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# Creating online personal medical accounts: Recent experience in two developed countries

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ABSTRACT

*Background:* Online personal medical accounts are increasingly viewed as a useful mechanism to both inform and educate patients and citizens about their individual health condition. A number of countries have announced major national projects to put this type of information system in place.
*Methods:* This article adopts a comparative health systems approach to examine the experience of two smaller developed countries – Taiwan and Estonia – that now have universal national medical account systems in current service. The comparison focuses on the structural similarities and differences of both core characteristics of these two health systems and of their specific personal medical account arrangements.
*Results:* While Taiwan has multiple separated systems with voluntary options for patients, Estonia has a single integrated one which is mandatory for all citizens. Further, the Estonian system is more advanced in providing the ability to book or cancel medical appointments. Both systems directly control patients for system management purposes, allow patients access to prior medical records, and reorient the focus of health management from curative toward preventive care. A centralized and technically competent government agency and the political willingness of citizens to grant information-gathering powers to it appear to be essential elements in the successful implementation of these systems. Concerns about individual privacy protection and citizens' ability to decide whether to participate are also discussed.
*Conclusion:* **A** number of core issues regarding the technical introduction and political acceptability of personal medical accounts remain unresolved and will require considerable attention in the future.


## Introduction

One of the more complex aspects of the ongoing information revolution in health care systems has been the development of online individual patient medical accounts. Different countries have set about simultaneously tracking and informing patients about their medical status and progress in quite different ways [1,2]. How best to balance the tightly inter-related but conflicting interests of government, medical professionals, patients and individual citizens concerning access to and use of electronic medical information files has become the subject of considerable debate [3–5]. Studies have shown that personal medical accounts could be effective in helping patients as well as physicians manage the medical records [6] and improving patients' health prompting behaviors [7]. Personal medical accounts along with other electronically based patient assistance systems also have potential in improving the quality of care and overall efficiency of a health system [8,9].

Several large developed countries like the United Kingdom and the United States have announced national electronic records projects – the precursors to establishing personal medical accounts – only to have them subsequently collapse in technical and organizational disarray [10,11]. Other countries have either initiated national mandatory personal account systems (Australia in 2018) or taken major steps toward their initiation (Singapore in 2018) only to encounter stiff citizen resistance (Australia) or, in Singapore's case, a July 2018 hacking of 1.5 million medical record accounts that shut down further project implementation [12,13].

In considerable contrast to those continuing difficulties, this article examines the relatively successful approaches to personal medical accounts taken by two smaller developed countries: Taiwan and Estonia. Despite their different cultural background and widely separated geographical location, these two countries share somewhat similar histories over the past half century. Politically, following a long period of authoritarian governance after World War II, they managed to democratize during the late 1980s and early 1990s. Demographically, they both have a major ethnic/national identity split (Estonian vs. Russian and Taiwanese vs. Chinese). Economically, they have recently become higher income

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developed countries with vigorous growth and a strong focus on the technology industry.

In terms of the development of their health systems, both Taiwan and Estonia have implemented social health insurance (SHI) systems that have a single-payer government-based insurer and are universal for all citizens. Moreover, both Taiwan and also Estonia – quite unlike most other European SHI systems but similar to other Asian health systems – require users to make relatively high co-payments and other out-of-pocket expenditures (22% of total health spending in Estonia and 34% in Taiwan in 2016) [14,15]. These institutional similarities make for a good comparison case regarding personal medical accounts. The two countries' differing design and implementation strategies illustrate alternative dimensions of how these accounts can be structured.

The purpose of this article is twofold. Using a comparative policy approach and literature review from the field of political science, the article first summarizes the current status of the personal medical account systems in the two countries, and seeks to identify parallel policy elements essential for successful implementation of such systems. Second, the article draws lessons from the experiences of these two countries that might be useful for policy makers in other countries also considering implementing a national personal medical account system. The materials analyzed in making these two assessments include academic literature, governmental reports, press releases and statistics, and legal documents. Subsequently, senior participants involved in the design and implementation of each country's system have independently confirmed the validity of the information in these written sources.

