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Coronavirus Pandemic

What is the current state of patient and family education on infection control? A descriptive study during COVID-19

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Abstract
Introduction: With the rise of multidrug-resistant healthcare-associated infections (HAIs) and the recent emergence of coronavirus disease 2019 (COVID-19), patient and family member engagement in infection control (IC) has gained increased attention. This study aimed to assess the level of education provided to patients and family members on IC measures in Hungary.

Methodology: A cross-sectional study was conducted among 412 patients and family members from seven hospitals in Hungary during the COVID-19 pandemic. A previously developed questionnaire, based on the Centers for Disease Control and Prevention guidelines for isolation precautions, specifically the section on patient and family education, was used to assess education on several IC measures.

Results: Of the 412 participants, 89.6% were patients, 59.2% were female, and 18.7% were experiencing their first hospital admission. The highest percentages of education were on respiratory hygiene (89.8%), HAIs (82.5%), and hand hygiene (82%). Regression analysis showed that counties were significant predictors of education on nearly all IC measures.

Conclusions: This study reveals a high percentage of education on IC measures among patients and family members education in Hungary, in comparison to the existing literature. To sustain this high level of education, it is recommended that Hungarian health authorities incorporate IC patient and family education into the government regulations governing IC practices in hospitals. Additionally, hospitals should foster a more participatory environment for patients and family members in IC.

Key words: COVID-19; infection control; patient education as topic; patient participation.

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Introduction

Healthcare-associated infections (HAIs) are the most common adverse event in healthcare settings worldwide [1,2]. An estimated 1.4 million people are affected by HAIs globally at any given time [3], contributing to increased mortality rates and significant financial burdens on healthcare systems [4]. The prevalence of HAIs across European countries ranges from 3.5% to 10% [5], while the incidence of multidrug-resistant (MDR) HAIs in Hungary was 29.35 per 100,000 patient days in 2017 [6].

In recent decades, the healthcare system has shifted toward providing patient-centered care to improve patient safety [7,8]. Patient-centered care emphasizes the empowerment and involvement of patients in the healthcare process, with a focus on health, education, and prevention rather than disease and treatment [9]. Patient empowerment begins with educating individuals about their health status, enabling them to actively participate in treatment decisions [8,9]. Several studies have demonstrated that empowered patients, who are engaged in healthcare decision-making, experience better outcomes compared to those who are not involved [9]. A quasi-experimental study by Pokrywkas *et al*. [10] indicated that patient education on hand hygiene (HH) significantly improved patient HH performance ($p < 0.0001$). This improvement had a positive effect on *Clostridium difficile* standardized infection ratios at the hospital, with ratios decreasing significantly for 6 months ($p \leq 0.05$) following the patient HH education intervention.

Despite progress in patient safety, HAIs continue to spread among hospitalized patients [8]. The World Health Organization has recommended several strategies to prevent HAIs, including the implementation of proper infection control (IC) measures (such as HH and standard precautions (SPs)), improving reporting and surveillance systems, ensuring the availability of resources for HAI surveillance, enhancing staff education and accountability, and conducting research on the involvement of patients and their families in HAI reporting and control [4]. Additionally, several studies have demonstrated that patients and family members can play a role in preventing the transmission of HAIs [10-13]. Consequently, greater emphasis has been placed on empowering patients and their families, and actively involving them in IC practices [13]. The Centers for Disease Control and Prevention (CDC) has also recommended educating patients on various IC measures. According to CDC guidelines for isolation precautions, patients can be provided with information on HH and respiratory hygiene/cough etiquette upon hospital admission, as well as information on isolation precautions, the reasons for isolation, and the use of personal protective equipment (PPE) when isolation is initiated [13]. Furthermore, the emergence of coronavirus disease 2019 (COVID-19) has become a global health concern [14], underscoring the importance of public education in enabling patients to prevent infection [15].

