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CLINICAL PATHWAYS AND THE NEED FOR SYSTEM INTEGRATION

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ABSTRACT

Rationale, aims and objectives: Resources to deliver healthcare are getting scarce all around the world. Clinical pathways are key tools to make health delivery in clinical settings efficient. Clinical pathway design, operation and follow-up all suffer from bad information systems integration. This might badly harm the adherence to clinical pathways. We have very little research on how clinical pathways are followed. This study assesses the functioning of a clinical pathway for elderly people in a Finnish case. At the same time it documents the hardships of getting information on the patient flows in a clinical pathway.
Method: To support our theoretical discussion with a real case, a case study was performed on the follow-up of clinical pathway for elderly patients in emergency care. The data is on all patients aged 75 years or more who had visited the emergency unit of the city hospital in 2006–2008 was collected. The study sample comprised 24,195 admissions. The flow of patients after the first care at the emergency unit was analyzed, collecting data from various scattered sources.
Results: The results show that the planned patient pathways seem not to be followed always. Yearly about 17% of the patients were referred to the university hospital, the more expensive care, but about 74% of these referrals did not follow the agreed procedure. The excess costs of referring patients to a non-standard, more expensive clinical pathway were 2,57 Million Euros over a period of three years for the studied population of 24,195 admissions, also averaging 106 Euros per admission. The case study clearly documents that adherence to the clinical pathway in the case is not as planned, and that system integration difficulties severely harm endeavors to analyze the functioning of and adherence to the pathway.
Conclusion: Clinical pathways were not followed in the case as planned and expected. Bad data because of missing system integration made the follow-up of the clinical pathway adherence in our very challenging. Follow-up information of clinical pathway flows is often hard to collect because of fragmented information systems, that are not designed to document patient flows in clinical pathways. Reasons for these conditions should be better understood and studied in more depth.

KEYWORDS

Clinical Pathways, Information Systems, Health Care, Aged Patients, System Integration, Efficiency and Effectiveness of Health Care

1. INTRODUCTION

Labour shortages in social and health care are a global problem (Project Hope, 2022). World Health Organization (WHO) (2022) estimates a projected shortfall of 18 million health workers by 2030, mostly in low- and lower-middle income countries. The need for labour will increase further as the population ages and the use of services is high. It is not possible to increase the amount of education for demographic reasons. There is a shortage of labour in all sectors. Attempts can be made to solve the problem by digital means with information management (Rotter, de Jong, Lacko, Ronellenfitsch, & Kinsman, 2019).

Organizations hold a huge amount of data that is often scattered across the operational databases of different systems, so called silos (Schmaltz & Aziz, 2012). Such data silos make wide-reaching operations and process design challenging. Data management experts should solve the problem by extracting data from operational databases to a common data warehouse. It serves as a basis on which to build reporting that takes the overall picture into account, as well as analytics for the use of different levels of activity.

Studies on the workforce and resourcing of social and health care show that the service needs of the population can only be met in the future by making significant reforms by changing the way staff work (Madell, Villa, Hayward, & Le Comte, 2016). The efficiency and cost-effectiveness of health and social care activities will only improve when the expertise of all professionals is fully utilized. This can be done in knowledge-driven service entities, where information is used to support decision-making by managers who manage service system entities at different organizational levels (Rotter et al., 2019).

The service must be a seamless service continuum for the customer. Social and health care services are built as functional, independently operating services, rather than as customer-centric processes that take into account the customer's overall situation. The problem with the silage structure is inward heating and sub-optimization. When each unit is mainly concerned with its own operations and results, the management of the whole remains weak (Walker, 2021).

In the service continuity, the problem is the data transfer between different service providers. It should be realized in a timely manner, serving the customer's and producer's need for information, and providing maximum benefit to the customer. If the information is transferred poorly, a lot of duplication of work will have to be done and there will be delays, errors and inconsistencies in the service the customer receives (Mirbabaie, Stieglitz, & Frick, 2021). The importance of digital communication in the transmission of information is growing. New methods for organizing patient care should be developed in collaboration with health professionals (Prasad, 2021).

There is a lot of detailed information available about the activities of service providers and service users, which is not sufficiently used in management. Targeted management, planning, anticipation, and evaluation of organizations require that managers at different organizational levels can monitor the development of the health and well-being of the population, utilize information from service users by consistently combining it with the necessary resources. To achieve this, it requires good digital skills and the ability to innovate across borders across different professions and organizations. Information systems are currently being developed to manage service entities based on knowledge at different levels of an organization's operations. (3) The full implementation of these systems requires the participation of health care professionals in the field as part of in-service training.

Customer-oriented cost efficiency is not only created by restructuring, but also by developing operations and staff skills. Evidence and researched information must be used within and between different professional groups (Seidlein, Hannich, Nowak, & Salloch, 2022). Clinical pathways are a key tool to institutionalize best medical practices and evidence-based care.