## Comparative analytic framework

The structure and operation of health system financing and provider institutions, the internal operational mechanisms, and the governmental regulatory frameworks that together compose the main building blocks of modern health care systems vary considerably across countries. These variations reflect a range of structural differences in a country's context (geographical, historical, economic, social and political) as well as its dominant national culture (prioritized norms and values) [16,17]. A further factor affecting policy-related reforms in the health sector is the current rapidly changing attitude in developed countries to the unauthorized access to and/or use of personal data, as illustrated by the introduction in May 2018 in the European Union of the General Data Protection Regulation [18,19]. The issue of cyber security has become even more acute in Singapore, where large-scale theft of electronic medical records from the country's largest health provider system in mid-2018 has led to an extended pause to development of its national medical records project due to the issue of on-line security [13].

This mix of policy predispositions toward health care leads in turn to varying approaches to the design and adoption of new innovations, including new information systems such as individual patient accounts. The configuration and fit of these systems will vary substantially among countries, tied to both idiosyncratic institutional structure as well as to specific context-and culture-tied citizen and patient expectations. In addition, as a further overlay affecting the structure and outcome of these personal medical account systems, national policymaking will need to accommodate the complex technical issues involved in adapting computer networks to each country's changing political and social dynamics in the formation and implementation of its information systems [20].

In the comparison made below, both structural similarities and differences between the two selected countries are noted. While these parallels cannot of course predict the likelihood of success in introducing personal medical records in other countries, they can provide a useful frame of reference for internal analysis and potential future development.

## Personal medical accounts in Taiwan

### *Brief country background*

Taiwan has 23 million inhabitants located 110 miles off the Eastern coast of China. After the era of Japanese control ended in 1945, Taiwan moved through an authoritarian period into an era of democratization in the late 1980s. Taiwan's National Health Insurance (NHI) system was established in 1995 and now covers 99% of citizens as well as legal residents. Participation is compulsory, and participants have to contribute a 4.69% (since 2016) payroll premium. While the NHI provides public funding, most health care providers, including primary health care and hospitals, are privately owned not-for-profit in structure. Only 10.4% of the hospital beds belong to public hospitals [21]. Care providers contract with the NHI to provide services as defined by a fee schedule designated by the insurer, the National Health Insurance Administration (NHIA). The total health expenditure accounted for 6.34% of GDP in 2016 [14].

### *National Health Insurance Card: clinical information and provider payment*

As required by Taiwan's *National Health Insurance Act of 1995*, every citizen and legal resident is enrolled in the NHI and has a National Health Insurance Card (NHI Card) issued by the NHIA. It is not merely a legal identification of the NHI insured, but also has essential functions in terms of insurance administration.

Whenever one seeks services at a contracted medical institute (e.g. a primary health care clinic or a hospital), the first thing one will do is to present one's NHI Card to the institute staff. By swiping the NHI Card, the institute has access to the patient's insurance status as well as other related information (e.g. if the insured has registered as organ donor, if the insured is low-income household hence is qualified to a co-payment waiver, etc.). When a physician sees a patient, the patient's most recent six treatments recorded in the NHI Card can be accessed by the physician. Hence, the physician will know what conditions the patient has had recently and what drugs have been prescribed. This information can help the physician make better clinical decisions with regard to the patient's overall health condition and appropriate treatment plan.

After the physician has determined the treatment and drugs that the patient needs, these medical orders are recorded in the NHI Card and are uploaded to the mainframe in the NHIA building on a daily basis. Each month, the institute will file reimbursement claims to the NHIA according to the patient's treatment records in the NHI Card, and the NHIA could cross-check these claims with the information uploaded previously when needed.

The first version of the NHI Card was a paper card. There were six spaces at the back of the card and the medical institutes would stamp on one space each time a patient made a visit. In 2004, the second edition NHI Card was put in place [22]. The NHI Card became an IC card and is connected with the NHIA through its VPN system. The filing of reimbursement claims remained parallel paper-based and electronic-based for several years, but were now mostly digitalized. Throughout the process small primary health care clinics resisted the most, because they thought that introducing/investing in an IT system for their claims administration was a waste of money, an unnecessary expense. Hospitals, on the other hand, adopted the electronic system much earlier.

