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Article

Hospital integration to improve the chances of recovery for decubitus (pressure ulcer) patients through centralised procurement procedures

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Abstract: Introduction: In Central Europe, in Hungary, the state guarantees access to health care and basic health services partly through the Semmelweis Plan adopted in 2011. The primary objectives of the Semmelweis Plan include the optimisation and transformation of the health care system, starting with the integration of hospitals and the state control of previously municipally owned hospitals. The transformation of the health care system can have an impact on health services and thus on meeting the needs of the population. In addition to reducing health inequalities and costs, the relevant benefits include improving patients' chances of recovery and increasing patient safety. The speciality under study is decubitus care. Our hypothesis is that integration will improve the chances of recovery for decubitus patients through access to smart dressings to promote patient safety. **Objective:** to investigate and demonstrate the effectiveness of integration in improving the chances of recovery for decubitus ulcer patients. **Material and methods:** The research compared two time periods in the municipality of Kalocsa, Bács-Kiskun County, Southern Hungary. We collected the number of decubitus patients arriving and leaving the hospital from the nursing records and compared the pre-integration period when decubitus patients were provided with conventional dressings (01.01.2006–2012.12.31) and the post-integration period, which entailed the introduction of smart dressings in decubitus care (01.01.2013–2012.12.31). The target population of the study was men and women aged 0–99 years who had developed some degree of decubitus. The sample size of the study was 4456. Independent samples t-test, Chow test and linear trend statistics were used to evaluate the results. Based on the empirical evidence, a SWOT analysis was conducted to further examine the effectiveness of integration. **Results:** The independent samples t-test model used was significant (for Phase I: t (166) = −16.872, $p < 0.001$; for Phase II: t (166) = −19.928, $p < 0.001$; for Phase III: t (166) = −19.928, $p < 0.001$; for Phase III: t (166) = −16.872, $p < 0.001$). For stage III: t (166) = −10.078, $p < 0.001$; for stage IV: t (166) = −10.078, $p < 0.001$; for stage III: t (166) = −10.078, $p < 0.001$). for stage III: t (166) = −14.066, $p < 0.001$). For the Chow test, the p-values were highly significant, indicating a structural break. Although the explanatory power of the regression models was variable (R-squared values ranged from 0.007 to 0.617), they generally supported the change in patient dynamics after integration. Both statistical analyses and SWOT analysis supported our hypothesis and showed that integration through access to smart dressings improves patients' chances of recovery. **Conclusions:** Although only one segment of the evidence on the effectiveness of hospital integration was examined in this study, integration in the study area had a positive impact on the effective care of patients with decubitus ulcers, reduced inequalities in care and supported patient safety. In the context of the results obtained, these trends may reflect different systemic changes in patient management strategies in addition to efficient allocation of resources and quality of care.

Keywords: health; health care; efficiency; Europe; accessibility-management of health services; public health systems research; sustainability practices; patient safety; prevention

1. Introduction

Hungary, located in the Pannonian Basin in Central Europe, covers an area of 93,027 square kilometres, and according to the Hungarian Central Statistical Office, its population on 1 January 2024 was 9,765,254 permanent residents. Hungary is a unitary, parliamentary republic and a member of several international organisations, including the European Union, NATO, the OECD, the World Bank, the United Nations and the Schengen area.

1.1. Background

While the Hungarian health care system is characterised by a high degree of centralisation initiated by the central government, the corresponding organisational and financing structures are different. Following other European examples, Hungary introduced the Bismarck-type solidarity system in 1891. The system is funded by social security contributions shared between employees and employers, with an emphasis on equity, i.e., services are provided on the basis of need rather than contribution levels.

After World War II, Hungary adopted the socialist healthcare system of the former Soviet Union, which was based on strong state dominance and exclusive state funding. After regime change, from the 1990s onwards, Hungary, like other socialist countries in Eastern Europe, returned to a Bismarckian approach based on solidarity, while dismantling the socialist health system.

The Hungarian healthcare structure distinguishes between public and private providers, and private healthcare services are subject to fees. The main public providers are the national institutes, teaching hospitals, regional centres, city and county hospitals, clinics, ambulance stations and primary care institutions. Outpatient care is available in primary care institutions, clinics and ambulance stations, and inpatient care is available in higher-level institutions (Boncz, 2011; Boncz and Sebestyén, 2013; Hegedűs, 2021a; Szigeti et al., 2019).

Figure 1 shows the position of regional centres, city and county hospitals, clinics and ambulances, and primary care providers in the system (**Figure 1**). Outpatient care is provided by primary care, clinics and ambulances, while inpatient care is provided by the above-mentioned sectors in addition to outpatient care. Primary care includes general practitioners, public health services, occupational health services, school health services and dental services (Szivós et al., 2024).

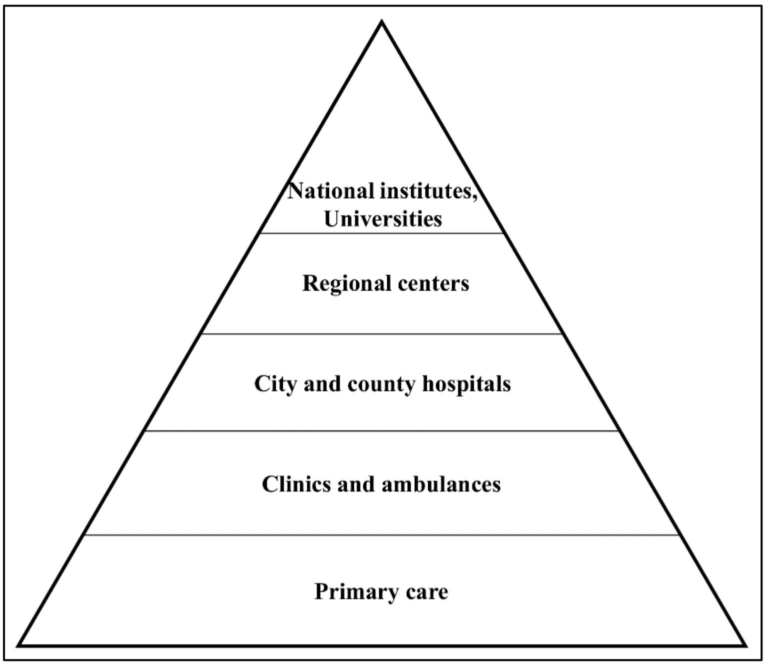

Figure 1. Structure of health services in Hungary.

According to the Statista database, there are 161 public hospitals providing healthcare to the population in Hungary. Hungary's healthcare spending is the sixth lowest in the EU as a share of GDP, after Luxembourg, Romania, Poland, Ireland and Slovakia, with 7.3% of GDP spent on healthcare in 2022. The other Visegrad countries will spend 7.6% of GDP on health, compared to the EU average of 9.1%, as the latter figure allows developed countries to provide high quality and efficient healthcare.

