

# Large-scale implementation and adoption of the Finnish national Kanta services in 2010–2017: a prospective, longitudinal, indicator-based study

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## Abstract

In Finland, implementation and adoption of the national Kanta services' second phase services were carried out step-by-step from May 2010 till December 2017. The Kanta services currently include integrated, interoperable health information from EMR, EHR, PHR and social welfare sources that can benefit patients, care providers and policy makers.

The Ministry of Social Affairs and Health steers the Kanta services, and was responsible of the first phase implementation activities since July 2007. For the second phase of implementation and adoption of the services, a new national operational coordination function was established by law in January 2011. The adoption and implementation of the Kanta services would not have been possible without joint efforts of stakeholders and provision of adequate (state) funding.

A set of indicators for various prospective, longitudinal monthly follow-up were used. Indicator data were collected from the various Kanta services in Kela and sent to the THL usually within a working week after end of a month. Indicator data were checked and entered to charts and tables, and reported for various functions.

The current principal Kanta services include My Kanta Pages (since May 2010), Prescription Centre (May 2010), Pharmaceutical Database (May 2010), Patient Data Repository and Patient Data Management Service (November 2013), Kelain (September 2016), and Client Data Archive for Social Welfare Services (May 2018) and Kanta Personal Health Record (May 2018).

**Keywords:** electronic health records, health information exchange, electronic prescribing, health records, personal Finland

## Introduction

Information and communication technology applications can improve information management, access to health services, quality and safety of care, continuity of

services and cost containment [1–9]. However, technology is used sparingly [10].

Electronic medical records (EMR) and electronic health records (EHR) are used by physicians and other health care professionals to improve quality of care and con-

tain costs [11–13]. EMR is a longitudinal electronic record of patient health information generated in a care delivery setting designed to provide a comprehensive picture of the patient's condition at all time [11,13,14]. Thus, EMR stores institutional data (partial patient medical history). EHR shares health information across providers, and EHRs are the building blocks of health information exchange (HIE) networks that provide interoperability between different entities and enable the sharing of data and information about patients' medical and health histories [15–20]. Personal health records (PHR) are electronic medical charts containing medical data and information about a patient that are maintained by patients themselves [11,13]. Patients can access PHRs online (patient portal).

Integrating health information from all three EMR, EHR and PHR sources can potentially benefit patients, care providers and policy makers by providing a comprehensive view as required in the concept of patient centered care. However, the benefits of such high-volume, comprehensive data integration do not come cheaply [1,3–5,13].

The implementation and adoption design of information systems has traditionally been a choice between a top-down and a bottom-up approach with consequences [21–23]. Major restructuring of services usually needs large scale information systems projects that suffer from recognized and well-documented problems [22–24], with published examples of failure [9,25–28]. Barriers and facilitators to information systems adoption and data sharing in health care settings are identified in the literature [3,29,30].

Generally, information systems adoption is complex, multi-dimensional and influenced by a variety of factors at individual and organizational levels [3,21,25,31–33]. The larger the scale, the greater its chances of failure [31]. The past lessons and difficulties facing large information systems projects point, for example, towards modularisation [2,22,23,34]. Building national or large scale health information systems infrastructure is a problem entirely different from that of simply replicating a clinical system across many different institutions [21]. Implementation is not a simple straightforward

linear process [9], and shared electronic patients' records are not just plug-in technologies [31]. Adoption and implementation is not the same thing: just because an information system has been adopted, it does not necessarily mean it is being used (or used in the way it was intended). The more comprehensive the technology or the wider the span of the implementation, the more difficult it is to achieve success. Measuring success is not straightforward, and consequences are likely to be multiple and require measurement of outcomes at multiple levels. Health care settings are complex as are information systems, too [35,36]. Thus, implementing information systems is a risky business.

Whilst the literature on implementation of EHR is limited, there are nonetheless a number of salutary case studies [25,37,38]. However, there is likely a positive bias due to non-publication of negative results [39]. For successful adoption and implementation, provision of adequate funding is the primary organizational requirement [9,39]. The challenge to successful implementation is primarily around the socio-technical and contextual domains [40,41].

For EHR implementation and adoption follow-up purposes, sets of indicators have been used [42–44]. In addition, various populations have been subjects for questionnaire studies to gather user needs and experiences in regard to health or social care information systems. In Finland such investigations have been carried out among social welfare and health care organisations [45–51], citizens [52–55], health care [56–64] and pharmacy [65] professionals.

The study purpose was to document central building blocks of a large-scale nationwide development process that was set up to implement electronic services based on national legislation in Finland. The study objective was to describe implementation and adoption of the national Kanta services in 2010–2017 in Finland by using indicators during follow-up.