The NHIA updates the VPN system regularly to satisfy internet security concerns. Some medical institutes had complained about the connecting time from the institute side to the VPN

system (recall that the medical orders given by the physicians will be uploaded to the NHIA mainframe); however, this was largely due to hardware limitations. Also some physicians experienced technostress due to the use of electronic medical records [23].

*Patient issues*

Patients and citizens concerned about privacy have the right to set up their own password for their personal NHI account. The medical institutes' staffs can still access the patients' basic information for the purpose of checking insurance status and filing reimbursement claims, but physicians will need the patients' permission (typing the password) to access their previous health records. This mechanism gives the patients more privacy protection. However, the default setting is that there is no password barrier, thus entrusting physicians by granting them full access to health records.

This issue is particularly relevant in the cases of HIV/AIDS positive patients. On one hand, studies worldwide [24–26] and in Taiwan [27,28] have reported that these patients face unwelcoming attitudes when visiting physicians. They may be reluctant to disclose their infected status to health care providers if the purposes of their visits are not related to HIV/AIDS. On the other hand, health professionals argue that it is necessary for patients to disclose their HIV/AIDS positive status, since the health professionals could then treat them with the best clinical decisions, and, importantly, the health professionals could take necessary precautions to avoid their own infection [29,30]. Under current regulations, this information is not noted on the patients' NHI Card.

The default setting of complete provider access can also be defended for frail elderly who are not able to interact regularly with their medical record accounts, but who, conversely, typically need more and more extensive clinical and non-clinical services. However there are ethical issues raised by both these cases [31,32].

*Medical personnel ID Card*

An integral part of Taiwan's personal medical account system is that physicians must be officially credentialed in order to have access to clinical records. Before a physician can record a medical order into a patient's NHI account, that physician must first insert his/her own medical personnel ID Card. This unique medical personal card is issued by the Ministry of Health and Welfare (MOHW) to each registered provider, authorizing patient medical orders to be recorded into their NHI Card. This additional credentialing process is to ensure that all treatments and drug prescriptions are provided by properly credentialed medical professionals, thereby serving a type of basic quality control function. More generally, all medical personnel practicing in Taiwan are required to register for and obtain a medical personnel ID Card, whether he/she works for a NHI-contracted medical institute or not. This requirement started in 2003, administered by the Healthcare Certification Authority (HCA), under the supervision of MOHW [33].

*The NHI information bank: My Health Bank and NHI Medi-Cloud System*

Besides the NHI Card, Taiwan also has developed a more extensive "citizen information bank." This information bank is also managed by the NHIA, but contains much more information than what is recorded on the NHI Card. In addition to claims data, the NHIA encourages medical institutes to upload further detailed information to the NHIA mainframe. Starting in 2014, a special payment project named "Project Encouraging Contracted Medical Care Institutions Using National Health Insurance Medi-Cloud System" has been implemented by the NHIA to provide financial incentives for those medical institutes that voluntarily upload information additional to the insurance claims. There are two interfaces that use this database to provide services. On the patient/citizen side, it is called *My Health Bank*, while on the care provider side, it is called *NHI Medi-Cloud System*. Both of these broader access systems retrieve data directly from the NHIA mainframe, however, they target different user populations.

My Health Bank is a personalized online service provided by the NHIA since 2014. The idea of My Health Bank is derived from online deposit records for bank accounts. Much like a citizen managing his/her financial status with a deposit record, the idea is that the citizen can also manage his/her health status with a similar health record. Once an insured registers on the designated website, that individual can log into the system and access his/her own records. The officially stated function of My Health Bank is to narrow "the information asymmetry between doctor and patient" and make "medical care safer, better and more effective" [34].