1.2. Theoretical framework

Integration is seen as an opportunity to reform health systems worldwide. Looman's research focused on 17 case studies from 8 European countries and identified 10 mechanisms for successful implementation of integrated care. Specific approaches included effective implementation by successful implementers, the use of a gradual upward growth model, and a balance between flexibility and formal integration structures. Among the mechanisms identified, leadership and governance, the involvement of all stakeholders, the use of collaborative governance and the sharing of leadership at all levels of the system played an important role. Implementers were able to develop a multidisciplinary team culture through mutual recognition of each other's roles. New roles and competencies were built in as incentives. They favoured long-term funding over fragmented funding and emphasised innovative payments. Collaboration and communication were prioritised over administrative procedures, and emphasis was placed on monitoring continuous feedback. Consequently, these efforts resulted in the alignment of different actors and levels of the health and social care system (Looman et al., 2021; Smeets et al., 2023; Troisi et al., 2022). In the light of further international research, we can examine the possible reasons for the failure of integration. Among the factors identified in relation to Belgium are issues that need to be addressed at the meso level, such as power imbalances, political fragmentation, mistrust, lack of clarity on reform efforts, incompatibility of existing funding and the new model, governance gaps, multiple actors on different platforms, inadequate and unclear definition of common goals, and lack of continuous feedback (Steel, 2022).

The current system is at the limits of its capacity due to an ageing population, an increase in the number of patients and a shortage of human resources in the health sector, and is no longer sustainable under current conditions (El Archi et al., 2023; Hegedűs, 2017; Menyhárt et al., 2018).

In recent decades, the high quality of health care has played a prominent role in increasing life expectancy, but it has also become a source of problems due to funding and structural difficulties. Technical and technological advances and the introduction of new procedures have led to rising costs in health care, while health care institutions are struggling to finance the additional costs of compensating for rising wages and other expenses (Hegedűs and Pataki, 2013).

Observing the Hungarian healthcare system, we see that it is constantly changing, and one of the key words in this process, based on the experience of recent years, is the integration of institutions.

The Semmelweis Plan of 2011, which also serves as a handbook for the implementation of hospital integration in Hungary, describes the need to ensure the prerequisites for good health, effective health promotion, health protection, disease prevention and patient care (Beneda et al., 2011). This is unthinkable without an efficient and modern health care system that provides high quality services and is accessible to all inhabitants of the country under nearly equal conditions.

"Although the Semmelweis Plan is in line with Western European efforts that focus on disease prevention, same-day care, patient-centred and cost-effective care, its approach is centralised and its style is autocratic" (Beneda et al., 2011). The Semmelweis Plan reflects the aspirations of Western Europe (Hegedűs and Pataki, 2013; Hegedűs, 2019). The importance of integration was already articulated by the Systems Analysis Department of the Institute for Quality and Organization Development in Pharmacy and Health (now the National Institute of Pharmacy and Food Health) in a 2012 study, which argued that integrated care facilitates collaboration between providers, thereby enabling mandatory cost savings in health care (Asad et al., 2024; WHO, 2008).

In 2013, the integration of outpatient care further complicated the tasks of each institution and increased the need for expert support. It was hoped that with the necessary collaboration and effort, the development of software to support the supervision of healthcare providers would be feasible. They also called for a common approach, transparent data reporting, measurable performance, the development of an evaluation principle, support for each other's work and an increase in the professional status of budget-certified inspectors (Hegedűs, 2013). Unfortunately, it is now clear that integration processes have not always been successful. Debt reduction measures such as frequent changes of direction, constant changes in legislation, over-regulation and rigidity have prevented the unhindered economic development of the health sector (Hegedűs, 2021b).

1.3. Justification

Pressure-related injuries are serious, preventable complications that can increase mortality and healthcare costs. They are associated with pain, infection, longer hospital stays, increased hospital costs and in some cases death (Forster et al., 2021).

Many causes play a role as predisposing factors in the development of decubitus ulcers, making understanding a complex task in which health policy and the health care system play a crucial role, and the results can be used to make recommendations to policy makers to improve the situation (Cseh et al., 2023).

While individual patient safety and quality patient care are largely the result of direct interaction between patient and health professional, the organisation of health services can limit or improve the doctor-patient wound care relationship (Pauline et al., 2018).

The many advantages of treating decubitus ulcers with smart dressings include faster and more effective healing, no or minimal likelihood of complications and lower costs. Decubitus ulcers, the circumferential tissue necrosis caused by prolonged pressure, should be treated as a public health problem. It significantly impairs patients' quality of life, distorts body schema, triggers negative psychological processes and affects patients' life prospects (Bokor, 2014). The importance of the present study is underlined by the fact that decubitus is essentially a diagnosis of nosocomial infections, which is also an indicator of the quality of hospital care (Lăzăroiu et al., 2024). Knowledge of its stages is essential to make the effectiveness of this study meaningful to decision makers: stage I (erythema): represents a reversible condition in which no tissue damage occurs. Stage II (epithelitis): a reversible process with blisters, shallow craters, severe pain, also reversible with appropriate care. Stage III (gangrene) is characterised by subcutaneous connective tissue damage or complete necrosis, which extends deep but does not yet penetrate the fascia (ligament). Stage IV (tissue necrosis) is characterised by full-thickness or complete skin loss, tissue necrosis, muscle and bone damage and damage to the support system. Complications of decubitus may include sepsis, osteomyelitis, malignant degeneration, amyloidosis (starchy, protein-based precipitate that precipitates in tissues). The use of decubitus risk scales to predict the likelihood of decubitus is important in the assessment. The most commonly used scales are: Norton, extended Norton, Braden, Waterloo (Bokor, 2014).

The effective treatment of decubitus ulcers has been a real success over the past decade, thanks to the advent of smart dressings. Not so long ago, in the hospital setting, it was not uncommon for ulcers to be treated with granulated sugar (for its rapid antibacterial, wound disinfectant, anti-oedematous, anti-inflammatory and analgesic effects), in addition to the use of traditional dressings, whose effectiveness in treating ulcers was minimal and often led to wound deterioration.

Most hospitals operate on the principle of "good management", so the question was how inpatient departments use the financial resources available to them. In general, the available budget was not sufficient to cover decubitus treatment. As the effective management of decubitus ulcers is an indicator of the quality of hospital care, it was considered important to set up a decubitus team dedicated exclusively to the care of decubitus patients, monitoring and documenting wounds or lesions, while a separate cost centre was created for the prescription of dressings for decubitus patients. At the same time, the integration of the Holy Cross Hospital in Kalocsa into the Bács-Kiskun County Hospital took place, which, thanks to centralised joint procurement procedures, made it possible to make smart dressings available to the Kalocsa site.

The proper use of smart dressings requires appropriate training and education for both team members and all professionals working in inpatient wards where decubitus may occur. In 2013 and the following 2 years, the use of smart dressings, gauze bandages and preventive devices was demonstrated through several training sessions, in small group (ward) and large group training sessions, The training sessions were documented and a report was produced at the end of the course. In each ward where decubitus ulcers may occur, a colour brochure illustrated with photographs (according to the stages of decubitus) was displayed to demonstrate the use of smart dressings, ensuring consistent and appropriate wound care. Of the 427 qualified staff at the Kalocsa site, 308 attended the training, representing more than 72% of the total number of qualified staff.