There is a research gap concerning empirical the adherence of medical professionals to defined clinical pathways. Although implementations of clinical pathways have reduced medical errors, lowered costs, and improved patient outcomes, monitoring whether a patient is following the intended pathway is problematic (Konrad, Tulu, & Lawley, 2013). Some results anyway exist. Moth & al (2008) studied asthmatic children care pathway adherence in Denmark, and found that care was in accordance with guidelines in all three indicators of quality only in 7% of the cases. Hospital specialists provided care in accordance with guidelines nine times more often compared with General Practitioners, but still only one quarter of these children had pathways in accordance with guidelines to different care pathways.

As a case study, this article interrogates adherence to a clinical pathway defined for elderly care in a Finnish middle-sized city with 170 000 inhabitants. In addition to finding the low adherence to the planned clinical pathway, it contributes to the understanding of the hardships of distilling clinical pathway adherence information from standard patient records. In the case information had to be collected from two separate electronic patient records.

The article unfolds further as follow. In the next section we discuss clinical pathways, and how the efficient implementation of them needs far-reaching system integration. In the next section we perform a case study of elderly care episodes in emergency Unit at City of Turku, Finland. article ends with conclusions, including assessment of the study and recommendations for further research.

2. CLINICAL PATHWAYS AND SYSTEM INTEGRATION NEEDS

2.1 Clinical Pathways

McGraw-Hill Concise Dictionary of Modern Medicine (McGraw-Hill Concise Dictionary of Modern Medicine, 2002) defines a clinical pathway as “a standardized algorithm of a consensus of the best way to manage a particular condition”.

Clinical pathways (CPWs) are a common component in the quest to improve the quality of health. CPWs are used to reduce variation, improve quality of care, and maximize the outcomes for specific groups of patients (Lawal et al., 2016). According to the European Pathway Association (EPA) (2020) “a care (clinical) pathways is a complex intervention for the mutual decision making and organization of care processes for a well-defined group of patients during a well-defined period”. It is worth noting that the use of the term “Care Pathway” extends the use of the term “clinical pathway” to areas outside core medicine, such as social care.

Kinsman & al (2010) found after a literature review five characteristics that are typical for clinical pathways:

1. The intervention was a structured multidisciplinary plan of care
2. the intervention was used to channel the translation of guidelines or evidence into local structures

3. the intervention detailed the steps in a course of treatment or care in a plan, pathway, algorithm, guideline, protocol or other 'inventory of actions
4. the intervention had timeframes or criteria-based progression (that is, steps were taken if designated criteria were met); and
5. the intervention aimed to standardize care for a specific clinical problem, procedure or episode of healthcare in a specific population.

According to EPA (European Pathway Association, 2020) characteristics of care pathways include:

1. An explicit statement of the goals and key elements of care based on evidence, best practice, and patients' expectations and their characteristics
2. the facilitation of the communication among the team members and with patients and families
3. the coordination of the care process by coordinating the roles and sequencing the activities of the multidisciplinary care team, patients and their relatives
4. the documentation, monitoring, and evaluation of variances and outcomes; and
5. the identification of the appropriate resources.

Lawal (2016) posited four common definitions for clinical pathways:

1. The intervention was a structured multidisciplinary plan of care
2. the intervention was used to translate guidelines or evidence into local structures
3. the intervention detailed the steps in a course of treatment or care in a plan, pathway, algorithm, guideline, protocol or other 'inventory of actions' (i.e. the intervention had time-frames or criteria-based progression); and
4. the intervention aimed to standardize care for a specific population.

Clinical pathways are examples on how to implement integrated care approach. Many different models and approaches to integrated care have been developed and this has resulted in different definitions and conceptual frameworks. One synonym term for integrated care is seamless care referring to seamless clinical pathway where a patient can use different services by various service providers and related patient data can be accessed at each point of care concerning all the pathway care actions and operations. From the patient viewpoint a qualified clinical pathway produces the best possible actions and outcomes for the patient, depending on the care situation, with a coordinated delivery of the services. Important for the clinical pathways are that they are designed according to the multidimensional needs of the patients and service providers and delivered by a multidisciplinary service team at various levels of care and supported with patient data management by the electronic health record systems.

Literature review (Kurpas et al., 2021) showed that clinical pathway models have been developed to respond to the increasing chronicity and co-morbidity in population and one concern in adopting these models in practice is an understanding of how much these systems need development of new organizational solutions. Successful integrated care models need to include enabling patient engagement and self-management support, multiprofessional working culture, evidence-based clinical pathways and protocols, effective management of resources and supporting information technologies (WHO Regional Office for Europe, 2016). At the best, integrated care models, clinical pathways may be effective in supporting proactive care management and ensuring that patients receive relevant clinical interventions and/or assessments when needed. This can lead to improvements in service quality and service efficiency without adverse consequences for patients. Clinical pathways may also support adherence to guidelines or treatment protocols thus reducing variation in practice. Additionally, clinical pathways may support better documentation of treatment goal and documentation of

communication with patients, carers and health professionals and enhance patient satisfaction, increase perceived quality of care, and enable even better access to services for the patients (Allen, Gillen, & Rixson, 2009; Baxter et al., 2018)..