Three types of individual citizen information are available on the website. **First**, it provides the insured's most recent three years health records, including records of primary health care, inpatient, outpatient, dentistry, and Chinese traditional medicine services, allergy history, examination results, medical imaging results (e.g. X-rays, CT scans, MRIs), pathological results, adult regular health examination results, and vaccinations. In effect, information about every service covered by the NHI plus public health services delivered by NHI-contracted medical institutes is available on an insured's My Health Bank account. **Second**, My Health Bank provides information with regard to the insured's insurance status, including whether one's NHI Card is active or temporarily suspended for some reasons, and premium payment records (receipts showing how much the patient has paid and the estimation of how much the patient will have to pay). All the information mentioned can be downloaded to the user's own electronic device. **Third**, in an updated version released in July 2016, My Health Bank includes synergistic information such as personal health records statistics, data visualization and personalized health management information, including timely alerts for regular health examinations, health education information, and disease prognosis and risk assessment information, according to the patient's health status [35]. The idea here is to enhance each user's efficacy in managing his/her health status.

Besides the website version, NHIA also provides an app for My Health Bank service. The app is available for both iOS and Android systems. Both website and app versions function across national borders. As long as the insured has registered on the NHI website, he/she can access his/her My Health Bank account anywhere in the world with a proper internet connection.

The data that can be retrieved on NHI Medi-Cloud System is similar to that on My Health Bank. The difference is that only medical professionals with a valid medical personnel ID Card can access NHI Medi-Cloud System. The idea is to provide patients' visits and records information to physicians to enhance care quality and overall efficiency by avoiding repeated prescriptions and examinations.

*Operational issues*

My Health Bank is a rather new innovation. Participation in the system is voluntary. The NHIA has thus far released only limited utilization data. According to a recent report, as of December 31, 2017, about 590,000 people have registered an account on My Health Bank [36]. This number is only about 2.7% of the total population of Taiwan, suggesting that this IT advancement has not yet been accepted, or perhaps not become widely known, by the general public. The system's potential impact on health education, per-

sonal health management, and quality improvement are thus not yet known.

*National Electronic Medical Record Exchange Center (EEC)*

The National Electronic Medical Record Exchange Center (EEC) of MOHW is the office in charge of the electronic medical record project. Initiated in 2009, the project recruits voluntarily participating hospitals to store and share patients' medical records. Up till the end of 2015, 81.9% ($n = 406/496$) of the hospitals in Taiwan participate in the project [37]. The electronic medical records will be stored for six months [38]. Despite its shorter storage period, different from the insurance information recorded in the NHIA mainframe (My Health Bank and NHI Medi-Cloud System), medical records in EEC are more substantive, including five types of records: outpatient medical record, outpatient drug record, blood test result, medical imaging result, and discharge summary. The purpose of EEC is to avoid repeated prescriptions, improve coordination between hospitals, and enhance overall system efficiency and care quality.

## Personal medical accounts in Estonia

*Brief country background*

Estonia became self-governing once again in 1991, having since 1940 been annexed as one of Fifteen Republics of the Soviet Union. In 2005 Estonia joined the European Union. It has a 2017 population of 1.3 million, split between 70% Estonian, 25% Russian, 2% Ukrainian and 1% Belarusian – the Russian population consisting largely of settlers sent by Soviet authorities predominantly to the Eastern part of Estonia [39] in the 1940s, 1950s and 1970s. Employers pay a 13% of salary payroll tax for each employee to the compulsory national social health insurance fund. 6.7% of GDP was spent on health care services in 2016 [15]. Hospitals are organized as publicly owned private hospitals (self-governing trusts, supervised by municipal governments) [40]. Electronic mechanisms are utilized widely for many activities in Estonia: 31% of votes were cast over the internet (2014); 96% of income tax declarations were filed electronically; and 90% of all fishing licenses were given out on-line [41].

*Estonia's country-wide patient portal*

The Estonian Health Information System (HIS) encompasses the entire country, registering virtually all residents' health history from birth to death [41]. The national HIS system gives all Estonian citizens a personal patient medical information account, which can be accessed either with an ID-card or a Mobile-ID anywhere in the world that has internet access. These individual patient accounts are under the individual's password control. The individual has the ability to close all access to his/her data, to mask access to sensitive data, and/or to restrict access to designated parts of his/her medical information to only selected medical personnel [41].