## Material and methods

### Study context

Kanta is the name of the Finnish national digital data system services that form a unique service entity based on legislation effective since July 2007. The principal services include My Kanta Pages (since May 2010), Prescription Centre (ePC) (May 2010), Pharmaceutical Database (May 2010), Patient Data Repository (PDR) and Patient Data Management Service (PDMS) (November 2013), Kelain (September 2016), Client Data Archive for Social Welfare Services (CDA) (May 2018) and Kanta Personal Health Record (Kanta PHR) (May 2018) (Figure 1). The Kanta services have been launched in stages. They are built jointly in cooperation with several national actors as well as health and social care service providers, pharmacies and system suppliers.

Records saved in the Kanta services are processed in a secure and reliable manner. The data are processed by pharmacies, health care (and later social welfare) professionals who need to verify their identity to access the Kanta services. All transfer of data between health care services, pharmacies and the Kanta services is encrypted between identified parties. The identity of users of the ePC and the PDR is verified using strong electronic identification.

### Kanta Client Test Service and Certification

The Kanta Client Test Service is meant for manufacturers of patient data and pharmacy data systems, as well as for health care organisations and pharmacies acting as their client testers. Data system manufacturers test the implementation of their systems in the test service against different Kanta services (ePC, PDR, CDA, other) before certification and for subsequent product development.

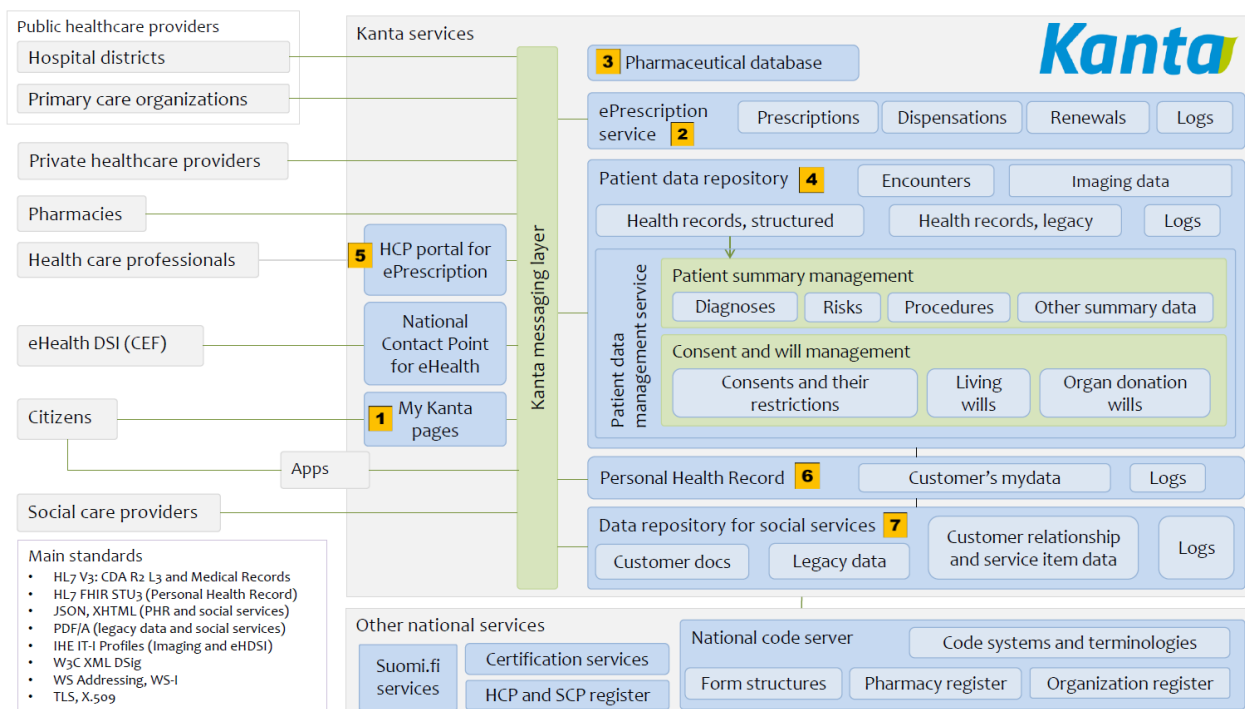


Figure 1. Current architecture of the national Kanta services in Finland (numbers refer to chapters in results).