A standard institutional protocol for decubitus care has been developed and is available to all staff via the internal IT system document library. The protocols have been trained at institutional level and the head of the decubitus team is currently training all new staff. The members of the decubitus team regularly attend professional training courses and then transfer the knowledge acquired to other staff in small group training sessions. In order to monitor decubitus recovery and the amount of materials used (cost-effectiveness), a decubitus treatment sheet was introduced, which not only made the recovery rate visible, but also made it clear to those coming on subsequent shifts what therapy had been started and where to continue wound care.

To make the health system work more effectively, it is first necessary to identify the problems that may prevent the professionals concerned from doing quality work (Douglas et al., 2011).

Access to and management of smart dressings as modern therapeutic tools and better public awareness can reduce health inequalities, as the Commission of the European Communities has pointed out in Brussels.

From a nursing point of view, the prevention, treatment and effective management of established decubitus ulcers requires a significant investment of time.

Accurate diagnosis–and staging in the case of pressure ulcers - is essential for further improvement of the patient’s condition, as it influences the effectiveness of therapy, the appropriate choice of treatment options, the number of years of health and the patient’s quality of life, which has long-term societal consequences. Governments often see health spending as a short-term investment and are only now beginning to recognise that investment in health can be a key element of economic growth (Byrne, 2004).

This study focuses on one area of health services that ensures effective treatment and equal access to decubitus care.

1.4. Objectives

This study examines the results of the joint integration of three healthcare institutions in Hungary. This structural transformation took place in the Southern

Great Plain region with the merger of three hospitals, the Szent Kereszt Hospital in Kalocsa, the Kiskunfélegyházi Hospital and the Bács-Kiskun County Hospital (BKMK) on 1 February 2013, resulting in one of the first integration models in Hungary (**Figure 2**). The period since integration can provide an objective picture of the feasibility and effectiveness of the Semmelweis Plan. The achievement of the objectives was examined mainly from the Kalocsa side. The cross-section of the present study, limited to decubitus patients, focuses on the assumption that increased access to smart dressings as a result of integration has led to more efficient patient care.

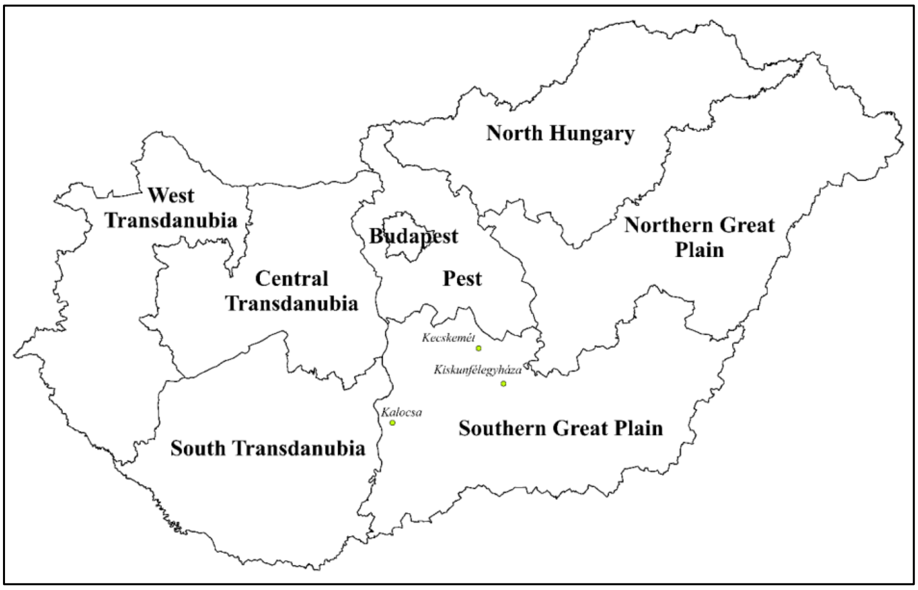

Figure 2. Map of the cities surveyed.

By exploring a small segment of the feasibility of integration-related efficiency factors in Hungary, we aim to show that the given integration model, if not fully developed, contains elements supporting the given goals, while it can serve as an example for other integrated hospitals and provide crucial data for decision makers (Szivós et al., 2024).

The aim of the study is to answer whether the previously mentioned objectives of the Semmelweis Plan, such as efficiency, equity and reduction of regional care inequalities, as well as the promotion of patient safety, have been achieved in the context of the launch of hospital integration models (Beneda et al., 2011).

2. Materials and methods

The process of our research is illustrated in **Figure 3**.

Our quantitative retrospective study was conducted at the Holy Cross Hospital in Kalocsa, Hungary, and the data were obtained from the MedWORKS health system. The health system used by the hospital is an internet-independent health system that contains all patient examination data presented at the hospital. The data was filtered according to different criteria and then processed using Excel. The resulting data was converted by a statistician into SPSS Statistics 25 software using the Python programming language, where the actual statistical analysis was performed.

Accordingly, independent sample *t*-tests were used to compare means between the two periods, while linear trend analysis was used to model changes over time. Structural analysis of the time series was performed using the Chow test. The significance level was set at a uniform 5%.