These individual medical records were set up under the *Health Services Organization Act* passed by the Estonian national parliament in 2008. This Act requires all healthcare providers to send certain health data to the national health insurance system. The set of documents is defined by the law, and access to those documents is limited only to licensed medical professionals. Included in the individual medical record are documents for hospitals, general practitioners, pharmacists, school nurses, and emergency medical services. The law also establishes the requirements for these records for both patients and medical staff, including setting up document standards. Specific reporting requirements for hospital inpatient care are tied to the attending doctor, a concept that has only recently been introduced in Estonian hospitals [41,42]. The Estonian HIS also provides a drug-drug interaction service and work incapacity certification [41].

The individual has the legal right to view all of his/her medical documents generated by the Estonian health system. This includes ambulatory case summaries, the results of exams (radiology, endoscopy, etc.), and ongoing treatment logs. In addition, the individual also can provide informed consent for organ donation and blood transfusion, name trustees entitled to view one's medical records, and declare specific treatment intentions and preferences. Further, procedurally, the patient portal account allows the individual to book, re-schedule, and cancel medical appointments [42].

Access to the health information system is secured by using an electronic identity card (ID-card) issued by the national government. This ID-card is a compulsory and primary document for the purposes of personal identification in Estonia. All attempts to view health care data are monitored both by patients and the Estonian E-health Foundation. Should there be suspicions of unlawful access, the necessary actions to shut down the penetrated records are taken by the health information system monitors "immediately" [42].

As of 2012, more than 90% of all hospital discharge letters are digital, and e-prescriptions also covered 98% of the total [41]. However while a high proportion of the population have documents on file in their accounts, only some 17% of the Estonian population accessed their personal file in 2015 [41]. One important statistic is that 100% of SHI claims were made digitally.

Estonia has experienced a number of standard start-up issues common to the introduction of many electronic records system:

- Physicians were initially somewhat reluctant to provide full accounts, or to use the standard language to describe conditions recommended by the HIS system.
- Individuals were slow to begin to access and utilize their health information accounts.
- Information security issues were a concern.
- Some individuals had inadequate computer skills or older computer systems.

Most of these initial issues appear to have been resolved and/or dissipated after several years in operation. The only issue that appears to remain a constant throughout has been patient concern for the integrity and security of their information [41].

## Discussion: trends and policy implications

*Differences and similarities of IT structures in the two countries*

Similarities and differences in the structure of personal medical accounts in Taiwan and Estonia can serve as useful markers for the current state of patient information access in developed countries with social health insurance systems. This comparison can also be valuable in pinpointing as yet unresolved issues in what continues to be a politically sensitive as well as an important financial and patient self-management-focused IT policy arena (Table 1).

*Similarities*

Similarities are quite noticeable in these two social health insurance systems, despite different histories and structures, in differently configured health systems, and different social and normative cultures.

First, the core function of both systems of personal health accounts is to directly control patients for health system management purposes. Both systems directly determine (a) patient access to new medical services, (b) physician and/or hospital access to patient histories, and (c) payment for delivered patient services that