A recent systematic review [16] examined patient education on IC worldwide. The review included 25 studies that assessed patient education on various IC measures, such as HAIs, central line-associated bloodstream infections, surgical site infections, HH, the rationale of isolation, isolation precautions, the use of PPE, and respiratory hygiene. Only 2 studies assessed patient education on multiple IC measures, while the remaining studies focused on 1 or 2 measures. The review identified a low percentage of IC education among hospitalized patients and emphasized the need for increased patient involvement in IC practices [16].

In Hungary, the government regulations governing IC practices in healthcare institutions [17] mandate that all healthcare institutions providing inpatient care develop and implement an IC program aimed at reducing and monitoring the transmission of HAIs and communicable diseases. Institutions with over 400 beds are required to establish an independent IC unit to oversee IC activities. However, the current Hungarian government regulation does not include standards for patient and family education on IC practices, leaving healthcare institutions without an obligation to educate patients and family members on these measures. Addressing this gap in the regulation is essential to enhance patient safety.

To date, research on patient education regarding IC has predominantly focused on HH [10,18-22] and HAIs, including risks, severity, transmission routes, and prevention [23-25], despite the fact that IC programs encompass a wide range of measures and processes throughout hospitals.. Education on IC measures beyond HH and HAIs, however, remains underexplored. This study seeks to address this research gap. Additionally, no previous studies have been identified that examine patient and family member education on IC in Hungary, underscoring the need for a detailed assessment of such education, particularly in light of the current COVID-19 pandemic. Therefore, the objective of this study is to assess patient and family member education on IC measures in Hungary.

Methodology

Study design, setting, and inclusion criteria

This study used a multisite, cross-sectional design. Due to the inability to survey all hospitals in Hungary, hospitals in the Southern Transdanubian region (excluding specialized clinics) were invited to participate. The Southern Transdanubian region of Hungary comprises 3 counties: Baranya, Somogy, and Tolna. Approval was obtained from a total of 7 hospitals.

Inclusion criteria for participation required patients to be admitted to inpatient units (medicine, surgery, critical care units, obstetrics-gynecology, and hematology-oncology), aged 18 years or older, admitted for at least 24 hours, conscious, and willing to complete the questionnaire. Family members caring for or staying with patients, regardless of the patient's age (including pediatric patients under 18 years old), and willing to complete the questionnaire, were also included. However, visitors were excluded from the study.

Data collection and samples

Upon receiving the approval from each hospital, hard copies of the questionnaires were provided to the hospital's top management. Hard copies were distributed instead of online questionnaires to minimize nonresponse bias. Prior to data collection, clear instructions were given to head nurses to ensure consistent distribution across different hospitals and units, reducing potential bias. Head nurses distributed the questionnaires to a convenience sample of eligible patients and family members present during the data collection period. Questionnaires were administered during the patients' hospital stay to maximize participation and minimize recall bias. Patients were approached between their second day of admission and discharge to ensure they had the opportunity to receive education. Head nurses later collected the completed questionnaires. The researcher retrieved the questionnaires 3 months later. Data collection began in February 2020 and concluded in June 2021.

The required sample size was calculated using the Thompson equation [26].

$$n = \frac{N \times p(1-p)}{[N - 1 \times (d^2 \div z^2)] + p(1-p)}$$

With the total number of operational hospital beds in Hungary as the population size (N = 68 112 beds) [27], an estimated variability of 0.5 (p), margin of error of 0.05 (d), and a z-score of 1.96 (z), the required sample size was determined to be 382 participants.

The questionnaire

According to a previous systematic review on patient education regarding IC measures [16], only 2 studies have examined patient education on multiple IC measures. The first study, conducted by Merle *et al.* [28], assessed patient education on HAIs, risk factors for HAIs, IC methods, and the organization of IC within the hospital. The second study, conducted by Hammoud *et al.* [29], examined patient and family education on various IC measures using a questionnaire developed in accordance with the CDC guidelines for isolation precautions, specifically the section related to patient and family education [13]. In this study, a modified version of the questionnaire developed by Hammoud *et al.* was employed [29]. Permission to use the tool was not required, as it is available under Creative Commons Attribution 4.0 International (CC BY-NC-ND 4.0). The self-administered questionnaire consisted of 2 parts: the first part gathered demographics information such as gender, age, educational degree, and admission status of patients and family members, in addition to details about the county, hospital type, and nursing unit. The second part included 9 close-ended questions (1 more than the original questionnaire) concerning the education provided by nurses on HAIs, the risks of acquiring an HAI, HH, respiratory hygiene/cough etiquette, the receipt of flyers on HH and/or respiratory hygiene, isolation status, education on the reason for isolation and the use of PPE, as well as the timing of the provided education. Education on HH was the question that was added to the original questionnaire. No questions were specifically added to assess patient education on COVID-19, as the aim was to assess education on IC measures generally, which are applicable to both HAIs and disease outbreaks. Responses to each question were coded as Yes (1) or No (0).