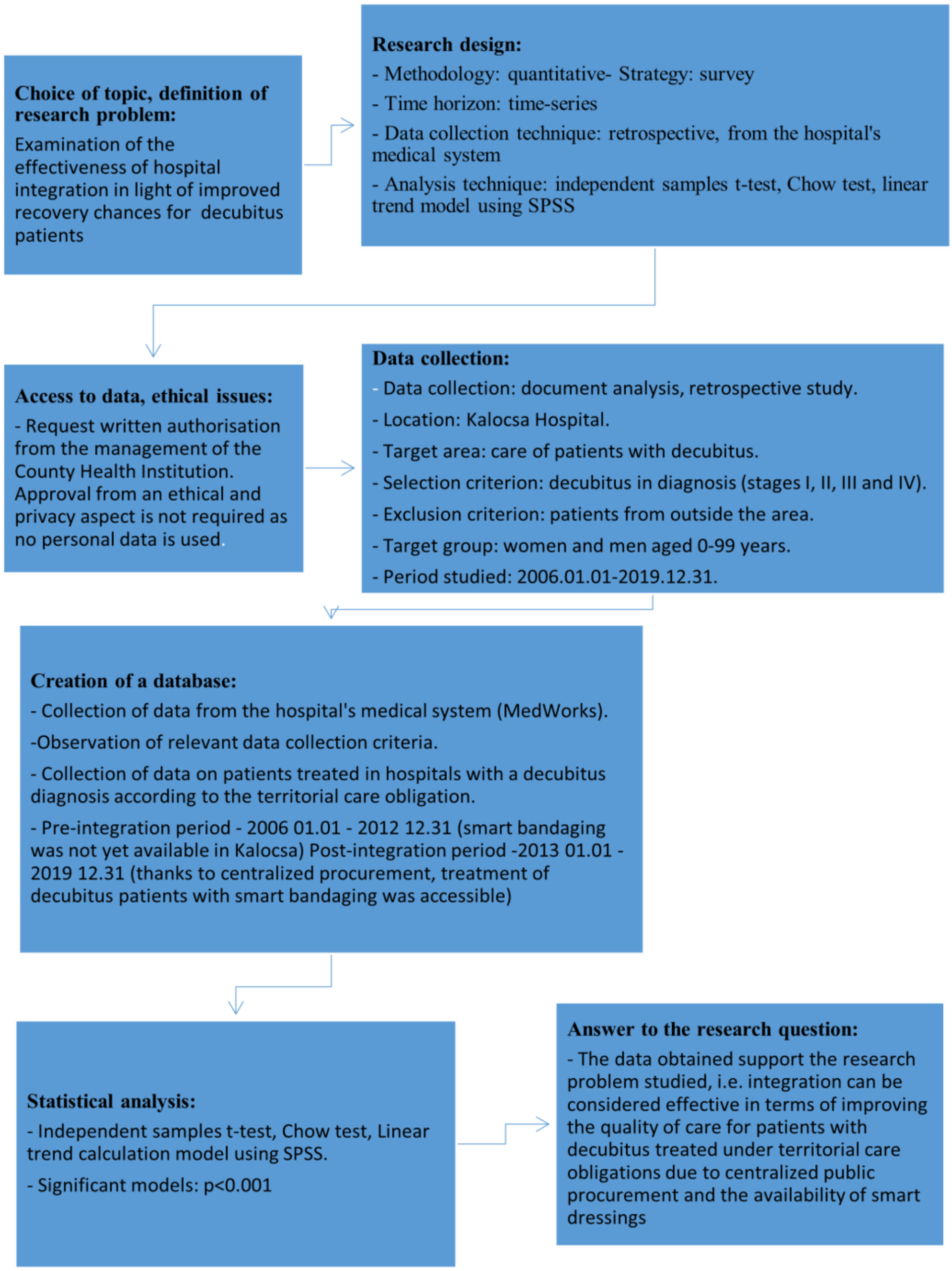

Figure 3. The research process.

Source: own compilation.

The total study sample was 4456 patients. Data were collected by documentary analysis, including patients who were admitted to hospital with a diagnosis of decubitus in the pre-integration period: between 1 January 2006 and 31 December 2012 (using conventional dressings) and patients with the same diagnosis in the post-integration period: between 1 January 2013 and 31 December 2019 (using smart dressings).

When analysing the average number of arrivals in **Table 1**: *t*-tests showed significant differences in stages I, III and IV of decubitus. For Stage I, t (166) = −5.222, $p < 0.001$; for Stage II, t (166) = −0.536, $p = 0.593$; for Stage III, t (166) = 9.858, $p < 0.001$; and for Stage IV, t (166) = 2.351, $p = 0.02$. The results show that there are significant differences in the number of decubitus patients arriving at the hospital before and after hospital integration at different stages. In particular, the quality of care for patients with stage III and IV decubitus appears to improve, as evidenced by the reduction in the average number of such patients after integration. However, the number of patients with stage I decubitus has increased and there has been no significant change for stage II decubitus.

Table 1. Average number of decubitus patients arriving at the Kalocsa site before and after integration (N = 84).

The stage of decubitus	Period	*N*	*M*	SD	Levene (*F*, Szig)	*T*-test (*t*, Szig)
I.	Before integration	84	7.67	1.724	13.145	−5.222
	After integration	84	8.82	1.066	< 0.001	<0.001
II.	Before integration	84	4.21	1.223	0.833	−0.536
	After integration	84	4.31	1.075	0.363	0.593
III.	Before integration	84	1.76	0.830	0.179	9.858
	After integration	84	0.58	0.715	0.673	<0.001
IV.	Before integration	84	0.70	0.724	8.756	2.351
	After integration	84	0.48	0.502	0.004	0.020

Source: own compilation.

The number of arrivals by stage of decubitus is shown in **Figure 4** and **Table 2**.

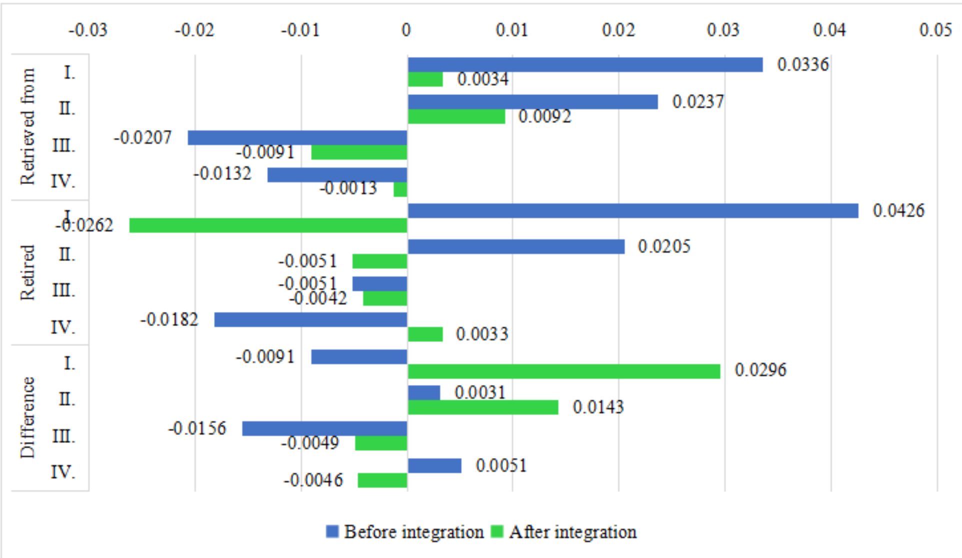

Figure 4. Estimated monthly trends in the number of decubitus patients arriving and leaving hospital and the difference between them (Roman numerals indicate decubitus stages).

Source: own compilation.

Table 2. Results of tests examining trends in the number of patients admitted to hospital with decubitus ulcers by stage of decubitus ulcer.

	I.	**II.**	**III.**	**IV.**
Chow test:				
F (2; 166)	6.950	9.811	3.755	7.317
p-value	0.001	<0.001	0.025	0.001
Full period model (2006–2019):				
R-square	0.222	0.044	0.507	0.087
F (1; 82)	47.290	7.658	171.000	15.790
Szig (*F*)	<0.001	0.006	<0.001	<0.001
permanent	6.983	3.843	2.376	0.913
st. error	0.211	0.175	0.106	0.094
t (82)	33.023	22.003	22.393	9.725
sig (*t*)	<0.001	<0.001	<0.001	<0.001
trend	0.015	0.005	−0.014	−0.004
st. error	0.002	0.002	0.001	0.001
t (82)	6.877	2.767	−13.078	−3.974
sig (*t*)	<0.001	0.006	<0.001	<0.001
Model used for the period before integration (2006–2012):				
R-square	0.225	0.223	0.370	0.196
F (1; 82)	23.860	23.520	48.210	20.000
Szig (*F*)	<0.001	<0.001	<0.001	<0.001
permanent	6.241	3.208	2.642	1.261
st. error	0.336	0.239	0.146	0.144
t (82)	18.568	13.434	18.100	8.766
sig (*t*)	<0.001	<0.001	<0.001	<0.001
trend	0.034	0.024	−0.021	−0.013
st. error	0.007	0.005	0.003	0.003
t (82)	4.885	4.850	−6.943	−4.472
sig (*t*)	<0.001	<0.001	<0.001	<0.001
Model applied for the post-integration period (20013–2019):				
R-square	0.006	0.044	0.096	0.004
F (1; 82)	0.491	3.746	8.668	0.336
Szig (*F*)	0.485	0.056	0.004	0.564
permanent	8.395	3.144	1.730	0.643
st. error	0.620	0.613	0.396	0.292
t (82)	13.545	5.128	4.363	2.198
sig (*t*)	<0.001	<0.001	<0.001	0.031
trend	0.003	0.009	−0.009	−0.001
st. error	0.005	0.005	0.003	0.002
t (82)	0.701	1.936	−2.944	−0.580
sig (*t*)	0.485	0.056	0.004	0.564

Source: own compilation.