**Table 1**
The health systems and the personal medical accounts in Taiwan and Estonia: a comparative summary.

| | Estonia | Taiwan |
|---|---|---|
| **Basic Features of Health System** | | |
| Share of total health expenditure in GDP | 6.68% (2016) | 6.34% (2016) |
| Highest Administration | Ministry of Social Affairs | Ministry of Health and Welfare |
| Main structure | Social health insurance (1992) | Social health insurance (1995) |
| Legal Basis | Health Insurance Act of 1991<br>Estonia Health Insurance Fund Act of 2001 | National Health Insurance Act of 1994 |
| Source of financing (%) | Social health insurance 62%<br>Out-of-Pocket 23%<br>Other 15%<br>(2015) | Social health insurance 52.8%<br>Out-of-Pocket 34%<br>Other 13.2%<br>(2016) |
| Insurer | Single-payer public independent body: Estonia Health Insurance Fund (EHIF) in effect in 2001 (integrated 17 Regional Sickness Funds and one Central Sickness Fund) | Single-payer administrative agency: National Health Insurance Administration (NHIA) in effect in 1995 (integrated 7 occupational-based SHIs) |
| Contribution | Earmarked social tax | Payroll premium<br>Supplementary premium |
| Budget decision | EHIP Supervisory Board | NHIA Committee |
| Benefit package and Prices | Universally defined by the List of Health Services, negotiated by EHIP Supervisory Board, approved by the Ministry of Social Affairs | Universally defined by two fee schedules (Fee Schedule and Reference List for Medical Services and Drug Dispensing and Fee Schedule), negotiated by NHIA Committee, approved by the Ministry of Health and Welfare |
| Payment Methods | PHC: age-adjusted capitation, FFS for selected areas, basic allowances, and a quality bonus scheme (QBS)<br>Hospital<br>Inpatient: DRGs and FFS<br>Outpatient: FFS | PHC: FFS<br>Hospital<br>Inpatient: DRGs and FFS<br>Outpatient: FFS<br>Global budget in every sector |
| Referral System | Gatekeeper: Family physicians<br>Some of the specialties and emergency services do not require referrals | Differentiated by co-payment rate |
| **Personal Medical Account** | | |
| ***Similarities*** | | |
| The main purpose of PMA | To directly control patients for health system management purposes, functions including:<br>-patient access to new medical services<br>-physician and/or hospital access to patient histories<br>-payment for delivered patient services that are to be sent to providers. | |
| Individuals autonomy | Individuals have access to their personal account<br>Individuals have the options to set barriers for care providers to access their account | |
| Care philosophy | Re-focusing from medically-oriented curative to more health-oriented preventive individual behavior | |
| ***Differences*** | | |
| System structure | One national e-health/ID-card system | Three sub-systems: the NHI system (including the NHI Card and the Information Bank), the EEC, and the ancillary Medical Personnel ID system |
| Individual participation | Mandatory for HIS | Mandatory for the NHI Card<br>Voluntary for My Health Bank |
| Horizontal coordination between government agencies | The ID card is used as a national identification across several public services | The use of the NHI Card is limited for insurance administration (available for filing income tax since 2016) |
| Patient/customer use | Patients/customers can book, re-schedule or cancel medical appointments by using the ID card | The NHI Card does not have this function. Appointments are to be made directly at the care provider side |

*Source:* This table is prepared by the authors. Information and data are retrieved from [14,15,39].

are to be sent to providers. These all are, of course, health-system-essential operational functions, not patient service or responsiveness issues. As an evaluative study shows, Taiwan's system performs well on collecting information for administrative use and research database and on minimizing administrative costs, while performing relatively poorly on providing information to the public and opening opportunities for public participation in governance [43]. This set of outcomes clearly highlights the system's major focus.

Second, both systems allow individuals access to at least part of their prior medical records, anywhere in their home countries and also globally via the internet. In Taiwan, the NHI system provides the access to the past six visits recorded in NHI Card and the past three years medical visit history including radiological and laboratory reports recorded in My Health Bank account. In Estonia, as of 2016 all medical records are available permanently, most going back to the start of the system, and on one integrated platform.

Third, both systems allow patients to place limits on the ability of medical personnel to access sensitive particulars in their electronic health file. In Taiwan, this consists of blocking access of any medical professional from past visits record. In Estonia, patients have a somewhat more targeted ability to restrict specific physicians and/or specific providers from access to specifically designated parts of their medical record.

Fourth, the designers of both systems intend to push patients from medically-oriented curative to more health-oriented preventive individual behavior. Each system seeks to provide extensive and specific health-related data to individuals in hopes of improving their health-related decisions and thereby reducing or postponing likely future service needs. In Taiwan, the My Health Bank designers in the latest 2016 iteration provide a range of personal health data intended to stimulate better personal health behaviors such as more exercise and better diets. In Estonia, the patient portal contains documents for nearly all citizens, regardless of their

recent use of curative clinical services. While the designers of both systems appear frustrated at the low numbers of citizens who have accessed their accounts thus far, in both countries they express expectations that utilization will grow across healthy as well as sickly segments of their population.

*Differences*

Equally informative are the differences between the systems set up in these two countries. While several of these involve the degree of multiple functionality, they speak to efficiency and, potentially, acceptance issues more generally.

The first area of difference is that Taiwan has two separate patient systems – the NHI system and the EEC system. In addition, there is a third ancillary system of medically approved provider cards, allowing them access into the two types of patient accounts.