Translation and validation of the questionnaire

It was not possible to distribute the questionnaires in English, the original language of the questionnaire, as most patients did not speak English, and Hungarian is the official language in Hungary. Therefore, translation and validation guidelines [30] were followed for translating the questionnaire. First, 2 Ph.D. candidates independently translated the questionnaire from English into Hungarian. Second, proofreading and comparison of the 2 translated versions were conducted by a committee, which resulted in a unified Hungarian version. Following this, blind back-translation into English was performed by 2 other Ph.D. candidates, again separately. All 4 individuals involved in the translation and back-translation process were bilingual Hungarian nationals, Ph.D. candidates in health sciences, and experts in the healthcare domain.

Subsequently, a comparison was made between the 2 back-translated questionnaires and the original English questionnaire. This comparison focused on the similarity of the questions, wording, sentence structure, meaning, and relevance. The comparison was performed by a Hungarian associate professor of linguistics and a bilingual medical doctor, both knowledgeable in health terminology and IC. This process resulted in the final Hungarian version of the questionnaire.

The content validity of the Hungarian questionnaire was assessed by a panel of 4 experts: an IC specialist, a physician, and 2 nurses. Content validity measures the content relevance of the tool's items [31]. The item content validity index (I-CVI) and scale content validity index (S-CVI/Ave) were calculated to determine the content validity [32]. Following Davis's method [33], a 4-point scale was used to rate item relevance: 1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, and 4 = highly relevant. The I-CVI for each item was then calculated as the number of panel members giving a rating of 3 or 4, divided by the total number of panel members. The S-CVI/Ave was calculated as the average of the I-CVIs [32]. According to Lynn [31] and to Polit and Beck [32], an I-CVI of 1 for panels with ≤ 5 members and an S-CVI/Ave ≥ 0.90 were considered satisfactory. All 9 questionnaire items had an I-CVI of 1, resulting in an S-CVI/Ave of 1 for the total items. Thus, the content validity of the final questionnaire was deemed satisfactory.

A pilot study was subsequently conducted on 15 patients and family members to assess the questionnaire's readability and internal consistency. The average completion time was 12 minutes. Based on feedback from this pilot study, minor wording changes were made. Cronbach's alpha for internal consistency was 0.814, similar to the original questionnaire value of 0.877, indicating a very good reliability coefficient.

Data analysis

Data analysis was conducted using SPSS version 20. Following the completion of data collection, data entry was performed using an Excel spreadsheet that contained all questionnaire items. The data were then coded and subsequently imported into SPSS, where the codes were verified. Descriptive statistics were initially applied. Frequencies and percentages were used for categorical variables, while the mean and standard deviation (SD) were used for the only continuous variable in the dataset (age). Next, variance analysis was performed. Since the dependent variable (IC education) was categorical, the Chi-square (χ^2) test or Fisher's exact test was used to assess the difference in IC education across demographic groups (independent variables). Finally, logistic regression analysis was conducted to identify independent predictors of patient and family education on each IC measure. All demographic variables were included in the logistic regression. The significance level was set at $p < 0.05$. Incomplete questionnaires were excluded from the analysis to manage missing data.

Table 1. Demographic characteristics of participants (n = 412).