Table 2 shows that although integration has improved the quality of care (reflected in the reduction in the number of stage I patients), the change in the model means that the number of stage I decubitus patients has not changed significantly from month to month after integration. Overall, the data support the hypothesis that hospital integration and the introduction of improved care practices have led to a change in the admission of patients with stage I decubitus. For stage II decubitus: the Chow test showed a significant structural break in January 2013, F (1, 166) = 9.81, $p < 0.001$. Prior to the structural break, the model significantly predicted the number of patients arriving. F (1, 166) = 23.52, $p < 0.001$, $R^2 = 0.223$. After integration, the predictive power of the model decreased, F (1, 166) = 3.75, $p = 0.056$, $R^2 = 0.044$. The Chow test confirmed a significant structural change in the trend of stage II decubitus patients in January 2013. Before integration, the model had high significance, explaining about 22.3% of the variance. However, after integration, the predictive power of the model decreased significantly, explaining only 4.4% of the variance. This suggests that after hospital integration, the number of patients arriving did not change significantly from month to month.

For stage III decubitus: the Chow test confirmed that there was a significant structural change in the trend of patient admissions in January 2013 (F (1, 166) = 3.76, $p = 0.025$). Prior to integration, the model significantly predicted patient admissions (F (1, 166) = 48.21, $p < 0.001$, $R^2 = 0.37$).

After the structural break, the model lost most of its predictive power (F (1, 166) = 8.67, $p = 0.004$, $R^2 = 0.096$). Despite this reduction, the trend remained statistically significant, albeit weaker, suggesting that the number of patients continued to decline, albeit to a lesser extent.

For stage IV decubitus: for patients with stage IV decubitus in January 2013, the model showed a significant structural break, F (1, 166) = 7.32, $p = 0.001$. The model for the period before structural change explained 19.6% of the variance, F (1, 166) = 20, $p < 0.001$, $R^2 = 0.196$. After integration, the model lost predictive power, explaining only 0.4% of the variance, F (1, 166) = 0.3362, $p = 0.564$.

3. Results

The primary hypothesis that hospital integration affects the dynamics of decubitus patients, potentially creating a structural break in the data, was robustly supported by the Chow test at all stages, and p-values were highly significant, suggesting a structural break. Although the explanatory power of the regression models was variable (R-squared values ranged from 0.007 to 0.617), they generally supported the change in patient dynamics after integration.

The results provide strong support for the hypothesis that integration and the introduction of new care protocols and technologies have led to improvements in patient care, particularly for patients with more severe forms of decubitus**,** as illustrated in **Figure 5**.

In the analysis of the average number of discharges: t-tests showed that the number of patients leaving hospital at different stages of decubitus decreased significantly after integration. For stage I, t (166) = 9.047, $p < 0.001$; for stage II, t (166) = 15.629, $p < 0.001$; for stage III, t (166) = 18.692, $p < 0.001$; for stage IV, t

(166) = 14.484, $p < 0.001$.

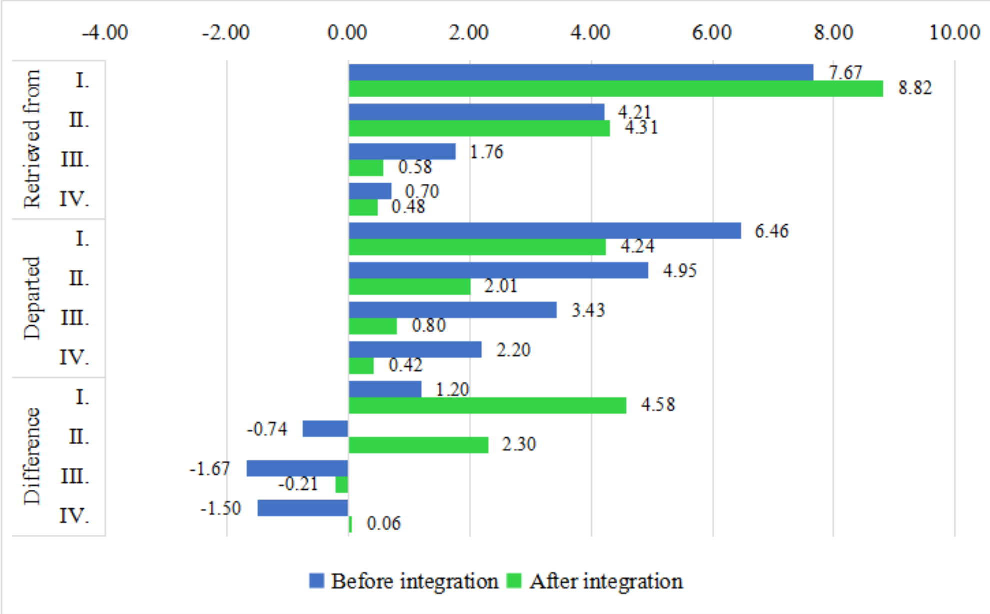

Figure 5. Evolution of the number of patients arriving and leaving hospital and the difference between them according to the stage of decubitus (Roman numerals indicate the stage of decubitus).
Source: own compilation.

The results of the *t*-test clearly show that the number of patients discharged from the hospital with different stages of decubitus decreased significantly after hospital integration. This decrease was most marked for patients with more severe stages III and IV. This is strong evidence of a significant improvement in the quality of care following integration. Overall, the results support the hypothesis that the introduction of central dressing budgeting, decubitus groups and advanced dressings had a positive impact on patient care, as shown in **Table 3**.

Table 3. Trends in the number of patients discharged from hospital with decubitus ulcers by stage of decubitus ulcer (*N*84).

The stage of decubitus	Period	*N*	*M*	SD	Levene (*F*, Szig)	*T*-test (*t*, Szig)
I.	Before integration	84	6.46	1.675	3.357	9.047
	After integration	84	4.24	1.510	0.069	<0.001
II.	Before integration	84	4.95	1.388	11.788	15.629
	After integration	84	2.01	1.024	0.001	<0.001
III.	Before integration	84	3.43	1.112	17.733	18.692
	After integration	84	0.80	0.655	< 0.001	<0.001
IV.	Before integration	84	2.20	0.991	9.012	14.484
	After integration	84	0.42	0.542	0.003	<0.001

Source: own compilation.