A second area of difference concerns the decision of the individual to participate in this electronic medical information system. In Estonia, the Health Information Service account is mandatory even if individuals choose not to access it, with citizens not allowed to opt out of the ID card programme. But in Taiwan, individuals must actively opt-in to have access to My Health Account. Moreover, the NHI Card, My Health Bank, NHI Medi-Cloud System and the EEC system are used only for health services and neither health account is linked to other governmental records or matters outside the health sector. Also in Taiwan, the horizontal coordination between the several government agencies could be improved. The NHIA is one of the agencies with the most advanced IT support, so that it could establish this kind of services for insured and care providers. For example, the tax system and other agencies are also online, however there is not much coordination between them and the health system (note that the NHI Card could be used as the personal identification to file income tax since 2016). Some other administrative areas, such as voting and driver's license, are still paper-based. Taiwan government has recently announced a reform project on issuing a new design of electronic national identification card (eID), integrating governmental services of several agencies [44]. However, whether the NHI will be included remains uncertain at this moment.

Quite differently, in Estonia, not only the Health Information Service account is mandatory, further, the ID card is in effect a national identity card for many different online and other identification and government service purposes. It is directly linked to the individual's entire national government file, including citizen (voting) information, tax liability and payment information, driver's licenses, even fishing licenses. While this has obvious efficiency advantages for government, the Estonian approach conversely has a greater potential to increase unwanted exposure and/or security breaches of individuals' medical information.

A third area of difference concerns the ability to book, reschedule or cancel medical appointments. This capacity is explicitly built into the Estonian system; however, it is not part of the Taiwanese structure. Scheduling and making appointments for visits and examinations are under the control of each care provider's clinic or hospital operation. The NHIA does not get involved in that process.

Taken together, these distinctions between the Taiwanese and Estonian systems appear to reflect differences in national culture and objectives, much as would be expected given the broader differences in the overall national context and culture of these two countries. In Taiwan, as part of the relatively recent and continued process of democratic nation-building [45,46], the structure and function of the health information accounts could be seen as a combination of strengthening solidarity and national identity-building. In this sense, improving these personal health accounts is focused mostly on achieving governmental administrative objectives. It also reflects the mostly private nature of both hospitals and primary care providers in the Taiwanese health care system, and tries to knit them more closely into an effective and integrated – and less expensive – nationally directed health system.

In Estonia, by contrast, the purpose of these personal health accounts is to more efficiently organize health services as part of a smaller lower-cost national government, and by that means to encourage further growth and development of the Estonian economy's international trading, exporting and also information technology activities. In Estonia, therefore, the primary purpose of these health accounts is to automate and thereby in multiple ways reduce the footprint of government and administration in the day-to-day operation of what is a publicly owned and operated hospital system (primary care doctors are mostly private in Estonia as in Taiwan).

*Policy implications*

The implications of this comparative assessment for other health care systems are complex. The big picture seems to be that a medical IT structure like those in Estonia and Taiwan requires a centralized governmental agency, at least in the health sector, that has the authority to establish an all-encompassing medical IT structure and to effectively operate it. This on one hand requires a national government standing behind the SHI system capable of marshalling sufficient administrative and managerial capacity, and on the other hand requires citizens and users willing to accept a national government agency with the necessary authority needed to collect and coordinate this enormous cache of sensitive personal information.

In a decidedly contradictory relationship, the most technically and cost-effective way to empower individual citizens in terms of their own medical data is to first empower a large national bureaucratic IT apparatus. Thus, full centralization of public power over patient information appears as a necessary pre-requisite for full decentralization of individual power over highly personal medical and health information. This problematic model of governance necessitates adequate political protections capable of guaranteeing the integrity as well as the legitimacy and accountability of the centralized national system. Further, given the specifics of these two country examples, one could speculate that key national characteristics – in particular having recently (re-)introduced democratic government and having an on-going nation-building commitment – may improve the willingness of citizens to grant information-gathering powers to their national government. Conversely, however, past experience with authoritarian government may also trigger a strong negative reaction to any bureaucratic or political abuse of this centralized database, which would potentially endanger the entire personal medical account project [47].