Demographics	Respondents, n (%)
Status	
Patient	369 (89.6)
Family member	43 (10.4)
Gender	
Female	244 (59.2)
Male	168 (40.8)
Age (years)	
18-27	36 (8.7)
28-37	70 (17.0)
38-47	50 (12.1)
48-57	74 (18.0)
58-67	77 (18.7)
68-77	83 (20.1)
> 77	22 (5.3)
County	
Baranya	142 (34.5)
Tolna	125 (30.3)
Somogy	145 (35.2)
Hospital type	
City	135 (32.8)
County	211 (51.2)
University	66 (16.0)
Department	
Medicine	79 (19.2)
Surgery	128 (31.1)
Critical care unit	23 (5.6)
Obstetrics-Gynecology	72 (17.5)
Hematology-Oncology	94 (22.8)
Pediatrics	16 (3.9)
Educational level	
Elementary school	109 (26.5)
Secondary school	236 (57.3)
University degree	67 (16.3)
First hospital admission	
No	335 (81.3)
Yes	77 (18.7)

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki and received ethical approval from the Regional Research Ethics Committee of the Medical Center, Pécs, Hungary (Record number: 7862 - PTE 2019). Prior to administering the questionnaires, participants were informed that their participation was voluntary and anonymous. Written informed consent was obtained from all participants. No complaints were reported during the study.

Results

Demographic characteristics

Of the 7 included hospitals in the study, 3 were located in Baranya County, 3 in Tolna, and 1 in Somogy. All 7 hospitals were public institutions, comprising 1 university hospital, 2 county hospitals, and 4 city hospitals. A total of 418 participants responded out of 760 participants invited, yielding a response rate of 55%. After reviewing the incomplete questionnaires, 6 were excluded, resulting in a final sample size of 412 participants.

Of the 412 participants, 89.6% were patients, and 59.2% were female. The participants' ages ranged between 18 to 90 years, with a mean age (± SD) of 52.67 ± 17.442 years. A total of 57.3% of participants had a secondary school degree, and 18.7% were experiencing their first hospital admission. The complete demographic details of the respondents are presented in Table 1.

Infection control education of patients and family members (provided by nurses)

The highest percentage of education was related to respiratory hygiene/cough etiquette, with 89.8% of participants reporting receiving this education, while the lowest percentage (75.7%) reported receiving brochures on HH and/or respiratory hygiene. Regarding the timing of education, the majority of participants (62.6%) indicated that they were educated upon admission and during their hospital stay. The results of all IC education questions are presented in Table 2.

Table 2. Participants' education on infection control measures (n = 412).

Infection control education (provided by nurses)	Respondents, n (%)	
	Yes	No
Educated on healthcare-associated infections	340 (82.5)	72 (17.5)
Educated on the risks of acquiring a healthcare-associated infection	326 (79.1)	86 (20.9)
Educated on hand hygiene	338 (82.0)	74 (18.0)
Educated on respiratory hygiene/cough etiquette	370 (89.8)	42 (10.2)
Provided with brochures on hand hygiene and/or respiratory hygiene	312 (75.7)	100 (24.3)
I am in isolation right now	84 (20.4)	328 (79.6)
Educated on the reason for isolation†	68 (81.0)	16 (19.0)
Educated on the use of personal protective equipment†	67 (79.8)	17 (20.2)
Time of education		
Upon admission	128 (31.1)	
Upon admission and during the stay	258 (62.6)	
Upon discharge (previous admission)	48 (11.7)	
No education was given	11 (2.7)	

† Percentages were calculated from a total of 84 participants who were in isolation.

Table 3. Patients' and family members' education on infection control across demographics (n = 412).

