login).[3]

Consistent with the previously mentioned EU Directive, the eHDSI project specifically addresses unplanned or emergency cross-border healthcare situations. Only a basic scenario is contemplated when a patient usually domiciled and treated in Country "A" needs a treatment or medicine dispensation in another EU Country "B." Therefore, the medical data from Country "A" must be transferred to Country "B" (Note: Country "B" always initiates this transfer, which is also known as a "pull scenario"). There is no provision for other workflows such as a "push scenario"—getting data from Country "B" to Country "A" or even more complex scenarios (such as involving even another Country "C" in the scheme).

Each EU country should establish a single National Contact Point for eHealth (NCPeH). The national one is the sole responsibility of that particular country and is designed to connect to the national eHealth systems of the said country. The second interface, the international one, is standardized and used to connect to another NCPeH. As the "pull scenario" is always used, the request for data runs from national systems in Country "B" via the NCPeH in Country "B" to the NCPeH in Country "A" and then to the national eHealth system in Country "A," whereas the desired information runs in the opposite way. This is also depicted in Figure 1.

Documentation written in any language in Country "A" should be available in Country "B's" native language, facilitating the use of professionals fluent in that language to overcome the challenge of 24 different languages in the EU. To do so, a Master Value Sets Catalogue (MVC) defines which international coding system is used for a particular data element (e.g., SNOMED (Systemized Nomenclature of Medicine); ICD-10 (International Classification of Diseases, Tenth Revision), etc). At the NCPeH of Country "A" using the MVC, the information is translated from one language to a commonly agreed English format (so-called "pivot document") and sent to the NCPeH of Country B. There the pivot document

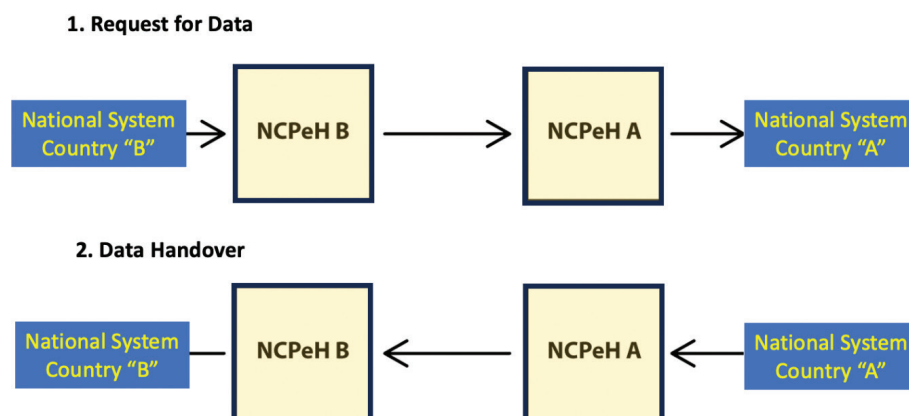**1. Request for Data**

2. Data Handover

Fig. 1. Pull scenario (basic workflow of eHDSI): National Contact Points for eHealth. eHDSI: eHealth Digital Service Infrastructure; NCPeH: National Contact Points for eHealth for Country "A" and Country "B."

is translated into the other country's language. Each EU country is responsible for developing translation from national standards and national valuesets to the MVC (see Figure 2 for a detailed overview).

The eHDSI started with two basic services: the exchange of PS and the dispensation of medication. The latter service is, for technical reasons, subdivided into two distinct services—ePrescription (eP—requesting the data about issued ePs by Country "B" from Country "A") and eDispensation (eD: notifying Country "A" by Country "B" that the medication was collected in the latter country, thus the eP should be rescinded). So, under the eHDSI, the whole process of dispensing medication is usually denominated as eP/eD service. "A" third service for exchanging OrCD was recently introduced. Laboratory results, hospital discharge reports, medical images, and medical image reports will be sent from Country "A" to Country "B" in a PDF format. These documents will remain in the original language, so there will be no translation in this service.

Each project transaction relies on a direct connection between two distinct NCPeHs. Although a pivot document with a well-defined structure and content is used to deliver data from one NCPeH to another, the system has no central node. Therefore, the whole system should be seen as a point-to-point operation. On top of that, the pull principle means that there are two different scenarios between two NCPeHs; in one of them, NCPeH acts as Country "A," whereas in the second, it acts as Country "B." Moreover, every service under eHDSI (PS, eP/eD, and OrCD) is introduced separately and stepwise.