For other countries seeking to develop a similarly centralized health system information system, experience from Taiwan and Estonia suggests several issues as important in system design. Once the initial investment in the necessary electronic infrastructure has been completed, this universal personal accounts model has the potential to improve operating efficiency and reduce overall administrative costs. In addition, the level of health-system-related trust in government is not necessarily permanently fixed. If a new personal IT account structure works well, overall trust in the national government's management of the SHI system could well increase.

A second point is that with such a comprehensive IT structure, the protection of individual privacy and the existence of the necessary checks and balances between executive, legislative, and judicial branches of the national government are essential. Strict and inviolable safeguards must exist to avoid having the IT system's data either corrupted or abused, given that it contains politically

sensitive as well as commercially valuable information. A deeper issue is how to avoid allowing the IT system to be degraded into a means of social control (both in health and in other dimensions). Decisions in this medical information arena can be both complicated and controversial. The case in Taiwan of noting the HIV/AIDS positive status on a patient's NHI Card is a good example. As mentioned earlier, revealing the information may harm the privacy of patients; however, not revealing it may make medical professionals feel unsafe in their workplace and lead them to distrust the decision making of the national health authority.

A third point concerns the ability of citizens to decide whether to participate in the online personal medical account system. In Estonia, participation is mandatory, whereas in Taiwan participation in the card-based system is mandatory however participation in the broader health-oriented My Health Bank service is volitional. It is noteworthy that, at least in the initial years, volitional rates of participation were small – only 2.7% of the Taiwanese population. There is an interesting comparison on this issue with Australia, where opt-out for the full electronic personal account was allowed for a short sign-up period in late 2018. Some 900,000 actively opted out, and political demands were placed to revise the authorizing legislation to prevent transfer of any health-related information in the electronic record to any other governmental agency without first obtaining a court order [12]. This wide range of citizen choices and decisions suggests that as yet there is no clear consensus on how best to structure and operate access to these personal medical accounts.

A final point concerns the stated intention in both Taiwan and Estonia to reorient the focus from curative to preventive behaviors in the implementation of these personal health information accounts. Utilizing personalized risk assessments and health behavioral recommendations, users can decide to take better control over their own health. If they adopt more healthy behaviors, they potentially could reduce overall rates of disease and the associated medical care costs. However, a danger is that the system seems to implicitly suggest that, since users/citizens now have access to their personal health information, they not only *could*, but also *ought to* respond or act accordingly, changing his/her lifestyle and behaviors to take more responsibility for his/her own health. By normatively emphasizing the role of individuals in managing their own health, personal medical accounts could serve to underplay or even undermine some of the recently emerging emphasis on the important contribution to overall population health of social and structural determinants of health [48].

The comparative analysis presented in this article is subject to several limitations. Both Taiwan and Estonia are relatively small countries and have a relatively similar historical and political context, specifically in terms of the trajectory of democratization. This potentially could limit the generalizability of this paper's findings to other bigger developed countries that have been democratically governed for a longer period of time. Likewise, the findings might not be generalizable to developing countries where their basic information and governance infrastructures are not yet fully developed and reliable. In addition, the results from comparative analysis are to an extent necessarily subject to the researchers' individual selection of the relevant focal points of observation.

## Conclusion

How these and related health policy implications will play out in different national contexts and under different geographical and economic conditions remains to be seen. In Europe, the implementation in May 2018 of the European Union's General Data Protection Regulation may generate a range of as yet unknown consequences in this policy arena [49]. How the thus-far rather contentious implementation of the program in Australia, and when/under what restrictions the program in Singapore resumes, will also provide additional new information about the expectations of citizens and patients in a range of different national contexts and cultures. Of particular interest will be to what extent Confucian-based Asian health systems will approach these issues differently from those in Western Europe and – quite differently – in North America and The Antipodes [50].

In this still-experimental environment, the comparison in this paper of the personal medical account systems in two seemingly disparate countries on opposite sides of the world, with two rather different health care systems and histories, suggests that a number of core issues regarding the technical introduction and political acceptability of personal medical accounts remain unresolved, and that going forward they will continue to occupy considerable attention from both health system administrators and national policymakers.

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