Education on HAIs			
	Yes, n (%)	No, n (%)	*p* value
County			
Baranya	108 (76.1)	34 (23.9)	0.001
Tolna	99 (79.2)	26 (20.8)	
Somogy	133 (91.7)	12 (8.3)	
Ward/Unit			
Medicine	67 (84.8)	12 (15.2)	0.001
Surgery	97 (75.8)	31 (24.2)	
Critical care units	21 (91.3)	2 (8.7)	
Obstetrics-Gynecology	52 (72.2)	20 (27.8)	
Hematology-Oncology	87 (92.6)	7 (7.4)	
Pediatrics	16 (100)	0 (0)	
Admission			
Not first admission	270 (80.6)	65 (19.4)	0.032
First admission	70 (90.9)	7 (9.1)	

Education on risks of HAIs			
	Yes, n (%)	No, n (%)	*p* value
County			
Baranya	99 (69.7)	43 (30.3)	< 0.001
Tolna	94 (75.2)	31 (24.8)	
Somogy	133 (91.7)	12 (8.3)	

Education on respiratory hygiene			
	Yes, n (%)	No, n (%)	*p* value
County			
Baranya	109 (76.8)	33 (23.2)	< 0.001
Tolna	122 (97.6)	3 (2.4)	
Somogy	139 (95.9)	6 (4.1)	
Type of hospital			
City hospital	116 (85.9)	19 (14.1)	< 0.001
County hospital	203 (96.2)	8 (3.8)	
University hospital	51 (77.3)	15 (22.7)	
Ward/unit			
Medicine	65 (82.3)	14 (17.7)	< 0.001
Surgery	124 (96.9)	4 (3.1)	
Critical care unit	18 (78.3)	5 (21.7)	
Obstetrics-Gynecology	59 (81.9)	13 (18.1)	
Hematology-Oncology	89 (94.7)	5 (5.3)	
Pediatrics	15 (93.8)	1 (6.2)	

Education on hand hygiene			
	Yes, n (%)	No, n (%)	*p* value
County			
Baranya	106 (74.6)	36 (25.4)	0.018
Tolna	108 (86.4)	17 (13.6)	
Somogy	124 (85.5)	21 (14.5)	

Receiving brochures on hand hygiene and/or respiratory hygiene			
	Yes, n (%)	No, n (%)	*p* value
County			
Baranya	102 (71.8)	40 (28.2)	< 0.001
Tolna	84 (67.2)	41 (32.8)	
Somogy	126 (86.9)	19 (13.1)	
Ward/unit			
Medicine	62 (78.5)	17 (21.5)	0.019
Surgery	96 (75)	32 (25)	
Critical care unit	17 (73.9)	6 (26.1)	
Obstetrics-Gynecology	44 (61.1)	28 (38.9)	
Hematology-Oncology	79 (84)	15 (16)	
Pediatrics	14 (87.5)	2 (12.5)	

Education on use of PPE			
	Yes, n (%)	No, n (%)	*p* value
County			
Baranya	19 (79.2)	5 (20.8)	0.012
Tolna	31 (93.9)	2 (6.1)	
Somogy	17 (63)	10 (37)	

Chi-square (χ^2) was used for the comparison; HAIs: healthcare-associated infections; PPE: personal protective equipment.

Variance analysis (patient and family education on infection control across demographics)

Table 3 presents the results of the variance in IC education for patients and family members across demographic groups. Only significant results are displayed in this table. The percentage of IC education did not vary by participant status (patient or family member), gender, age, or educational level; however, it varied across different counties. For example, participants from Somogy had the highest percentages of education on HAIs ($p = 0.001$), the risks of HAIs ($p < 0.001$), and receiving flyers on HH and/or respiratory hygiene ($p < 0.001$). On the other hand, participants from Tolna had the highest percentages of education on HH ($p = 0.018$), respiratory hygiene ($p < 0.001$), and the use of PPE ($p = 0.012$).

IC education varied across hospital departments. Participants from pediatrics and hematology-oncology departments had the highest percentages of education on HAIs ($p = 0.001$) and receiving flyers on HH and/or respiratory hygiene ($p = 0.019$). Additionally, participants from the surgery, hematology-oncology, and pediatrics departments reported the highest percentages of education on respiratory hygiene ($p < 0.001$).

Education on respiratory hygiene varied across different hospitals, the highest percentage reported among participants from the county hospitals ($p < 0.001$). Finally, education on HAIs differed based on participants' admission status, with those experiencing their first hospital admission being more educated than their counterparts ($p = 0.032$).