Certification is a process for verifying that information systems meet the key requirements. Certification applies to information systems related to the Kanta services and to Kanta transmission services. As part of certification, joint testing is carried out with Kela's Kanta services and an information security audit is performed with an information security inspection body accredited by the Finnish Communications Regulatory Authority. As a result of accepted certification, a system or transmission service will receive a mandatory conformity certificate for systems joining the Kanta services. At present, 21 systems have passed joint testing for ePC, 20 systems for PDR and 3 systems for CDA. In addition, one system has passed joint testing for archiving imaging data.

### **National Code Service**

The task of Code Service activities is to ensure the quality of the data structures used nationally in social welfare and health care and to take responsibility of their development and maintenance by the National Institute of Health and Welfare (THL). The data structures include code sets, classifications, form structures, texts, register data as well as vocabularies and terminologies related to them.

The standardized data structures required by the electronic client data systems in social welfare and health care as well as the central code sets of the statistical and register data collection are all published on the code server. The code sets are available on the Code Server free of charge.

### **Methods**

A set of indicators for various monthly follow-up, communication and reporting purposes are shown in Table 1. Monthly time series data are presented in Figures 2 and 3, and annual time series data in Figure 4. The statistical material is based on census, and thus, neither statistical testing nor confidence interval calculations were performed.

Kela Kanta services provided prospectively the indicator material from January 2010 to December 2017. Indicator data in this study were collected from the various Kanta services in Kela and sent to the THL usually within a working week after end of a month. Indicator data were checked and entered to charts and tables, and reported mainly internally for those who needed to know the detailed information.

### **Results**

#### **[1] My Kanta Pages**

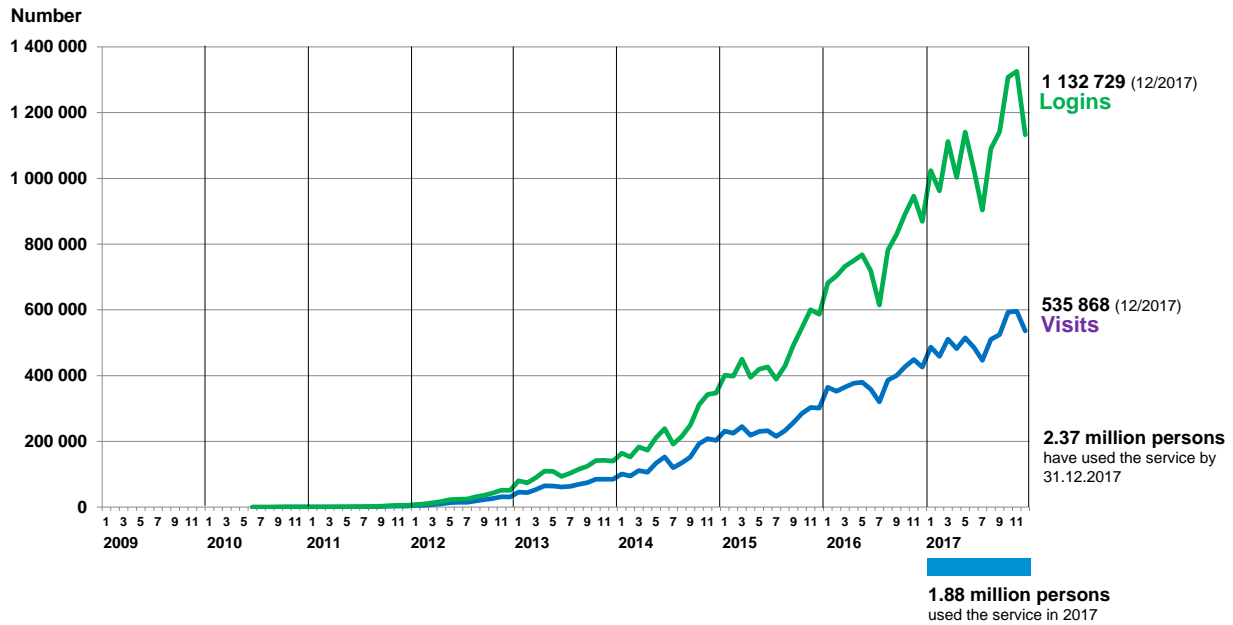
My Kanta Pages is an online service where citizens can browse their own information recorded in the ePC and the PDR regardless of whether they have used public or private health care services. My Kanta Pages does not have a database of its own.

My Kanta Pages can be used by a person who has a Finnish personal identity code. To access My Kanta Pages, a person must select an identification method out of three possibilities: identification using online banking codes, or mobile identification, or certificate card (electronic ID card).