Having a functional NCPeH is a basic prerequisite for an EU country, but it does not necessarily imply operational readiness. The national interface and transfer of documents to and from MVC have to be developed. The National eHealth systems have to be connected to the national interface. After this stage, using the international interface, the NCPeH has to be connected one by one to every other NCPeH in the EU. Also, this has to be done for each of the three services separately and for both "directions"

independently. So, for a long time in the future, to describe the present state of eHDSI accurately, it will be necessary to describe which NCPeH is connected to which other NCPeH, what kind of services it runs at present, and whether all of them work bilaterally or unilaterally. To accomplish interoperability in the whole EU, it will be necessary to introduce and test more than 2,000 different scenarios (as there are 27 EU countries, three services, and two directions).

Development and Current Use of eHDSI

Various KPIs comprehensively cover the eHDSI project and are published quarterly on a dedicated public portal.[4] Due to the gradual development of the project, only some KPIs are monitored. The majority of used KPIs fall into the first category, denoted as KPI-1.1 to KPI-1.12, covering the basic operation of the eHDSI. KPI-3.3 and KPI-3.4 describe the uptime/downtime periods of NCPeHs. KPI-7.1 to 7.4 cover laws, institutions affected by eHDSI, etc. Each KPI has its dedicated page, on which every quarter of a year covered by the KPI can be selected. Currently, the last quarter covered is the third quarter of 2023, with some KPIs having only a limited data set. Different KPIs are presented in various ways:

- A simple map is used (as in KPI-1.1, where a country with an operational NCPeH is depicted in the map), or
- Map & transactions are shown (as in KPI-1.2, where the map also depicts the flow of transactions; moreover, an originating country can limit transactions, and even every transaction can be viewed independently), or
- Map & entities are shown (as in KPI-1.9.1, where the map depicts pharmacies in the map also, single pharmacies can be reviewed one-by-one), or
- A table is used (as in KPI-7.1, where each law and regulation is listed in a table).

The whole set of presently used KPIs is shown in Table 1, including how the particular KPI is presented. While visually appealing, this presentation style poses challenges for
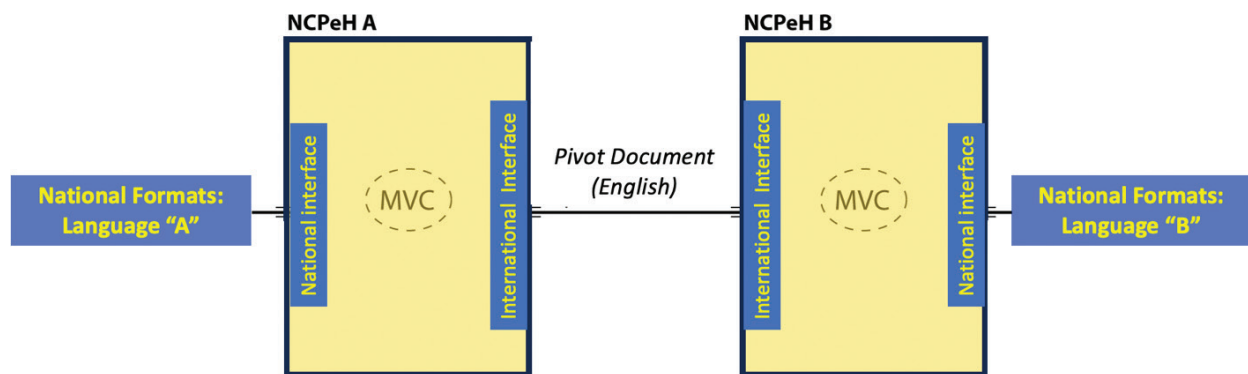

Fig. 2. Translation between national languages using MVC and pivot document. eHDSI: eHealth Digital Service Infrastructure; mMVC: Master Value Sets Catalogue; NCPeH: National Contact Points for eHealth.

Table 1. Presently used eHDSI KPIs.