Logistic regression analysis

The logistic regression analysis presented in Table 4 revealed a significant association between Hungarian counties and patient and family IC education. Participants from Somogy County were 3.5 times more likely to receive education on HAIs (95% CI: 1.723-7.064), 4.8 times more likely to be educated on the risks of HAIs (95% CI: 2.413-9.605), and 2.6 times more likely to receive brochures on HH and/or respiratory hygiene during hospitalization (95% CI: 1.420-4.764) compared to participants from Baranya County. Additionally, participants from both Tolna and Somogy were twice as likely to receive education on HH (95% CI: 1.142-4.075 and 95% CI: 1.103-3.644, respectively). Furthermore, being in Tolna increased the likelihood of receiving education on respiratory hygiene by 12 times (95% CI: 3.672-41.280), while being in Somogy increased the likelihood by 7 times (95% CI: 2.837-17.342).

Significant associations were also found between hospital type, ward/unit, and admission status and IC

Table 4. Logistic regression analysis of factors associated with infection control education of patients and family members (n = 412).

	Education on HAIs		**Education on risks of HAIs**		**Education on hand hygiene**	
Predictor	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
County						
Baranya	Reference					
Tolna	1.199	0.672-2.139	1.317	0.767-2.263	2.158	1.142-4.075*
Somogy	3.489	1.723-7.064**	4.814	2.413-9.605***	2.005	1.103-3.644*
Admission						
First admission	2.407	1.057-5.481*				
	Education on respiratory hygiene		**Distributing brochures on hand hygiene and/or respiratory hygiene**		**Education on use of PPE**	
Predictor	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
County						
Baranya	Reference					
Tolna	12.312	3.672-41.280***	0.803	0.476-1.355		
Somogy	7.014	2.837-17.342***	2.601	1.420-4.764**		
Type of hospital						
City	Reference					
County	4.156	1.764-9.792**			0.230	0.058-0.911*
University	0.557	0.262-1.182			0.250	0.042-1.479
Ward/unit						
Medicine	Reference					
Surgery	6.677	2.112-21.108**	0.823	0.421-1.606		
Critical care unit	0.775	0.246-2.441	0.777	0.265-2.275		
Obstetrics-Gynecology	0.978	0.425-2.249	0.431	0.211-0.882*		
Hematology-Oncology	3.834	1.315-11.177*	1.444	0.669-3.118		
Pediatrics	3.231	0.394-26.515	1.919	0.397-9.279		
Educational level						
Elementary school	Reference					
Secondary school	2.216	1.074-4.574*	1.730	1.036-2.890*		
University degree	1.109	0.460-2.673	1.333	0.673-2.641		

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. OR: odds ratio; CI: confidence interval; HAIs: healthcare-associated infections; PPE: personal protective equipment.

education for patient and family members; however, these associations were identified for only 1 or 2 specific IC measures. Further details are provided in Table 4.

Discussion

This study aimed to assess education on IC measures for patients and family members in Hungary. The results indicate a high percentage of IC education compared to the findings from the systematic review on patient education regarding IC measures [16].

The highest percentage of education was on respiratory hygiene, which shows higher results than those reported by Hammoud *et al*. [29] in Lebanon. Education on HAIs and the risks of HAIs also exhibited higher percentages compared to existing literature. Specifically, these findings exceed those reported by Seale *et al*. [25] in Australia, Ocran and Tagoe [24] in Ghana, and Madeo *et al*. [23] in the United Kingdom for HAIs education, as well as those reported by Smyth *et al*. [34] in Australia, Merle *et al*. [28] in France, and Hammoud *et al*. [29] in Lebanon for education on the risks of HAIs. Additionally, the level of HH education observed in this study is higher than that reported by Li *et al*. [20] in China, Srigley *et al*. [22] in Canada, and Ong *et al*. [21] in Singapore. The lowest percentage of education was on receiving flyers on HH and/or respiratory hygiene; however, this still represents better results than those of Hammoud *et al*. [29]. Finally, education on the reason for isolation and the use of PPE was found to show higher results than those reported by Guilley-Lerondeau *et al*. [35] in France, although the results are similar to those of Hammoud *et al*. [29].