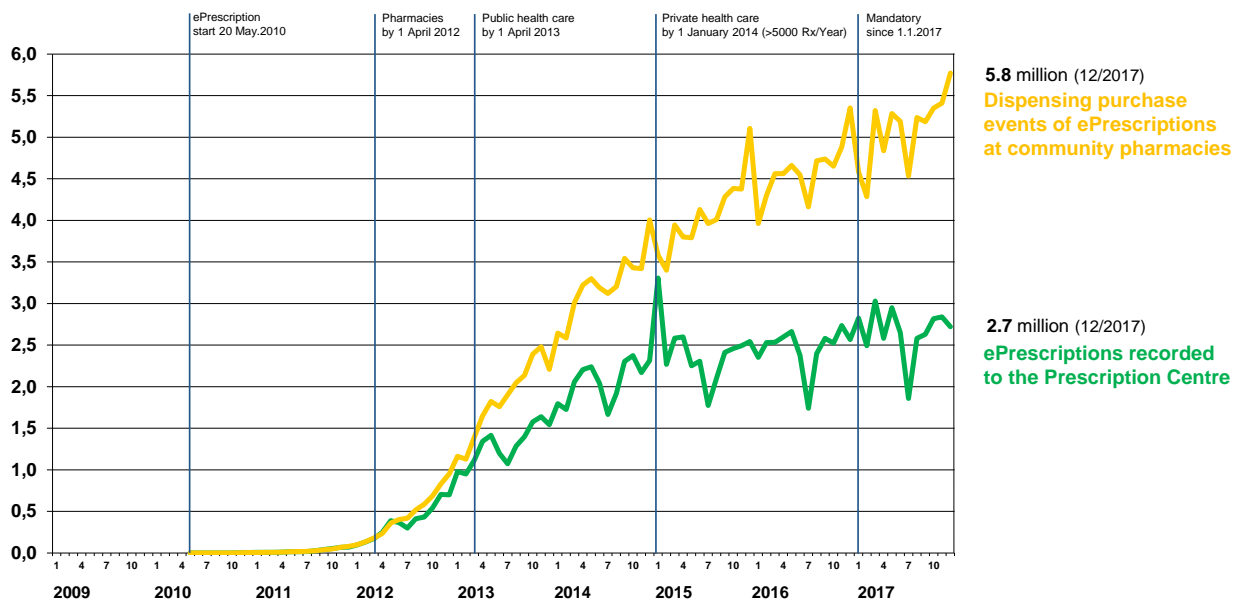
In My Kanta Pages one can monitor the use and submission of one's own information. One can see which organisations have viewed and processed one's electronic prescription (ePrescription) data or where one's patient data has been submitted to. One can also ask health care services who has processed and viewed information concerning oneself. ePrescriptions and medicine purchases can be viewed in My Kanta Pages for 2.5 years from the date the ePrescriptions were issued. However, medical records will be available in the service for as long as the law requires.

**Table 1.** Large scale implementation and adoption of the Finnish national Kanta services: follow-up indicators by year in 2010-2017, cumulative numbers.