KPI	KPI Definition	Presented as
KPI-1.1	Number of Countries with Operational NCPeH	Simple map
KPI-1.2	Number of transactions between Countries	Map & transactions
KPI-1.3	Number of ePrescriptions exchanged	Map & transactions
KPI-1.4	Number of eDispensations exchanged	Map & transactions
KPI-1.5	Number of Patient Summaries exchanged	Map & transactions
KPI-1.8.1	Number of Operational eP-A services	Simple map
KPI-1.8.2	Number of Operational eP-B services	Simple map
KPI-1.8.3	Number of Operational PS-A services	Simple map
KPI-1.8.4	Number of Operational PS-B services	Simple map
KPI-1.9.1	Pharmacies operational with eHDSI services	Map & entities
KPI-1.9.2	Hospitals operational with eHDSI services	Map & entities
KPI-1.9.3	Other Points of Care operational with eHDSI services	Map & entities
KPI-1.9.4	A coverage percentage of the Points of Care operational with eHDSI services	Simple map
KPI-1.10.1	Number of citizens who are potentially able to benefit from eHDSI services	Simple map
KPI-1.10.2	Number of citizens excluding themselves from eHDSI services	Simple map
KPI-1.11	Number of citizens who have used the ePrescription service	Simple map
KPI-1.12	Number of citizens who have used the Patient Summary service	Simple map
KPI-3.3	NCPeH uptime	Simple map
KPI-3.4	NCPeH downtime periods	Table
KPI-7.1	Laws and regulations affected and amended to enable cross-border services interoperability	Table
KPI-7.2	Institutions affected by the cross-border services interoperability	Table
KPI-7.3	International standards used at national level for the provision of MyHealth@EU	Table
KPI-7.4	Level of provision by the national infrastructure of coded information using international standards	Table

eHDSI: National Contact Points; eP: electronic prescription; KPIs: Key Performance Indicators (e.g., KPI-1.1, etc.); NCPeH: National Contact Points for eHealth; PS: Patient Summary.

in-depth analysis. For example, theoretically, every transaction that occurred throughout the whole operation of the system can be shown, but this can be achieved only by manually selecting such transactions one by one (at present, the KPI-1.2 shows over half a million transactions between Q4-2019 and Q3-2023).

According to KPI-1.1, the first six NCPeHs went alive in Q4-2019—Croatia (CR), Czechia (CZ), Estonia (EE), Finland (FI), Luxembourg (LX), and Malta (MT). Next came Portugal (PT) in Q1-2020, France (FR) in Q3-2021, Spain (SP) in Q4-2021, Netherlands (NL) in Q1-2022, and Poland (PL) in Q3-2022, making it 11 operational NCPeHs so far. This progress is illustrated in Figure 3.

The number of transactions as set by KPI-1.2 (e.g., a PS retrieval is seen as one, eP/eD service is seen as two separate transactions) has risen from 237 in Q3-2019 to 77,024 in Q3-2023 (of which, over 50,000 have a "test attribute" set to "no" which should denote a live transaction). Similarly, the number of eP exchanges has risen from 0 to 20,769, of which over 15,000 were "live." However, this led to 5,541 live eD transactions (each should mean dispensing a drug based on a cross-border eP). There was no significant number of PS transactions (as set by KPI-1.5). All the numbers are set out in Table 2.

For some reason, KPI-1.8.1 to 1.8.4 is not updated on the public portal, so the number of active PS and eP/eD services has to be assessed from transactions in KPI-1.3 and KPI-1.5. Using the former one, eP/eD capability currently has NCPeH of CR, CZ, EE, FI, PL, PT, SP, and Cyprus (CY). Using the latter one, PS capability has NCPeH of CR, CZ, EE, FI, FR, LU, NL, and SP, but also CY and Greece (GR). This also shows that in addition to 11 operational NCPeHs (as per KPI-1.1), there are two more in the testing phase so far (CY and GR).

KPIs 1.9.x and 1.10.x provide limited explanatory power. However, KPI-1.11 shows the number of citizens using eP/eD service divided by the origin of the data (Country A). As shown in Table 3, the number of such users has risen significantly in the last time, but Finnish citizens still prevail. The total number of users in the third quarter of 2023 amounts to 2,019, which corresponds well to the number of eD transactions, 5,541. It can be expected that every user will use the cross-border service more than once. With very limited use of PS exchange, there is no need to analyze KPI-1.12.