The tradition of knowledge-based management in social and health care organizations is new, although it is required to lead a strong expert organization. Effective and efficient management requires planning, anticipation, and monitoring of operations. The problem with social and health care organizations is often that the information needed for management is difficult to access and scattered across different databases, registers, and organizational systems. The information needed by managers is often fragmented, narrowly spanning their own unit. It is not possible to manage entities, or it is considered impossible to do so, because it is not always possible to combine the necessary information from the systems of different organizations. The co-operation between the organization's financial management, care and medical professional groups is also lame. Clinical pathways are tools used to guide evidence-based healthcare that have been implemented internationally since 1980s (Kinsman, Rotter, James, Snow, & Willis, 2010).

2.2 Clinical Pathways and Need for System Integration

Despite the common agreement of the positive effects of clinical pathways by both academics and practitioners, it is very common that clinical pathways are not always adhered to. Indeed, there exists doubts about the studies that have documented the (good) effects of clinical pathways. El Paz & al (2007) evaluated 115 publications reporting the effects of utilizing clinical pathways. They classified just 33 percent of the papers as having good quality, and 67 percent as displaying bad quality. In general it is thought that non-adherence to clinical pathways leads to deterioration of case quality: Negative variation in the management of patients with the same clinical condition is frequent, and affects quality of care (Caminiti, Scoditti, Diodati, & Passalacqua, 2005). Vanhaect & al (2006) found in a self-assessment exercise supported by the Care Process Self Evaluation Tool (CPSET) that care processes supported by clinical pathways had the highest CPSET scores, were also self-evaluated by hospitals and their staff as better care processes than the ones for which clinical pathways were not defined.

Integrated care with clinical pathways is a promising approach that could bring many benefits both for citizens and health professionals. However, implementation and deployment in many countries has been constrained by various barriers and challenges, these are related e.g. to gaps in leadership, organizational culture, information technology, communication, capacity, resources and provider commitment (European Commission, 2019; European Commission (DG ECFIN)-EPC (AWG), 2018). Our previous study (Ovaskainen, Alin, Arve, Suomi, & Nykänen, 2022) showed that the planned clinical pathways were not always followed and this resulted in excess of care costs. Additionally, following the flow of the clinical pathway was difficult because the electronic health record systems were not able to collect data supporting the clinical pathway.

In a good case, a clinical pathway could start from primary care and/or social care and proceed to specialized care, covering many visits, and then return back to any of the mentioned service sectors and continue possibly years or even decades. Following this would require that the electronic health record systems are designed to relate the patient visits with each other along the pathway, build e.g. links between the visits, though the visits may have been at various service providers. This would be possible as the regional data stores and information systems

provide their data, but the systems do not support well the clinical pathway viewpoint in data access.

Different methods have been proposed to monitor and add to adherence of clinical pathways. Konrad & al (2013) propose the use of HL7 messages to perform monitoring. Maheshwari & al (2019) tested the use of machine intelligence to form patient groups and monitor their clinical pathway adherence with good results. Already in year 2006 Vanhaecht & al (2006) found 15 clinical pathway audit tools, and analyzed seven of them in detail. Ovaskainen et al (Ovaskainen, 2005; Ovaskainen, Kortekangas, Ojanlatva, & Rautava, 2007; Ovaskainen, Rautava, Ojanlatva, Päkkilä, & Päivärinta, 2003) found by analyzing clinical pathways comparisons can be made between medical care at different hospitals, between municipalities and between the expenditure patterns.

3. CITY OF TURKU ELDERLY CARE CASE

3.1 The Clinical Pathway for Elderly Patients

Finland is undergoing a large health- and social care reform[1], to be implemented at the beginning of year 2023.

According to the Finnish Ministry of Social Affairs and Health, the purpose of the social and healthcare reform is to create a new kind of service structure for public social and health care, the aim of which is to ensure equal, cost-effective, customer-oriented, and high-quality social and health services throughout the country in Finland. Whatever the future financial and administrative organizational model is in the reform, these goals can only be achieved if services are delivered with new operating models. Municipal health and social expenditure accounts for more than half of municipal expenditure, and 50–80% of health expenditure costs consist of personnel expenditure. Still, new researched and cost-effective multi-professional operating models are not used in municipalities and associations of municipalities. The utilization of personnel data alongside operational and financial data is important today in the social and health services sector. It is particularly important now when the new health care areas are being prepared. The potential of knowledge management has been identified more clearly in several areas and in the national preparations for reform. (Ovaskainen, Suvivuo, Virjonen, & Leino, 2016).

In Finland, we have regional health information system networks in the hospital districts where all the health information systems can share patient data with other components of the regional system and this makes it possible to access, and collect, data from any of these regional systems without asking a consent from a patient. However, the health information systems, e.g. electronic health record systems, are not designed to support the flow of patient data according to the pathway. Rather, these electronic health record systems operate in such a way that they document patient data based on the visit, operation or action.