The high level of IC education observed among patients and family members in this study may be attributed to a key factor: the research was conducted during the COVID-19 pandemic. Given that COVID-19 has resulted in higher fatalities compared to previous coronavirus epidemics (severe acute respiratory syndrome and Middle East respiratory syndrome), patient education has become crucial to combat the virus [15]. Consequently, strict regulations were implemented in Hungarian hospitals to mitigate the virus's spread, which may have contributed to the high percentage of education on respiratory hygiene. This was followed closely by education on HAIs and HH, as both HH [14,36,37] and respiratory hygiene are essential IC measures for combating COVID-19 [38,39]. These findings align with a recent study in Hungary that evaluated IC education from the nurses' perspective, where HH and respiratory hygiene also showed the highest percentages of education across all IC measures [40]. The consistency between these studies suggests the reliability of the results. Future research could benefit from including and comparing both patients' and nurses' perspectives on IC education.

It is important to note that while the government regulations governing IC practices in Hungarian healthcare institutions [17] do not specifically address patient education on IC, they do require compliance with the European Union (EU) Council recommendation [41] on patient safety, including the prevention and control of HAIs. These recommendations mandate that EU healthcare institutions educate patients about the risks and prevention of HAIs. However, the substantial time gap of over a decade between the EU recommendations and this study may not fully account for the high percentage of IC education observed. Additionally, the handbook of Hungarian healthcare standards [42] emphasizes providing patients with information on HH, and Hungarian inpatient and outpatient accreditation standards [43] stress the importance of educating patients and their families on infection prevention, particularly for high-risk patients.

Regarding the timing of education, it is noteworthy that most participants reported receiving education both upon admission and throughout their hospital stay. This suggests that nurses are providing continuous IC education, rather than limiting it to admission or discharge periods.

The highest percentage of IC education was observed in the pediatrics and hematology-oncology departments for education on HAIs and the distribution of flyers on HH and/or respiratory hygiene. Additionally, education on respiratory hygiene was highest in the surgery, hematology-oncology, and pediatrics departments. This may be attributed to the heightened attention given to patients in these units due to their specific conditions. Patients in hematology-oncology are particularly vulnerable to HAIs due to neutropenia, while surgical patients are at increased risk for postoperative infections. In the pediatrics unit, the emphasis on education likely reflects the focus on family members, primarily parents, to protect children from HAIs and disease outbreaks. Conversely, participants experiencing their first hospital admission received more education on HAIs compared to those with prior admissions. This may indicate that healthcare workers (HCWs) are more cautious with first-time patients due to their limited experience in hospitalization and HAIs.

The results of the regression analysis revealed that counties were significant predictors of IC education.

The higher likelihood of receiving education on most IC measures among participants from Somogy County may be attributed to the fact that only 1 hospital from this county was included in the study due to difficulties in obtaining ethical approval from additional hospitals. The included hospital was a county hospital, whereas the other 2 counties featured a mix of hospital types: a university hospital and 2 city hospitals in Baranya, and a county hospital and 2 city hospitals in Tolna. County and university hospitals, being larger and having stricter policies and procedures [40], may account for the higher levels of IC education observed in Somogy, especially since all the participants from this county were from a single county hospital, unlike participants from the other 2 counties who were from a variety of hospital types. These findings may assist Hungarian health authorities in targeting counties where IC education is less prevalent.

Strengths and limitations

Since this study included hospitals of various types and from different counties, the results may be generalized to reflect the state of patient and family education across all hospitals in Hungary. However, there are some limitations to consider.

First, the use of convenience sampling may have introduced selection bias. Second, participants' health literacy was not assessed. To address this, simple language was employed in the Hungarian translation of the questionnaire to accommodate participants of varying age groups and educational backgrounds. Third, as participants were assessors of the IC education they received, recall bias might have occurred. Efforts were made to minimize this by collecting data during hospitalization rather than after discharge.