KPI-3.3 indicates consistently high uptime, exceeding 99.9%, for all 11 operational NCPeHs. KPI-3.4 lists every downtime period. KPIs 7.1–7.4 focus on regulatory
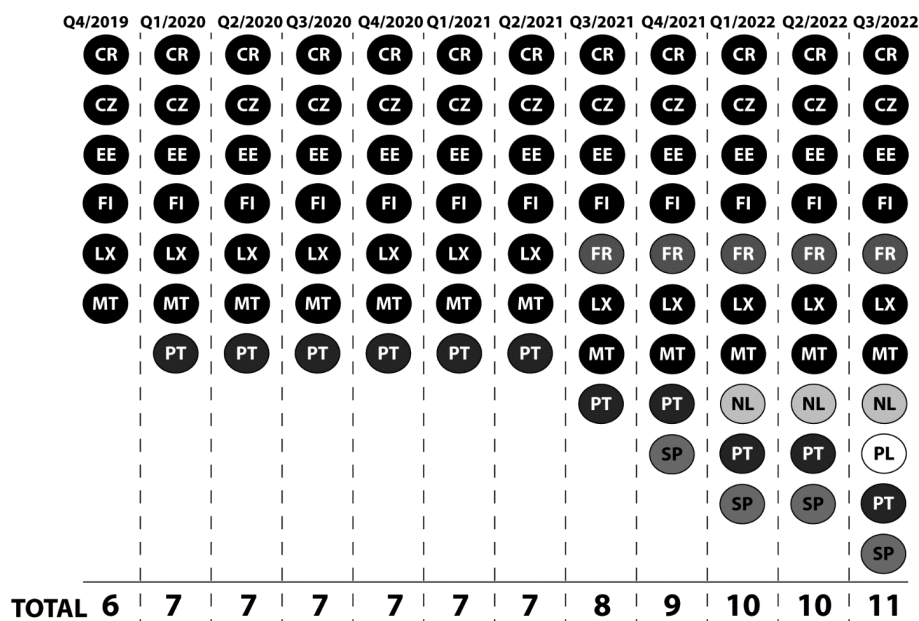
Fig. 3. Progressive introduction of NCPeH (National Contact Points for eHealth). CR: Croatia, CZ: Czechia, EE: Estonia, FI: Finland, FR: France, LX: Luxembourg, MT: Malta, NL: Netherlands, PL: Poland, PT: Portugal, SP: Spain.

Table 2. Transaction data of eHDSI.

KPI	Q4-2019	Q3-2023	Q3-2023 (test "no")
KPI-1.2	237	77,024	50,254
KPI-1.3	0	20,769	15,436
KPI-1.4	0	7,090	5,541
KPI-1.5	83	113	7

eHDSI: eHealth Digital Service Infrastructure; KPI: key performance indicators.

affairs and technical aspects of interoperability rather than operational aspects of eHDSI.

The Actual and Possible Future Use of eHDSI

The usage of eHDSI has not been covered thoroughly. Previously, mostly technical aspects of the system were studied.[5] In a previous study, the author of this editorial found that eHDSI is predominantly utilized for testing purposes only.[6] Just recently, a Croatian case study emerged describing the implementation of eHDSI in Croatia.[7]

Despite the epSOS project's launch in 2008 and the subsequent initiation of eHDSI in 2014, the first six NCPeHs became operational only in the last quarter of 2019. Until now, there are five more operational NCPeHs, with another two in the testing phase. Of these 11 working NCPeHs, seven have the eP/eD capability, and eight have the PS exchange capability. Until now, the OrCD has not been listed among the operational transactions. Nevertheless, even having the capability of a service does not mean the service is already used.

Based on KPI analysis, it appears that PS exchange is rarely, if ever, used at present. In contrast, the eP/eD service is more developed, with data from the third quarter of 2023, indicating that over 2,000 EU citizens obtained their medication abroad using ePs. Most of these were Finns, and they predominantly collected their medication in Estonia (when analyzing KPI-1.4). Czech citizens come second in getting their medication, mainly in Poland, and Polish come third in collecting medication, predominantly in Finland, but also in Spain and Croatia.

As already said, the EU consists of 27 countries— therefore, having 11 out of 27 NCPeHs operational can hardly be described as extensive coverage. Countries with NCPeHs account for 203 million inhabitants, which is 45% of EU citizens. However, only 117 million citizens (26%) have access to eP/eD capable NCPeHs. Moreover, not every one of these seven NCPeHs can connect to every other point, or this connection works unilaterally so far (for example, five other NCPeHs can serve as Country "B" when Czech NCPeH is the Country "A," whereas only three of them can be used as a Country "A" when Czech NCPeH serves as Country "B").