For the difference between the mean number of patients arriving at the hospital and leaving the hospital with decubitus, in other words, the difference between the number of patients arriving at different stages of decubitus and leaving the hospital with decubitus, the *t*-test showed significant changes after integration. For stage I t (166) = −16.872, $p < 0.001$; for stage II t (166) = −19.928, $p < 0.001$; for stage III t (166) = −10.078, $p < 0.001$; and for stage IV t (166) = −16.872, $p < 0.001$. t (166) = −14.066, $p < 0.001$. This supports the hypothesis that integration, including the central budget for smart dressings, was effective in improving patient care. The data strongly support the claim that the quality of care improved as a result of these interventions, as shown in **Table 4**, which also shows the difference between the average number of arrivals and departures of patients with decubitus.

Table 4. Differences in the number of decubitus patients arriving and leaving hospital by stage of decubitus (*N*84).

The stage of decubitus	Period	*N*	*M*	SD	Levene (*F*,Szig)	*T*-test (*t*, Szig)
I.	Before integration	84	1.20	1.249	0.484	−16.872
	After integration	84	4.58	1.346	0.488	<0.001
II.	Before integration	84	−0.74	0.933	0.006	−19.928
	After integration	84	2.30	1.039	0.936	< 0.001
III.	Before integration	84	−1.67	1.010	4.087	−10.078
	After integration	84	−0.21	0.851	0.045	< 0.001
IV.	Before integration	84	−1.50	0.871	26.493	−14.066
	After integration	84	0.06	0.523	< 0.001	< 0.001

Source: own compilation.

For stage I decubitus, the Chow test predicted structural fracture in January 2013 (F (1, 166) = 6.95, p = 0.001). Before structural fracture, the model significantly predicted the number of patients (F (1, 166) = 23.86, $p < 0.001$, $R^2 = 0.225$). The results of the *t*-test for the difference between the number of patients arriving and leaving the hospital showed significant changes after integration. For each stage of decubitus, these differences became less negative or positive, suggesting that more patients arrive at the corresponding stage of decubitus than leave. After integration, the model lost predictive power (F (1, 166) = 0.491, p = 0.485, $R^2 = 0.006$). There is evidence that a structural break occurred in January 2013, indicating that hospital integration had a significant effect on the arrival of patients with stage I decubitus. Before integration, the model was statistically significant, explaining about 22.5% of the variance. After integration, the model lost its predictive ability and explained less than 1% of the variance.

Table 5 for stage I decubitus shows that the patient dynamics (arrivals minus discharges) for patients with stage I decubitus show a highly significant structural change, F (1, 166) = 36.51, $p < 0.001$.

The model was very robust over the whole period, explaining 55.8% of the variance and predicting a monthly increase in the net number of patients by 0.0328 units per month, F (1, 166) = 209.3, $p < 0.001$. The models before and after the structural break were significantly different, with *R*-squared values of 3.1% and 28.8%, respectively. This suggests that structural fracture plays a key role in influencing patient dynamics in stage I decubitus.

Table 5. Research data on the trend in the number of patients discharged from hospital with decubitus according to the stage of decubitus.

	I.	**II.**	**III.**	**IV.**
Chow test:				
F (2; 166)	36.514	31.880	36.795	26.727
p-value	<0.001	<0.001	<0.001	<0.001
Full period model (2006–2019):				
R-square	0.558	0.617	0.183	0.411
F (1; 82)	209.300	267.800	37.250	116.000
Szig (*F*)	<0.001	<0.001	<0.001	<0.001
permanent	0.125	−1.695	−1.820	−1.902
st. error	0.221	0.174	0.166	0.127
t (82)	0.567	−9.720	−10.955	−15.034
sig (*t*)	0.571	<0.001	<0.001	<0.001
trend	0.033	0.029	0.010	0.014
st. error	0.002	0.002	0.002	0.001
t (82)	14.468	16.364	6.103	10.770
sig (*t*)	<0.001	<0.001	<0.001	<0.001
Model used for the period before integration (2006–2012):				
R-square	0.031	0.007	0.142	0.020
F (1; 82)	2.662	0.556	13.590	1.681
Szig (*F*)	0.107	0.458	<0.001	0.198
permanent	1.588	−0.872	−1.003	−1.715
st. error	0.272	0.206	0.207	0.191
t (82)	5.831	−4.231	−4.841	−8.978
sig (*t*)	<0.001	<0.001	<0.001	<0.001
trend	−0.009	0.003	−0.016	0.005
st. error	0.006	0.004	0.004	0.004
t (82)	−1.631	0.746	−3.686	1.297
sig (*t*)	0.107	0.458	<0.001	0.198
Model applied for the post-integration period (20013–2019):				
R-square	0.288	0.113	0.020	0.046
F (1; 82)	33.160	10.400	1.649	3.932
Szig (*F*)	<0.001	0.002	0.203	0.051
permanent	0.837	0.491	0.406	0.640
st. error	0.662	0.571	0.491	0.298
t (82)	1.264	0.860	0.825	2.147
sig (*t*)	0.210	0.393	0.412	0.035
trend	0.030	0.014	−0.005	−0.005
st. error	0.005	0.004	0.004	0.002
t (82)	5.758	3.225	−1.284	−1.983
sig (*t*)	<0.001	0.002	0.203	0.051

Source: own compilation.

Importantly, after the structural change, the net monthly number of stage I decubitus patients increased significantly by 0.0296, F (1, 166) = 33.16, $p < 0.001$. For stage II decubitus: a highly significant structural change in the patient dynamics (arrivals minus discharges) of stage II decubitus patients was observed, F (1, 166) = 31.88, $p < 0.001$. The model for the whole period was robust, showing 61.7% of the variance and a net increase in the number of patients by 0.0293 units per month, F (1, 166) = 267.8, $p < 0.001$. The models before and after the structural break were significantly different. The R-squared of the pre-integration model was 0.7%, while the post-integration model explained 11.3% of the variance. Importantly, after the structural change, the net number of patients with stage II decubitus increased by 0.0143 per month, F (1, 166) = 10.4, $p = 0.0018$. For stage III decubitus: a significant structural change in patient dynamics was observed for patients with stage III decubitus, F (1, 166) = 36.80, $p < 0.001$. The model for the full period was relatively weak but significant, explaining 18.3% of the variance in net patient number, F (1, 166) = 37.25, $p < 0.001$. Notably, before the structural change, the net number of patients decreased by 0.0156 units per month, F (1, 166) = 13.59, $p < 0.001$. After the structural change, the model lost most of its explanatory power, with no significant monthly change in the net number of patients, F (1, 166) = 1.649, $p = 0.203$. For stage IV decubitus: a significant structural break was observed in the patient dynamics of patients with stage IV decubitus, F (1, 166) = 26.73, $p < 0.001$. Overall, the model was fairly robust, explaining 41.1% of the variance in net patient number, F (1, 166) = 116, $p < 0.001$. Prior to structural change, the model had little explanatory power, with no significant monthly change in net patient number, F (1, 166) = 1.681, $p = 0.198$.