The national patient data archive, Kanta[2] collects patient data from individual electronic health records and the clinical pathway is either with Kanta easy to follow based on these visit-based documentations. One reason for this might be that the integration between individual

[1] See more at https://soteuudistus.fi/en/frontpage
[2] See more at https://www.kanta.fi/en/citizens

sectors of the health care system is not yet complete, e.g. in the public health system primary care and specialized care are not well integrated, and health and social care are still separated at the level of funding and organization. However, the biggest challenges are related to electronic health records which need improvement, e.g. they should be able to collect and access patient data in a more comprehensive manner that would support coordinated people-centered care. These could be achieved by using the clinical pathway as a new framework for the design, this would be a new approach and would potentially bring many improvements in data access and sharing.

This study was performed to test the adherence to clinical pathway specifications designed for elderly patients arriving to emergency care in City of Turku, Finland (195 500 inhabitants). The adherence to clinical pathways would increase the quality of care, and a alleviate resource shortages, as in rightly constituted clinical pathways care and cure activities are allocated to the right, most efficient, level of care.

The study focused on inhabitants aged 75 years or more. In 2006 they numbered 15 196 inhabitants, in 2007 they were 15 381, and in 2008 they were 15 481.

The city has two publicly funded hospitals where patients from emergency care can be further transferred: the university hospital (run by a health district comprising of municipalities in the area) and the city hospital run by city of Turku (Figure. 1). The university hospital specializes in treating critically ill patients and the city hospital specializes in general practice and rehabilitation. Both hospitals receive patients directly from home or nursing homes to the emergency unit.

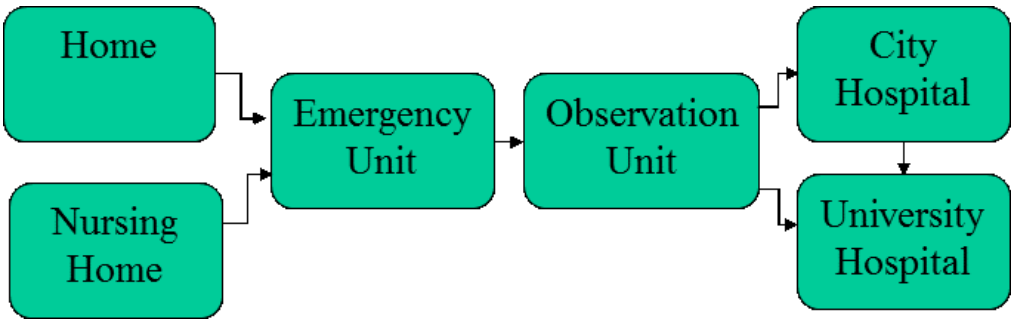

Figure 1. The core patient's pathway from home to emergency department via the observation unit to the city or the university hospital

The hospitals have an agreement that patients with stroke or acute myocardial ischemia or who require surgery are treated at the university hospital, while all other patients are treated at the city hospital, unless their clinical condition demands treatment in the university hospital. Due to cost issues there is a need at the emergency and observation units to be restrictive in sending patients to the university hospital.

The use of different electronic health record systems in the two hospitals, which makes patient transfers and their follow-up difficult. It would be important that the healthcare managers get real-time information about the patients' pathways. They should be provided with visual reports about the financial effects and be alerted immediately if the pathways are not adhered to as planned.

The purpose of this study was to assess the adherence to the clinical pathway designed for the elderly patients coming to emergency care and then needing further care (elderly critical pathway, ECP). Electronic patient record information from both involved hospitals were used for this assessment.

3.2 Data and Methods

The study population consisted of inhabitants in the city of Turku, Finland, aged 75 years or more who visited the health care centre or social services in 2006–2008. In total 11 360 persons met the criteria and were selected for observation over the study period. In total 24 195 ECP episodes were recorded for the study during the study time 2006–2008 (Table 1), also 2.13 episodes per patient.

Table 1. ECP episodes per year studied

Year	**Episodes**
2006	7 710
2007	8 014
2008	8 471
Total	24 195

Data was collected from the two different electronic medical record systems (Pegasos® and Miranda®). and inserted to a temporary Research Data Mart (RDM). The RDM contained information on each ECP episode for each individual patient in chronological order. Only the information on complete pathways (i.e., those that ended in patient discharge) was included in the RDM. Information on the incidents was identified from the patient documentation files, and information on waiting list placement for further care place was retrieved from the SAS Pro Consona program.

Statistical analyses and data integration were performed with SAS® software release 9.2 (SAS Institute Inc, Cary, NC, USA). The analysis of referral amounts was based on number of monthly referrals analyzed with a regression model with first-order autoregressive errors.

All data was in operative and transactional form. It consisted of encrypted patient information, and included demographic variables, diagnoses, admission, and discharge information. The data was anonymized after the health care data of two hospitals had been combined with the same algorithms. The following pieces of information were collected of the individuals of the study population: diagnoses, age, gender, and habitation. Additional general background information was also collected: size of the age groups, number of people treated by the home care service, estimated amount and cost of use of health care facilities used. The cost estimate was grouped by year, day and incident. All data of a single pathway was combined using the patient's anonymized identification code and date of admission as key identifiers.

The data from different source systems was first transformed into a common structure by patient and date and then, if available, by date of the assumed logical direction (arrival, health care center emergency unit, university hospital emergency unit, care periods). Timestamp and 'send to / arriving from' information was also used.