Kanta service	Indicator	2010	2011	2012	2013	2014	2015	2016	2017	
<b>My Kanta Pages</b>	Logins	996	26 948	357 918	1 679 131	4 459 608	9 993 554	19 279 211	32 448 040	
	Electronic prescription renewal requests	0	0	0	0	0	101 350	1 659 547	3 956 184	
	Parents or guardians acting on behalf of children <10-yr	0	0	0	0	0	0	138 972	1 059 953	
	Visits by children <18-yr	0	0	0	0	0	0	16 988	22 844	
	Visits	712	17 246	218 152	1 010 694	2 719 763	5 696 021	10 300 844	16 446 265	
	Persons	683	11 866	113 747	368 902	825 507	1 348 587	1 893 891	2 369 521	
<b>Prescription Centre</b>	Electronic prescriptions (ePrescriptions) recorded	11 733	344 044	4 845 793	20 357 844	44 514 696	72 441 457	102 051 632	133 560 573	
	ePrescriptions recorded	11 733	344 044	4 845 793	20 357 844	44 514 696	72 441 457	102 051 632	133 156 984	
	ePrescriptions recorded from EMRs / EHRs	11 733	344 044	4 845 793	20 357 844	44 514 696	72 441 457	102 032 080	132 835 518	
	ePrescriptions recorded from Kelain	0	0	0	0	0	0	19 552	321 466	
	Prescriptions recorded at community pharmacies	0	0	0	0	0	0	0	403 589	
	Paper prescriptions	0	0	0	0	0	0	0	262 413	
	Telephone prescriptions	0	0	0	0	0	0	0	134 742	
	Special permission prescriptions	0	0	0	0	0	0	0	6 434	
	Dispensations (purchase events) at community pharmacies	9 343	358 844	5 714 509	28 269 092	67 190 186	116 219 459	171 335 201	232 746 667	
	Systems approved or certified	3	9	10	13	19	14	20	20	
	EMR / EHR systems	1	5	6	9	16	11	16	16	
	Pharmacy systems	1	3	3	3	3	3	3	3	
	Prescription Centre subscribers	11	639	947	1 018	1 193	1 245	1 772	2 262	
	Subscribers, pharmacies	10	617	818	815	815	815	815	815	
	Subscribers, public health care providers	1	22	129	172	173	176	179	179	
Subscribers, private health care providers	0	0	0	31	205	254	778	1 268		
Kelain subscribers	0	0	0	0	0	0	5 094	15 249		
<b>Patient Data Repository</b>	Patient Data Repository (PDR), recorded / archived documents	0	51 407	116 051	468 468	56 197 475	296 274 994	599 229 063	973 547 042	
	PDR, service encounters	0	19 737	43 703	340 254	35 430 389	169 712 428	335 408 343	519 938 514	
	PDR, persons	0	(nr)	(nr)	(nr)	2 715 316	4 725 516	5 408 652	5 771 969	
	Patient Data Management Service (PDMS), informings	0	0	0	0	2 242 251	3 638 407	4 658 620	5 574 844	
	PDMS, consents	0	0	0	0	693 697	1 556 154	2 288 058	2 877 246	
	PDMS, refusals	0	0	0	0	9 847	23 898	47 018	68 349	
	PDMS, organ donation testaments	0	0	0	0	0	0	149 031	223 998	
	PDMS living wills	0	0	0	0	0	0	33 983	55 898	
	Systems approved / certified	0	1	1	1	6	12	20	20	
	EMR / EHR systems	0	0	0	1	6	8	12	12	
	Patient Data Repository subscribers	0	0	0	1	125	176	256	502	
	PDR subscribers, public health care providers	0	0	0	1	125	176	179	179	
	PDR subscribers, private health care providers	0	0	0	0	0	0	77	323	
	(nr) = no data	Population (at least 18 year old adults)	4 290 980	4 319 501	4 347 944	4 374 590	4 396 261	4 414 248	4 431 392	4 446 869
		Population (all)	5 375 276	5 401 267	5 426 674	5 451 270	5 471 753	5 487 308	5 503 297	5 513 130



**Figure 2.** My Kanta Pages online service: logins and visits by month in 2010–2017 in Finland.



**Figure 3.** ePrescriptions recorded to the national Prescription Centre and dispensing purchase events based on ePrescriptions at the community pharmacies by month in 2010–2017 in Finland.

Altogether 2.37 million persons had used My Kanta Pages by 31st December 2017 (Figure 2, Table 1). The proportion of use is 43% of the total population in Finland but adults is actually the reference population

(53% of the adults) since under 18-year-old children have used the service only 23,000 times. My Kanta Pages has been used 16.45 million times (32.45 million logins). The number of visits and logins increased in an

exponential fashion from 2010 to 2017, and use of the service was characteristically lower in the summer months. In 2017, My Kanta Pages was used by 1.88 million persons 6.15 million times (13.17 million logins).

One can send ePrescription renewal requests via My Kanta Pages (service available since November 2015) only for ePrescriptions that have already been used for buying medicine. If the ePrescription is valid for two years, it can be renewed for 28 months from the issue date. Other ePrescriptions can be renewed for 16 months. Altogether, 3.96 million renewal requests were sent via My Kanta Pages by 31st December 2017 (Table 1). In 2017, there were 2.30 million renewal requests.

In My Kanta Pages, parents and guardians can view the medical records of children under 10 years of age (data born since August 2016, and service available since October 2016). As before, parents and guardians of children over the age of 10 can ask their health care services or pharmacy for information on their children's health or prescriptions. Parents or guardians used the service 1.06 million times by 31st December 2017 (0.92 million times in 2017) (Table 1).

Also children under 18 years of age can view their medical records (data born since August 2016, and service available since October 2016). In total, 22,844 visits were recorded by 31st December 2017 (Table 1).

The Patient Data Management Service (PDMS) has been implemented as part of the PDR. Information about the fact that the patient has been informed of the nationwide data system services is recorded in the PDMS. A person can read the information and give one's consent to view the data so that the people who are treating one can view his/her medical records. In My Kanta Pages, a person can also give one's refusal to share one's ePrescription and patient data. These settings can be changed at a later date if one so wish. By 31st December 2017, PDMS had records of 5.57 million informings, 2.88 million consents and 68,349 refusals (Table 1).