Fourth, the questionnaires were distributed by head nurses and evaluated the IC education provided by nurses. This could have introduced potential bias in responses. To mitigate this, the researchers limited the involvement of head nurses in data collection and ensured the questionnaire was anonymous and voluntary questionnaire. Fifth, the study assessed education provided solely by nurses, which may be a limitation as other HCWs, such as physicians, also provide IC education.

Sixth, the response rate was relatively low. Despite this limitation, the diverse representation of patients from different types of hospitals suggests the findings can be generalized. Seventh, the proportion of family members in the sample was low due to COVID-19 restrictions in hospitals. Future studies should aim to include a higher number of family members or conduct a separate study focusing on family members' or caregivers' education on IC measures.

Eighth, our study was conducted during the COVID-19 pandemic, a period characterized by strict regulations in Hungarian hospitals. This may have influenced our results. It is recommended that future research reassess patient and family education post-pandemic. Finally, the questionnaire did not include specific questions on COVID-19 education beyond respiratory hygiene, HH, receiving flyers on HH and/or respiratory hygiene, the reason for isolation, and the use of PPE. Future research should consider incorporating questions that address COVID-19 symptoms, mode of transmission, and preventative measures.

Relevance for practice

With the rise of MDR infections and the recent emergence of COVID-19, patient and family engagement in IC has gained increased attention. While patient education on IC is often regarded as a passive strategy for reducing the burden of HAIs, it serves as the foundation for patient engagement and is a crucial first step toward patient empowerment. To foster active patient participation in preventing HAI transmission, nurses play a vital role in providing proper education on infection prevention and control measures and taking effective actions to involve patients in IC practices [5]. Previous studies indicate that patients are more inclined to engage in discussions about hygiene with HCWs, particularly nurses and doctors, when they receive motivation or encouragement from them [44]. Encouraging patients' active engagement enhances the likelihood of knowledge retention and promotes positive behavior change over time [45].

Efforts are required at both the national and institutional levels to sustain and improve the high percentage of IC education in Hungary. Based on the findings of this study, it is recommended that patients and family education on IC measures be integrated into the existing Hungarian government regulations governing IC practices in hospitals. This could involve specifying the IC measures on which patients and family members should be educated, as well as the optimal timing for such education. At the institutional level, hospitals in Hungary are encouraged to promote a participatory environment by involving patients and family members in discussions and encouraging them to ask questions about the information provided. However, it is essential to respect patient preferences, particularly in light of recent findings by Bányai *et al*. [46], which revealed that individuals in Hungary, Slovakia, the Czech Republic, and Poland prefer to receive more information from HCWs than being engaged in decision-making about their health status.

Conclusions

In summary, the present study reveals a high percentage of patients and family members education on IC measures in Hungary, in comparison to existing literature. The highest percentages of education were on respiratory hygiene, HAIs, and HH. Despite these promising results, maintaining this high level of IC education presents challenges, particularly in the post-COVID-19 context. To address this, it is recommended that Hungarian health authorities incorporate IC patient and family education into the government regulations governing IC practices in hospitals. Such an addition is deemed necessary and may potentially improve the performance of nurses in IC education, given that compliance with these guidelines is mandatory for all hospitals. Future researchers should explore patient and family education on IC measures after the COVID-19 pandemic, as the pandemic may have influenced the results of this study. Further studies assessing patient education on COVID-19 symptoms, mode of transmission, and prevention are also encouraged. Additionally, as Hungarian counties emerged as significant predictors of IC education, it is advisable for health authorities to focus on Baranya County, where participants were less likely to receive education on IC measures.

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Ethical approval

The study was conducted in accordance with the Declaration of Helsinki and received ethical approval from the Regional Research Ethics Committee of the Medical Center, Pécs, Hungary (Record number: 7862 - PTE 2019). Written informed consent was obtained from all participants.

Authors' contributions

Sahar Hammoud and Béla Kocsis were responsible for the conception and the design of the study, and the acquisition of data. Sahar Hammoud, Faten Amer, and Haitham Khatatbeh were responsible for the analysis and interpretation of data. Sahar Hammoud was responsible for drafting the paper. All authors revised the paper critically and approved the final manuscript.

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