Clinical pathways were conformed into ordered and transformed data by applying the following principle. The first pathway starts from the earliest observation of patient data, observations of individual patients from the same date are referred to the same pathway, full care periods in the hospitals are included. Outpatient observations connected with the care periods at the time are connected to the same pathway. The more complete patient flow diagram where also ECP takes place is depicted in Figure 2.

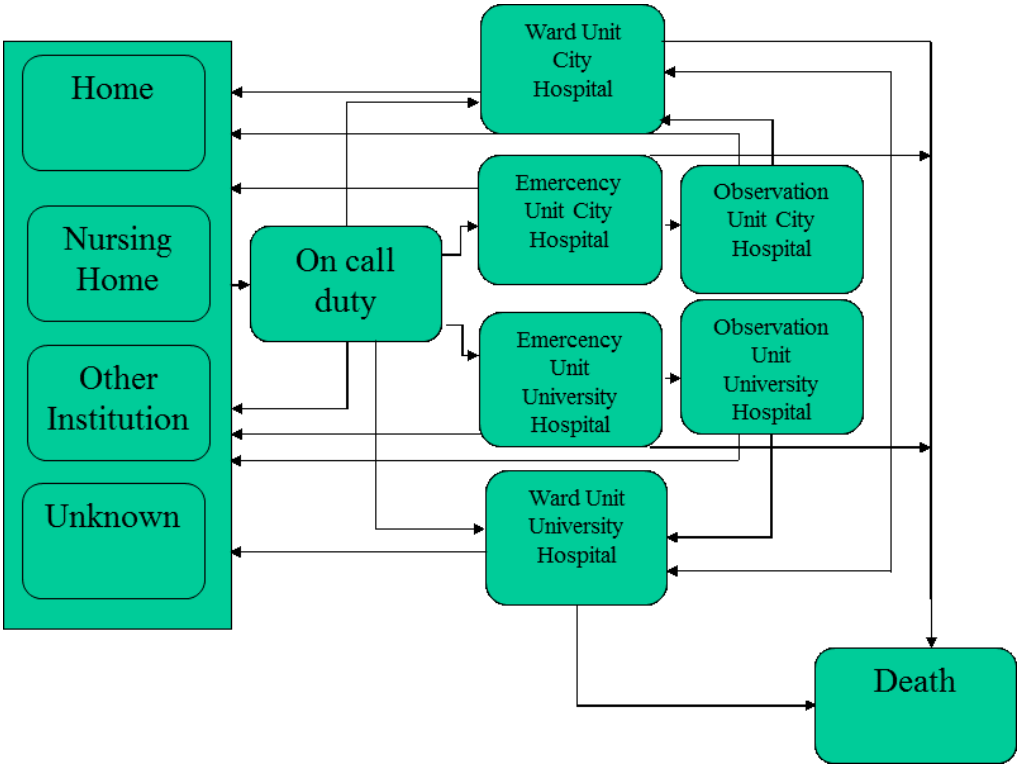

Figure 2. A detailed illustration of possible patient flows (in elderly care)

In cases where arrival information was not available it was assumed that it was from "home or home-like conditions" if the departure from the same or a previous pathway of the same patient was "home or home-like conditions". By applying this logic, in cases where departure information was not available it was assumed that it was "home or home-like conditions" if the "arriving from" information was "home or home-like conditions" in the same or next patient flow for the same patient. These two sets of logics where applied to 13 ECP episodes in order to fill data gaps. In this way we established the first arrival and last departure information for each ECP episode.

Cost analysis of different ECP variations was based on selecting the year 2007 as the reference year with the following key indicators:

1. number of pathways episodes
2. percentage of pathways to the university hospital
3. percentage of these without justified diagnosis

4. average number of days spent in the university hospital.

These four figures were retrieved from the RDM and combined with the official population forecasts of elderly people (Statistics Finland) for the city of Turku and with the constant excess cost.

4. RESULTS

4.1 Patient Flows

Of the patients who were sent directly from the emergency or observation unit to the university hospital, 29% (2006), 27% (2007), and 22% (2008) had a diagnosis based on an agreement, while 71% (2006), 73% (2007), and 78% (2008) did not (Table 2).

Table 2. Patient pathways from emergency and observation unit to a nursing home, the city hospital, or the university hospital in 2006–2008

Target point after the emergency and the observation unit	Not recorded diagnosis or diagnosis without based on an agreement			The diagnosis based on an agreement			Total number of the pathways		
	2006	2007	2008	2006	2007	2008	2006	2007	2008
Home or nursing home							5055 66%	5172 65%	5545 65%
Turku city hospital	1120	1442	1630	32	47	43	1152 15%	1489 19%	1673 20%
University hospital	1065 71%	992 73%	974 78%	*438* *29%*	*361* *27%*	*280* *22%*	1503 19%	1353 17%	1253 15%
Total	2185	2434	2604	470	408	323	7710 100%	8014 100%	8471 100%

The trend of justified transfers to the university hospital over time is shown in Fig. 3. As seen, the proportion of appropriate transfers decreased towards the end of the observation period.