One can set up a living will and/or organ donation testament in My Kanta Pages. In a living will, one can ex-

press wishes and give instructions about one's health care, and it is complied with when one is no longer able to express wishes. With the organ donation testament one can declare whether or not one agree to donate one's organs or tissues after one's death. The information is passed from My Kanta Pages to the health care services. By 31st December 2017, PDMS had records of 223,998 organ donation testaments and 55,896 living wills (Table 1).

## **[2] Prescription Centre**

All prescriptions are issued and dispensed electronically via the Kanta services since January 2017. Data on paper or telephone prescriptions are recorded to the ePC at community pharmacies. Once an ePrescription is issued, one will be given patient instructions as a paper copy, showing the names and dosage instructions of the medicines. The ePrescription is valid for two years if the validity period is not restricted. An ePrescription for central nervous system drugs (CNS) and narcotic medications is valid for a maximum of one year. ePrescriptions are issued and signed electronically and then saved in the ePC. The ePC includes records of ePrescriptions and medication dispensing at community pharmacies.

The issuer of an ePrescription can verify the patient's ePrescriptions and dispensed medications. The patient is given a set of patient instructions, which includes key information about the medicines prescribed electronically at any time. In the pharmacy, a pharmacist retrieves the ePrescription data from the ePC on the basis of the patient's personal details or the identifier on the patient instructions. They then save the dispensing data of the medication in the ePC. The dispensing data are also printed out and enclosed with the dose instructions of the medicine package.

Physicians can view the ePrescriptions they have issued themselves. A pharmacy can view the ePrescriptions when medicines are being collected. A physician or nurse treating one can view one's ePrescriptions if one gives a verbal consent to it. Without one's consent, a physician may view one's data only in an emergency.



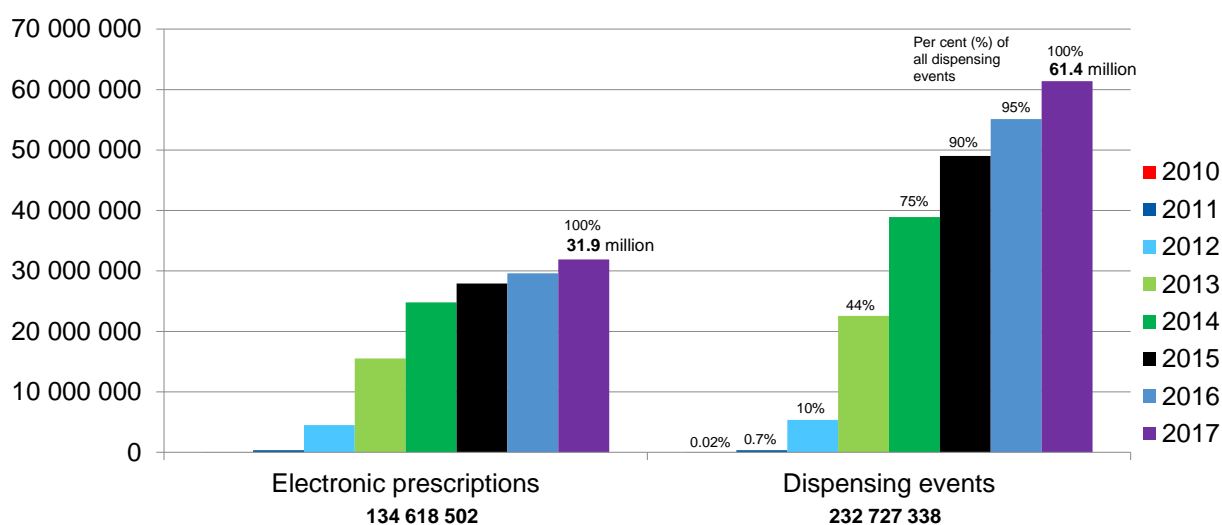
However, an important exception exists: if a physician prescribes CNS or narcotic medicines, they can view the ePrescriptions of the medicines in question. In My Kanta Pages, one can refuse permission for other physicians or pharmacies to view one’s ePrescription data. In this case one will only be able to get one’s medication from the community pharmacy by showing the patient instructions or a printed summary of one’s ePrescriptions.