After structural fracture, the net change in the monthly number of patients was marginally significant, decreasing by 0.0046 units, F (1, 166) = 3.932, $p = 0.051$.

If we apply a SWOT analysis to the integration of Kecskemét and Kalocsa, the strengths include common professional protocols and the opportunities include centralised procurement procedures that allow hospitals to purchase equipment and dressings at lower costs, which, in addition to cost-reducing effects, also leads to a reduction in health inequalities. The SWOT analysis is presented in **Table 6**.

Our hypothesis that integration improves the chances of recovery for patients with decubitus ulcers by providing access to smart dressings that promote patient safety was confirmed. The study sample was 4456 patients and the study period was 7 years. Both the sample size and the analyses provide strong support for our original hypothesis. The study process, inclusion criteria and statistical methods used are described in detail in the flow chart, as well as in the numerous statistical analyses and SWOT analysis presented throughout the study. The independent samples t-test model used was significant (for Phase I: t (166) = −16.872, $p < 0.001$; for Phase II: t (166) = −19.928, $p < 0.001$; for Phase III: t (166) = −19.928, $p < 0.001$; for Phase III: t (166) = −16.872, $p < 0.001$). For stage III: t (166) = −10.078, $p < 0.001$; for stage IV: t (166) = −10.078, $p < 0.001$; for stage III: t (166) = −10.078, p <0.001). for stage III: t (166) = −14.066, $p < 0.001$). For the Chow test, the p-values were highly significant, indicating a structural break. Although the explanatory power of the regression models was variable (R-squared values ranged from 0.007 to 0.617), they generally supported the change in patient dynamics after integration.

Table 6. SWOT analysis.

SWOT	Helps you achieve your goals	Obstacles to achieving the objectives
INSIDE FACTORS (organisational characteristics)	**STRENGTHS** (Strengths) Providing patients with specialised services that could not be provided locally due to a lack of specialist staff, thus implementing the principle of equity, i.e. equal access for patients. Uniform protocols to ensure that all patients receive the same care. Authorisation to participate in training courses with previously awarded TÁMOP funding (travel, participation fees, tuition fees). By taking advantage of the opportunities offered by the tenders, the staff at the Kalocsa site are professionally prepared and trained. Management and staff have adapted well to the changes of recent years (change of management, public ownership, integration). A good working relationship has developed between the staff at the sites. Ct diagnostics, funded by the EU grant TIOP2.2.6B to support integration. The use of a well-functioning IT system will allow telemedicine to be run using the expertise of the professionals working in the BKMK in areas where there are not enough specialists or where it is not necessary to "buy" specialists at huge cost.	**PUBLICATIONS** (Weaknesses) The current leadership is not transparent. It slows down business, creates more red tape. The county hospital cannot provide adequate assistance in the event of staff shortages. The division of labour between sites is not clear enough. The 90 km distance between the two institutions does not allow for a reasonable organisation of logistical processes.
FUTURE FACTORS (environmental characteristics)	**OPPORTUNITIES** (Options) Cost-cutting and cost-effective public procurement, such as the purchase of smart dressings for effective decubitus management, which will make a significant contribution to increasing equal opportunities. Doctors working at the Kalocsa site can participate in BKMK surgeries at any time, learning new techniques to provide patients with the highest level of care. Develop a profile with the necessary capacity (doctor, specialist), which can lead to safer patient care. Obtaining additional TÁMOP-type grants to support training. Improving psychiatric rehabilitation. using our TIOP 2.2.6 resources.	**TRIALS** (Threats) If the infrastructural conditions to facilitate integration had not been provided by TIOP 2.2.6 funding, it would not have been possible to achieve efficient and economical operation, which would have jeopardised the sustainability of integration. More doctors are emigrating.

Source: own compilation.

Welfare systems are only partially able to adapt to change due to a lack of resources, and therefore health integration cannot be assessed in isolation (Josep et al., 2008). When interpreting the functions of the health system, attention should be paid to the financing of health services, the quality of care, the development of resources and the appropriate level of government intervention (Carrin, 2003).

In line with the above findings, the present study can nevertheless be considered as a fruitful contribution to the study of this segment of integration. In our previous study, we investigated the effectiveness of integration from a different perspective, through CT diagnostic access, which was also found to be effective (Szivós et al., 2024). We investigated the direct effects of integration through real-life examples.

According to the well-known Maslow pyramid, human needs are hierarchical, and progression to higher levels can occur when the previous level is met. The second level is security, which includes the protection of health (Maslow, 1943). In their research, Bummi and his colleague argue, in line with Maslow's model, that the satisfaction of all these needs is necessary for the proper functioning of the individual and that the satisfaction of these needs is critical for physical and mental well-being. Unfortunately, health inequalities also exist in developed countries. This may be due to long travel distances, lack of infrastructure and staff, or lack of knowledge about individual health (Omodan et al., 2022). It is very important to highlight that these factors can indirectly lead to a deterioration in an individual's health status, which can reduce productivity (Bummi and Samuel, 2022). The European Union is also paying particular attention to the issue of health inequalities and smart health tourism, which can be addressed by widening the scope and accessibility of health facilities (El Archi et al., 2023).

The above-mentioned studies may support the claims of the present study, which call for reducing health inequalities by providing effective treatment for patients with decubitus ulcers, whose condition would be further exacerbated if conventional dressings were used. Gulyás (2013) reiterates that the state guarantees access to health care and basic health services. Gulyás's (2013) previous study is supported by the present research, highlighting that proper management of patients with decubitus can help to maintain health and access to effective health services guaranteed by the state in the basic integration requirements launched under the Semmelweis Plan. Effective wound care requires the use of smart dressings, the creation of a team for decubitus care, the redistribution of dressing material from the medical stock, regular specialist training of staff in recognising the stages of decubitus, the effective selection of smart dressings and the care of specific wounds. Furthermore, the involvement of relatives in the care of the lesions—allows wound care to continue in the patients' homes and brings the issue closer to the public.

4. Discussion

In Hungary, one of the pillars of the structural transformation plan of the State Secretariat for Health of the Ministry of National Resources was the development of an integrated care system at county level, with measures to improve patient care (EMMI, 2021). To achieve this and to exploit the potential of modern medicine, the central procurement of smart dressings should support safe patient care in acute and chronic care facilities. The current system is at the limits of its capacity to cope with an ageing population, an increase in the number of patients and a shortage of human resources in the health sector. This also means that the health care system is no longer sustainable under unchanged conditions and must respond to technological advances, ageing populations and increased population expectations (Mossialos et al., 2002).

Before the integration of the hospitals, Kalocsa could not effectively care for patients with decubitus, which often led to death due to complications caused by the lack of smart dressings, common protocols, a dedicated financial framework and continuous training of staff. When indicators of the quality of care provided in the hospital were calculated, the incidence of decubitus ulcers and the deterioration of the ulcer condition showed shocking results, highlighting the need for immediate action without any delay.

The primary objective of the present study was to explore the effectiveness of integration and equity of access to health services in the context of decubitus management through the availability of smart dressings through centralized procurement.