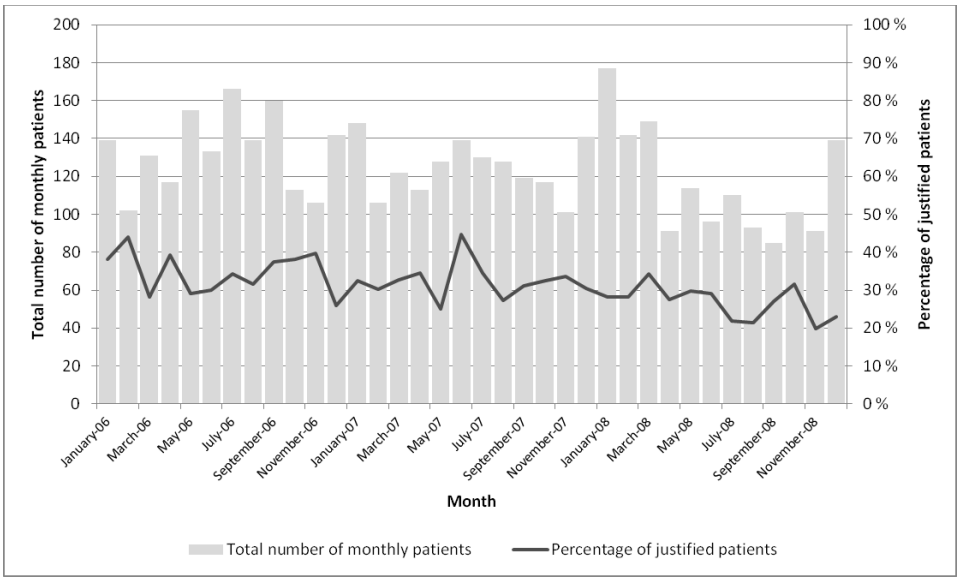

Figure 3. Number of patients directed from the city hospital emergency unit to the university hospital, and percentage of patients with a diagnosis, both justifying the transfer (black line)

Figure 4 shows the total amount of emergency patient care transfers from City Hospital to University Hospital, and the percentage of transfers that were not followed with a diagnosis. Starting from an average of 825 monthly referrals in 2006, there was a decrease to 723 average referrals in 2007 and an increase to an average of 763 monthly referrals in 2008. As it comes to the transfers without a diagnosis, the amount sharply rose during the study period.

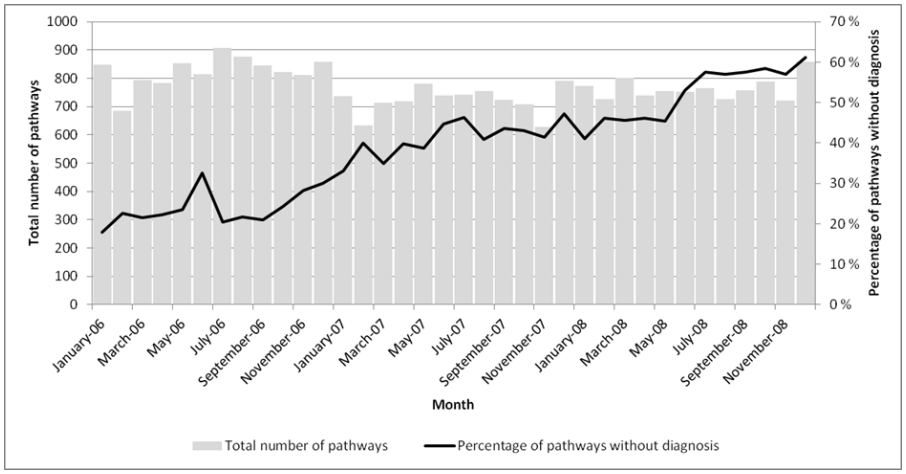

Figure 4. Number of ECP episodes directed from the city hospital emergency unit to the university hospital, and percentage of referrals without any diagnosis

4.2 Cost Consideration

The year 2007 was chosen as the reference year to provide a forecast platform to evaluate the cost associated with referring patients inappropriately (against the agreement made) to the university hospital. This year represented approximately the median number of inappropriate referrals.

The excess average cost of unjustified acute care is about 180 € per day, since the cost per day of acute care in the university hospital is approximately 500 €, and the corresponding cost in the city hospital or the health care center is 320 €.

The total excess costs were €1.15M in 2006, €0.78M in 2007, and €0.64M in 2008, and the full acute care day costs €13.79M, €11.46M, and €10.34M, respectively (Fig. 5). The excess hospital days associated with referring the patients without the proper to the university hospital were on average 5.73 days in 2006, 4.04 days in 2007, and 3.14 days in 2008.