The first ePrescription was issued, dispensed and recorded in the ePC in May 2010. Large-scale ePC subscribing deployment in community pharmacies started in September 2010 and 98% of the pharmacies had subscribed ePC by the 31st March 2012 deadline set in the legislation. Large-scale ePC subscribing deployment in public health care started in May 2011 and 95% of the 172 public health care providers had subscribed ePC by the 31st March 2013 deadline. Private health care providers were due to subscribe ePC in two phases: providers prescribing more than 5,000 prescriptions annually were due to subscribe ePC by the 31st March 2014 whereas the rest by 31st December 2016. The first private health care provider prescribed ePC in April 2013. All pharmacies, public health care providers and 1,268 private health care providers had subscribed ePC by 31st December 2017 (Table 1).

The number of ePrescriptions and medicine dispensing (purchase) events by month are presented in Figure 3 and Table 1. By 31st December 2017, altogether 133.56 million ePrescriptions were recorded in the ePC, and community pharmacies had dispensed 232.75 million medicine purchases based on ePC data (Figure 4, Table 1). In Finland, ePrescription became mandatory in January 2017 (100% coverage). In 2017, altogether 31.91 million new ePrescriptions were recorded, out of which 31.19 million (97.74%) were from EHRs and 0.32 million (1.01%) from Kelain. Community pharmacies recorded 0.26 million (0.82%) paper and 0.13 million (0.42%) telephone prescriptions to ePC.

**[3] Pharmaceutical Database**

The Pharmaceutical Database serves especially health care professionals. All health care units and pharmacies that have subscribed ePC use data based on the Pharmaceutical Database. The database includes the necessary and up-to-date information about medicines, their price and reimbursement status, about mutually substitutable medicinal products, and about reimbursable basic topical ointments and clinical nutritional preparations with respect to prescribing and dispensing of medicines. The database is updated twice a month.



**Figure 4.** Annual numbers of ePrescriptions recorded to the national Prescription Centre and dispensing purchase events based on ePrescriptions at the community pharmacies in 2010–2017 in Finland.



#### **[4] Patient Data Repository**

Information about one's medical care and test results is recorded in the PDR. Patient data in the PDR can be used by the health care provider that recorded the data. One's consent is needed for sharing the data with other health care providers. The consent is valid until further notice, and it concerns all patient data in the system and data recorded there at a later date. However, one can limit the use of one's data by issuing a refusal. One can cancel consent or refusal in the health care services or in My Kanta Pages. The PDR enables transmission of information between health care organisations, offering centralized archiving and long-term storage of electronic patient data.

The PDR was subscribed the first time in November 2013. Large-scale PDR subscribing deployment in public health care started in March 2014. In total, 57 (33%) public health care providers had subscribed PDR by the 31st August 2014 deadline set in the legislation, covering 29% of the population. The last public health care provider subscribed PDR in December 2015. The first private health care provider subscribed PDR in February 2016. All public and 363 private health care providers had subscribed PDR by 31st December 2017. Also oral health care data are recorded in PDR since May 2017 and one can view one's own data in My Kanta Pages. The PDR is used in mainland Finland but not in Åland Islands.

In total, there were 973.55 million patient documents from 519.94 million service encounters of 5.77 million persons in the PDR by 31st December 2017 (Table 1). The number of new documents in 2017 was 374.32 million (184.53 million encounters).

It is possible to submit health care certificates (such as medical certificate A for short-term sick leave) electronically to Kela from the surgery. Medical certificates are recorded in the PDR and can be viewed online at My Kanta Pages. Some health care units are using the service of archiving of old patient data (data born before subscribing the PDR), which facilitates data archiving that is compulsory by law. These data cannot be viewed in My Kanta Pages.

The national archive of imaging data in the PDR will be available in late 2018. Imaging materials such as X-ray and magnetic resonance images are archived in the service. The national archive of imaging data is meant for the use of health care professionals.

#### **[5] Kelain**

Kelain is an online service particularly suited for private use by physicians and dentists. Currently Kelain can be used for issuing and renewing ePrescriptions. There were 15,249 Kelain subscribers at 31st December 2017, and they had issued 341,018 ePrescriptions for 16,785 persons (321,466 ePrescriptions in 2017).

#### **[6] My Kanta Pages Personal Health Record (Kanta PHR)**

With My Kanta Pages Personal Health Record (Kanta PHR) one can monitor wellbeing and save health data in the service. The Kanta PHR is used with a wellbeing application (a mobile device such as a smartphone or a tablet, or a program or service used in a computer) approved by the Kanta services. In the future, data in Kanta PHR can also be utilized by health care professionals in support of one's care if one gives consent to it.