It would be challenging to determine the exact number of people who could benefit from a potential exchange of PS or cross-border medication dispensation. The number of people working in one country and residing in another (thus crossing borders daily or at least weekly) is estimated at 2 million EU citizens,[8] and intra-EU travel is estimated at over 200 million visits per year.[9] Yet, as shown previously, only over 2,000 citizens used the eP/eD

Table 3. Number of citizens who have used ePrescription service.

Country	Q1-2021	Q3-2021	Q4-2021	Q1-2022	Q2-2022	Q3-2022	Q4-2022	Q1-2023	Q2-2023	Q3-2023
Croatia	2		2	1		1	2	2	1	2
Czechia		8	11	8	8				36	430
Finland			473	468	862	1,257	1,113	1,075	1,317	1,353
Poland								22	58	209
Spain									16	25
Total	**2**	**8**	**486**	**477**	**870**	**1,258**	**1,115**	**1,098**	**1,428**	**2,019**

system to get their medication abroad in the last quarter already covered by KPI.

Therefore, it can be concluded that although eHDSI is a viable project, its real usage remains low (in the case of eP/eD) or has not started in earnest yet (PS exchange and OrCD). The technical aspects are quite challenging, mainly due to the incompatibility of national eHealth systems (for example, different eP systems in every EU country).[10] This is mirrored in the basic design of eHDSI consisting of point-to-point connections, three different services, and the necessity to address both "directions" separately. To use the eHDSI, NCPeH has to be implemented, and working connections with as many other NCPeHs have to be developed and tested.

As seen from the statistics, eHDSI gathered some momentum in the last year. However, with only 11 NCPeHs (eight having PS exchange capability, seven having eP/eD capability, and none having OrCD capability), surely, not more than 20% of the project is finished. It would be very optimistic to expect full capability of the project in 2027 (when the current funding of the eHDSI finishes so far). And even if this improbability happened, the real use of the system might lag. Therefore, it is quite probable that the system will still not be widely used before 2030.

The above-mentioned technical complexity may be the most significant barrier to the faster implementation of the eHDSI. Additionally, the national eHealth systems of some EU countries are less developed than those of others. Currently, most EU countries possess a functional eP system to which the eP/eD component of eHDSI can be connected. However, national electronic health records are much less common in many EU countries, making obtaining data for Patient Summaries (PS) challenging. This scarcity contributes to the lower adoption of PS in the eP/eD part of the eHDSI.

The EU does not actively facilitate the eHealth development in individual EU countries but instead focuses on interoperability, which, until now, has been voluntary. A proposed Regulation of the European Parliament and the Council on the European Health Data Space might make the exchange of health data mandatory. However, it is debatable whether this approach will accelerate the adoption of eHDSI. Alternative strategies, such as providing financial incentives or even developing prototypes of national eHealth systems (e.g., to enable the implementation of similar systems in various EU countries), could potentially be more effective in promoting the eHDSI. To date, there exists no documented discussion on this subject matter. Official outlets predominantly endorse the eHDSI without incorporating consideration for innovative approaches.

One should also not forget the limitations of the eHDSI and its use just for emergency cross-border health care. The EU aims in many aspects for much closer cooperation, so theoretically, in the future, an EU citizen might not need to differentiate between his "domestic" country and any other EU country. But even full implementation of eHDSI will not cover this. To achieve this, more advanced scenarios are needed, such as a "push scenario" (e.g., patient being treated in another EU country, and this information is transferred to the domestic national eHealth system) or even complex scenarios (e.g., patient from a country "A" being treated in Country "B" and the data transferred to Country "C").

Certainly, activities to enhance the eHDSI in this way will emerge in the future. However, this will make the whole implementation even more complex. It might be advisory to concentrate in the future years just on bringing the contemporary functions to wide use instead of insisting on making the eHDSI an even more potent tool for cross-border health care.

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Data Availability Statement

The author confirms that the data supporting the findings of this study are available within the article.

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Appendix A: Acronyms defined.

eD: dispensation

eHDSI: eHealth Digital Service Infrastructure

EMR: Electronic Medication Records

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eP: electronic prescription

epSOS: European Patient Smart Open Services

EU: European Union

ICD-10: International Classification of Diseases, Tenth Revision

KPIs: Key Performance Indicators (e.g., KPI-1.1, etc.)

MVC: Master Value Sets Catalogue

NCPeH: National Contact Points for eHealth

OrCD: Original Clinical Documents

PS: Patient Summary

SNOMED CT: Systemized Nomenclature of Medicine—Clinical Terms