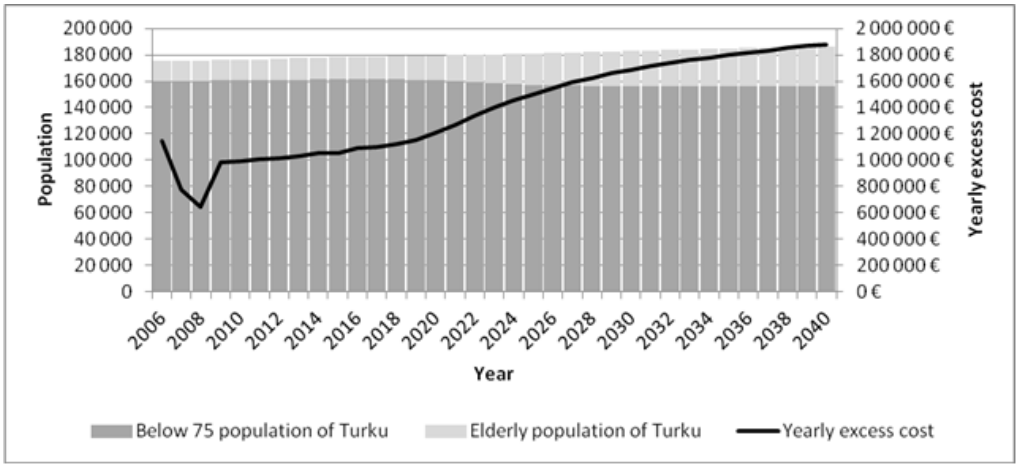

Figure 5. Yearly actual (2006–2008) and forecasted (2009–2040) excess cost of the unjustified patient transfers to university hospital in the ECP and the population distribution of Turku

In 2006–2008, the average number of ECP episode with respect to the population size was calculated to be 60%, i.e., approximately 60 ECP episodes a year for every 100 elderly citizens and 6 of them displaying unjustified transfer to the university hospital. The population size was taken from the official statistics and the forecasts of Statistics Finland. Costs were assumed constant. With these assumptions, the estimate graph in Fig. 5 was created for the years 2006–2040.

The calculations infer that the saving of taxpayers' money in the city of 175 570 inhabitants would have been at least one million Euros annually, if information about ECP episodes had been recorded and used properly. Upscaling this to the total Finnish population (5,5 million inhabitants) the yearly saving would be at least 35 million euros.

5. DISCUSSION

In 2006–2008 there was a decreasing overall trend of referring patients to the university hospital but an increasing trend of referring patients based on an agreement between the local hospitals and the university clinic. Still, most of the patients referred to the university hospital did not have a diagnosis as stipulated in the agreement defining the ECP. Such referrals were often followed by further treatment in the city hospital or the health care centre.

It was astonishing to see how many patient transfers happened without any diagnosis, this was even a growing trend during our study period. In a busy emergency room or similar setting it is not, understandably, always possible to obtain a full diagnosis, especially if no radiology or laboratory facilities are available. However, a suspected diagnosis should be recorded at the very least. The clinicians must understand the importance of documentation. Ovaskainen et al. studies 12-15 suggest that with CPWs may be used as predicting and planning tools as well as financing tools when municipalities and hospitals draw up contracts for health services. If clinical pathway decisions are to be made based on diagnosis (even maybe preliminary), there is little possibility to make clinical pathway decisions in the case of this central piece of information missing. Diagnosis has important implications for patient care, research, and policy. Public policy decisions are often influenced by diagnostic information, such as setting payment policies, resource allocation decisions, and research priorities. 16

There might have been situations where the patient's condition would have demanded care at the university hospital even if the patient had some other condition than the agreed ones, but our data did not allow us to evaluate this. The methods of analyzing narrative text are not very efficient and outside the scope of this research, and hence we had to use the available structured records. One potential discussion item of course is, if the agreement on the pathways is not up-to-date to best medical knowledge, and if there are plenty of other conditions not identified in the agreement that demand university hospital level treatment. The emergence of a multitude of new rare diseases 17 might contribute to this potential conclusion.

Health service planning needs data of high quality. If information is poor or lacking, it is impossible to evaluate the efficacy of treatment and the delivery of health services 18,19. Electronic health records have the potential of improving the efficiency and effectiveness of healthcare delivery. The use of patient data may be used to aggregate data for providing systematic answers to clinical and policy questions 20,21. Databases may be exploited to improve patient care and for cost-effective operative decision making 20,22,23. The sharing of information between organizations is particularly important for delivering highly coordinated health care services and for a better understanding of clinical pathways 24. Electronic health records improve the efficiency of making admission decisions and reduce the number of admissions of patients that may be managed in open care 25.

For analysis of health care processes, the EHRs of different organizations should be synchronized so that the information follows the patient through the whole clinical pathway 26. This calls for centralized systems capable of integrating and combining any kind of information in any structured or unstructured format from various different operational systems. Such centralized systems must also be able to take into account the data quality and analyze the combined data in real-time if they are to support timely and proactive decision making and management of the health care processes. At present, we are far from that. However, basic interconnectivity is provided by the national Kanta-service, but the service does not contain all details of care activities. Several systems also have connectivity at a bigger data detail level,

but so far, they are rather isolated islands of integration rather than widely available solutions. There are attempts to form one national warehouse, but the quality of the recorded data must improve remarkably before harmonized analyses are possible. The results of this study call for fast development of uniform and compatible information processing systems.