#### **[7] Client Data Archive for Social Welfare Services**

The first social welfare service providers are already recording their clients' documents in the Client Data Archive (CDA) for Social Welfare Services. From autumn 2018, other public and private social welfare service providers can also start using the CDA. At present, there are client documents of 10,817 persons in the CDA recorded by 2 data systems. A major, partially state-subsidized nationwide education program (focus on recording) was launched to support CDA implementation and adoption. The program has already produced 1,700 recording facilitators, who have coached 16,200 (19% in public and 2% in private social care) social care professionals. In the future, one will also be able to

view the social welfare data concerning oneself in My Kanta Pages (service available in 2020 at the earliest).

### ***Patient Care Record of Out-of-Hospital Emergency Medical Services***

The patient care record (ePCR) of out-of-hospital emergency medical services (EMS) introduces a new user group to Kanta services. The objective is to record the ePCR as part of the patient records in the Kanta services. An ePCR is created, for example, in the ambulance.

### **Discussion**

In Finland, implementation and adoption of the national Kanta services' second phase services was carried out in step-by-step series of service launches since 2010. The Kanta services currently include integrated, interoperable health information from EMR, EHR, PHR and social welfare sources that can benefit patients, care providers and policy makers.

In implementation and adoption design of information systems, a traditional choice would be between a top-down and a bottom-up approach. However, Finland applied the middle-out design approach [21]. We have asked for advice and identified needs of citizens, health and social care providers, the IT industry and government, and created a common set of technical goals and underpinning standards that can sit between them. For follow-up purposes of the implementation, roll-out and adoption, we applied a set of indicators [42–44].

In Finland, the Ministry of Social Affairs and Health is in a strategic role to steer the Kanta services, and carried out the first phase implementation activities since July 2007. For implementation and adoption of the services, a new role of a national operational coordination function with appropriate legal mandate was established by law to the National Institute for Health and Welfare (THL) in January 2011. The coordinating function has close working relationships and cooperation with several national actors as well as health and social care service providers, pharmacies and system suppliers. The

coordinating function works closely with Kela Kanta services – that run the integrated services – in development teams, groups and steering boards for operative decision making to construct infrastructure, develop services and carry out joint efforts to support citizens, service subscribers and system suppliers. Implementation and adoption support has included help desks, educative and guiding videos, written guidelines and presentations, newsletters, websites, national conferences twice a year, other seminars and meetings for focus subject matters, and especially, dedicated regional personnel in university hospital districts for regional support. The coordinating function has also granted state subsidies to provide partial funding for breakthrough pilots.

Finland's current state of Kanta services' adoption and implementation has not been possible without provision of adequate funding. Our challenges have been around the socio-technical and contextual domains not to forget communication and from time to time wide media coverage [40,41]. Basing on the Finnish experience, large scale national implementation and adoption of information systems has been complex, multi-dimensional and influenced by a variety of factors at individual and organizational levels in complex health and social care settings, indeed [3,21,25,31–33,35,36]. We appreciate the published lessons learned in the literature.

Major re-structuring of health and/or social services may not be possible without a pervasive information infrastructure [21]. The Kanta services are already a significant part of the social welfare and health care services in Finland. As a result of the reform in social welfare and health care services, it must be possible to share information between organisations, and the Kanta services enable it throughout the country. The reform also brings something new to the Kanta services. The most significant change is related to the citizens' freedom to choose their own social and health care centre. In the future, this choice can be made via My Kanta Pages.

Adoption and implementation is not the same thing: just because an information system has been adopted,

it does not necessarily mean it is being used (or used in the way it was intended). In Finland, large scale technology reports covering public and private care provider organisations have been published in health care regularly since 2003 [45–49] and in social care in 2002, 2014 and 2017 [50–52]. In addition, personal user needs and experiences in regard to health or social care information systems have been subjects for investigations among citizens [53–56], physicians [57–63], dentists [64], nurses [65] and pharmacists [66] in Finland. These reports and their results have provided us with additional background information in planning, feedback in operating and issues for further development of the Kanta services.

If implementation was defined as the process of planning, testing, adopting, and integrating information systems so that the technology becomes routinely used in the organization, we have completed the second phase of the implementation and adoption of the national Kanta services in Finland in 2017. The countries whose shared record systems are the most advanced have populations of around 5 million, though it is not known whether this figure is a critical ceiling or a coincidence [43].

### Acknowledgments

Updated information about the national Kanta services are provided on web pages at Kela Kanta services (<https://www.kanta.fi/en/>). Additional information about health care and social welfare information management is provided on web pages at the THL (<https://thl.fi/en/web/information-management-in-social-welfare-and-health-care>).

### Conflict of interest statement

The author has worked at the National Institute for Health and Welfare (THL) since August 2010 and was the director of operational management of the national coordinating function at the THL in 2011–2017.

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