The results of the statistical analyses can provide feedback to the healthcare decision-makers developing the Semmelweis Plan on the measurability and tangibility of the efficiency gains expected from integration. The total study sample size was 4456 patients. Independent samples *t*-tests were used to compare means between the two periods, while linear trend analysis was used to model changes over time. Structural analysis of the time series was performed using the Chow test. The results of the *t*-test clearly show that the number of patients discharged from hospital with decubitus at different stages decreased significantly after hospital integration. This decrease was most marked for patients with more severe stages III and IV. This is strong evidence of a significant improvement in the quality of care following integration. Chow's test robustly confirmed at all stages that hospital integration affects the dynamics of decubitus patients, potentially creating a structural break in the data, with highly significant p-values indicating a structural break. In the linear trend analysis, no change was detected in the number of patients arriving, while a decrease was detected in the number of patients leaving with decubitus. The SWOT analysis showed that the strengths of the integration of the hospitals of Kecskemét and Kalocsa lie in the common professional protocols and the opportunities include centralised procurement procedures, which allow the hospitals to procure equipment and dressings at lower costs, thus reducing costs and health inequalities. More studies and feedback of this kind are likely to be needed in the future, as it now seems that experts in health care organisation and reorganisation around the world believe that integration could be a way of allocating resources, redesigning and building a new health system that is more efficient, more responsive to patients' needs and more supportive of health equity.

This has positively changed access to care, while reducing mortality for patients of public health priority and the cost of treating patients with preadmission decubitus. The availability of smart dressings, thanks to integration, common protocols and the hospital's own measures, has greatly increased patients' chances of recovery, significantly reducing health inequalities. As patients' chances of recovery and survival increase, economic impacts such as shorter sick leave and early return to work, as well as the individual's return to 'productivity', are again positively felt (Szivós et al., 2024).

The link between health and economic growth is well known, as healthy individuals are less likely to be absent from their jobs and show higher levels of efficiency and effectiveness (Frenk, 2004). Thus, investments in health infrastructure and initiatives such as hospital integration not only improve health outcomes but also have an impact on economic performance, highlighting the link between health and socio-economic development.

4.1. Limitations and future directions

Despite the promising results observed in this study, it is important to acknowledge the limitations. The study period (1 January 2006–31 December 2019) does not necessarily capture long-term effects or potential changes in patient demographics and health needs. Furthermore, although the study focuses on the impact of smart dressing management of decubitus ulcers in the context of integration, other factors affecting health care and patient outcomes may not have been fully considered.

Future research should explore the lasting effects of hospital integration on patient care outcomes beyond the initial implementation phase. In addition, examining the wider implications of health system transformation, including the integration of additional diagnostic and treatment modalities, can provide comprehensive insights into building a more flexible and patient-centred health system. Although this study highlights the tangible benefits of hospital integration in improving patient care and promoting health equity, further research is needed to fully understand the long-term effects and to inform future healthcare policy makers and the professional practice community.

4.2. Relevance

The study was conducted in a single hospital in Hungary, which is truly significant as it represents a pioneering integration initiative in the country. This unique context underlines the importance of the study as it provides empirical evidence and feedback that is essential for evaluating the effectiveness of the integration efforts outlined in the Semmelweis Plan.

Given the lack of similar studies and the key role of real data and feedback in shaping future integration strategies, the results of this study are of considerable value in adding to the body of knowledge on health integration. The insights gained from the study not only shed light on the concrete outcomes and consequences of integration at the level of individual hospitals, but also provide a basis for guiding future integration efforts in healthcare across Hungary.

This study, as the first major integration initiative in Hungary, provides valuable insights into the challenges, successes and opportunities associated with hospital integration, and thus lays the groundwork for future research aimed at comprehensively assessing the long-term impact and sustainability of integration efforts. Further studies exploring the different aspects of integration, its impact on health care, patient outcomes and health equity are essential for evidence-based policy making and refining integration strategies to optimise health care and promote equitable access to services in the Hungarian health care system (Szivós et al., 2024).

5. Conclusion

Compared to the results of the above study, Hungary is still at the beginning of effective integration, but the data provide a workable example for the domestic health policy sector and decision-makers.

The aim of the study was to show how equal access to health services was achieved in the South Great Plain region in 2013, specifically for the city of Kalocsa and its nearly 70,000 inhabitants, through the implementation of hospital integration. The integration efforts have resulted in the availability of previously unavailable smart dressings, uniform protocols, regular professional education for the effective management of decubitus ulcers, giving patients the chance to achieve health equity in terms of preserving their health, treating wounds effectively and quickly and avoiding preventable deaths. Research highlights that the creation of favourable health conditions at the micro level plays a crucial role in enhancing productivity and thus macroeconomic performance (Bloom and Canning, 2000).

This study represents nearly a decade and a half of specialized research in the Hungarian health care sector, focusing on the significant benefits of expanding access to smart dressings for effective decubitus management. Our statistical analyses support the multiple benefits of making decubitus management with these types of dressings available, a key moment of which is the integration of rural health facilities, which, in conjunction with the opportunities offered by smart dressings, leads to increased access to effective decubitus management. The local provision of tools to support modern treatment will contribute to reducing health inequalities, a key priority of the European Commission in Brussels.

Through hospital integration, our research shows that access to diagnostic services that support modern wound care can be significantly improved, reducing health inequalities, improving access to appropriate care for a wider range of patients and increasing the range of health services available locally. In addition, integration has led to tangible benefits such as reduced costs, improved public health indicators and reduced absenteeism among working-age people, thereby reducing spatial inequalities in health care.

In line with the Semmelweis Plan's objectives of efficiency, equity and reducing spatial disparities in care, hospital integration has effectively enabled local populations to access high quality preventive and therapeutic services without increasing costs. Achieving equal access, as highlighted in our study, is a feasible outcome, taking advantage of the opportunities offered by integration initiatives.

Importantly, our findings suggest that integration has a positive impact on reducing health inequalities by making appropriate and safe specialist care locally available, emphasising the importance of prevention, reducing mortality from complications of inappropriate wound care and speeding up patient recovery, ultimately helping to return to the labour market more quickly and contributing to macroeconomic growth.

Following the use of smart dressings in decubitus care, it is clear that a significant proportion of patients with decubitus have improved or recovered from decubitus. Access to appropriate, high quality pressure ulcer care has improved. Spatial disparities in care have been significantly reduced. One of the cornerstones of the Ministry of National Resources' State Secretariat for Health's restructuring plan was the development of an integrated care system at county level, with measures to improve patient care. In order to achieve this goal and to take advantage of the opportunities offered by modern medicine, it is essential that all health care institutions have the appropriate equipment for safe, high-quality and uniform patient care, in this case a wide range of smart dressings. In the light of the above, the quality of patient care and access to care can be greatly improved through integration. In the light of this study, ensuring equal access, with its positive benefits, has become a realistic option in terms of the opportunities offered and exploited by integration.

In summary, the integration of health services has significantly improved the quality of patient care and access to health care, highlighting its importance in addressing health inequalities and promoting economic prosperity at both micro and macro levels.

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