Information about patients' clinical pathways is often lost, unavailable, or unused 27. That was also the case in the present study concerning the clinical pathways of the elderly. The health care managers are entitled to demand reliable and relevant information and usable software to support key decision-making. Information technology has great potential for improving the quality of health care data as well as for creating new service innovations.

In order to be able to analyze the health care processes, the electronic patient records of different departments should be synchronized so that the information of the records follows the patient through the whole clinical pathway 22. Information on patients in the information systems should be transferred from the home care to hospital care and back again. The responsibility lies with the health care personnel to record the information about the patient in the system, from where it then becomes available for experts, decision makers and everyone in the care process. This means that the patient flow need to be directed according to agreed rules, which take into consideration the resources defined by the taxonomy of care interventions 25. For this, the management need to construct an information system for the personnel from where to get visual, up to date reports on resources and inpatients, as well as predictive information on future patient volumes 28.

6. CONCLUSIONS

Resources to deliver healthcare are everywhere scarce. Clinical pathways implemented to make health delivery in clinical settings effective and efficient. Clinical pathway design, operation and follow-up all unfortunately suffer from insufficient information systems integration. This might badly harm the adherence to clinical pathways. We have very little research on how clinical pathways are followed. This study assessed the functioning of a clinical pathway for elderly people in a Finnish case, and highlighted the hardships of getting information on the patient flows along a clinical pathway. Even when we could not in detail show how the data needed for our study was parsed together, we could clearly show the hardships in the data collection.

Our findings indicate that planned patient pathways seem not to be followed always, which is well in line with previous literature (He, Bundorf, Gu, Zhou, & Xue, 2015; Hoffart et al., 2002). In our case 74% of referrals did not follow the agreed procedure. One possible option is of course even in our case is that the proposed and agreed-on clinical pathway was not up to the best practice and real needs, or that it delivered insufficient guidance for the medical professionals. The analysis of that condition is anyway beyond the scope of this article.

Methodologically we offered an example on how to calculate and visualize the real costs for healthcare emerging because of insufficient adherence to clinical pathways. We could show that even a single clinical pathway failure can over time cumulate remarkable financial losses.

Unavailable and distorted data because of missing information system integration made the follow-up of the clinical pathway adherence in our case almost a mission impossible. Follow-up information of clinical pathway flows is often hard to collect because of fragmented information systems, that are not designed to document patient flows in clinical pathways.

Our case study further documents that an analysis can be made on the adherence to Clinical Pathways, even in demanding circumstances where data is scattered in different system of rather low quality and data parsing must be done in great amount.

We were able to show that the ECP in city of Turku did not function as planned in years 2006–2008. However, we are not able to witness whether the ECP is designed well or badly, and subsequently whether it is odd or natural that it is not being followed. The difficulty of evaluating a digital pathway is also well documented in (El Baz et al., 2007).

Our study shows the potential for generating substantial savings through alert monitoring of the function of Clinical Pathways. It is also imperative that Clinical Pathways must be evident-based and reflect needs of reality. They cannot be based on local arrangements mainly based on cost considerations. Clinical pathways can never completely catch the complicated reality of human health. The clinical condition of the patient should be the most important argument when referring patients to the appropriate hospital, not financial considerations. This is both humane and at the long term most cost effective.

The digital health care institutions which belong to the digital public health service are more cost-efficient than the earlier traditional hospitals and health care centres and they aim at the better exactness and to capacity in the health care processes and in the diagnosing of illnesses. The digital hospital environment utilises digital electronic health records which are one, it the most central functions. This study shows that the data from two hospitals with different patient data systems can be combined due to the national harmonised data model for patient documentation. Both hospitals have made the huge investments in electronic health records. As technology continues to upgrade in this digital landscape, most hospitals and other healthcare providers of various sizes have invested a lot of time and money in boosting operational efficiencies while minimizing costs. For all these reasons, Enterprise Resource Planning technology (ERP) has come into play.

The work performed in this article is not without its limitations. The quality of data is essential if management in health care is to be effective (Weiskopf & Weng, 2013). The quality of data available for this study was moderate, in line with the normal state of the art (Reed, Schifferdecker, & Homa, 2008). Not all diagnoses were recorded in the electronic medical record systems. In many cases, the only diagnosis recorded by the attending physician was a diagnosis of ‘observation for suspected disease or condition’, not a complete final diagnosis. Securing that the identified emergency patient care episodes were complete and contained all stages of care was challenging. The financial calculations have to be made based on simplified average assumptions: in real life emergency patient care episodes take many and complicated ways, resulting in many unforeseen costs. It is most likely that our calculations of possible savings are rather moderate. Unfortunately, there are no common agreed nor fixed standards for health economic analysis covering the multiple dimensions of health care, and considering the limited capacity of related information technology to document the reality (Luzi, Pecorado, & Tampuris, 2016).

Our study offers various avenues for further research. At the conceptual level, the relationship between clinical pathways and information systems integration should be more deeply studied. Is too far reaching data privacy already harming effective health care in hospital settings? Methods to calculate patient total costs in their way through the clinical pathway should also be developed, as clinical pathways are a key component in modern healthcare. Finally, we hope our study could be replicated in different settings.

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