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Changes and continuities in undergraduate nursing education during and after COVID-19: a European comparative study from the perspective of health science

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Abstract

Background The education of healthcare professionals, including nurses, represents a critical intersection with health systems science (HSS), which is often considered the third pillar of healthcare education alongside basic and clinical sciences. Despite the amount of research on nursing education during the COVID-19 pandemic, there remains a gap in analysis from an HSS perspective.

Methods A Comparative Education Approach involving undergraduate nursing programs (UNPs) across Europe, with longitudinal data collection from 2002 to 2023. The aim of the study was threefold: (a) to summarize the overall changes in UNPs during the COVID-19 pandemic; (b) to identify the changes retained in the post-pandemic era; and (c) to identify the impact of the pandemic on nursing education as perceived by nurse educators across nine European countries.

Results This study compares the changes in nursing education in European countries during and after the COVID-19 pandemic using a qualitative approach with data from nine universities. The COVID-19 pandemic had a significant impact on education provision. During the first wave, government restrictions forced a complete shift to online learning for theory classes, clinical training and laboratories. In subsequent waves, a hybrid format was chosen that combined online and face-to-face sessions. A major challenge was the placement of nursing students alongside general university students. This approach neglected their need for practical clinical training, which is crucial for their future careers. To compensate for the lack of clinical hours, various alternative teaching methods were introduced. Students were also offered the opportunity to volunteer in large-scale public health initiatives such as vaccination and testing campaigns, although bedside care for COVID-19 patients remained limited. The pandemic has also left its mark in the post-pandemic period. Some UNPs have retained elements of online education, notably lectures, research seminars, meetings, consultations and even online exams. Interestingly, an initial increase in applicant numbers was observed at six of the nine participating UNPs.

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Conclusions The COVID-19 pandemic has widened the gap between university-educated nurses and the clinical setting, i.e. between theory and practise, underlining the importance of HSS in nursing education. Rebuilding strong partnerships is crucial, but simply returning to the pre-pandemic model is not enough. To ensure uninterrupted education during future crises, proactive planning, including the creation of predefined protocols for collaboration, is essential. The pandemic underscores the need for closer alignment between the two sectors, which would better equip future nurses with the skills they need to thrive in the nursing workforce and ensure they are prepared for the challenges of the 21st century.

Keywords Undergraduate nursing programs, Clinical training, Health systems science, COVID-19 pandemic

Introduction

The complete suspension of on-site education at the beginning of the coronavirus-19 (COVID-19) pandemic posed a significant challenge for undergraduate nursing programs (UNPs) worldwide [1–4]. Some higher education institutions (HEIs) had already established an infrastructure for online education and could transition swiftly and smoothly to online teaching as soon as the lockdown was announced, allowing students to continue their studies without undue delay. However, for the most part, HEIs were required to create and/or launch tools for online education from scratch, resulting in a period of suspension and uncertainty for both students and teachers. Perhaps during the pandemic, the most challenging aspect of nursing programs was ensuring continuity in clinical training [1, 5]. The regulations of the European Union [6] mandate that at least half of nursing program hours be spent in clinical settings. The continuity of nursing education during the pandemic was a challenge not only for HEIs but also for health care institutions. Both systems struggled to adapt delivery methods, necessitating cooperation during a period of disruption and great uncertainty. The two systems of health care and nursing education were left with a critical question of how to ensure effective and safe clinical training for students while prioritizing the safety of patients and staff.

The education of healthcare professionals, including nurses, represents a critical intersection with health systems science (HSS), which is often considered the third pillar of healthcare education alongside basic and clinical sciences. As defined by Fred and Gonzalo [7], the HSS encompasses the "principles, methods, and practice of improving quality, outcomes, and costs of healthcare delivery for patients and populations within systems of medical care". Separating nursing education from healthcare systems hinders the development of key competencies outlined by Fred and Gonzalo [7]. These include interprofessional collaboration, high-value care, population health and systems thinking. To fully grasp these concepts, nursing students need active participation and involvement in the clinical system, allowing them to experience their mechanisms first. The pandemic has drawn attention to the importance of HSS in medical education [e.g., 8, 9], where the debate is already well established [e.g., 10]. Notably, nursing education lacks similar reflection through the lens of the HSS, and no research has been produced to date.

The potential of an HSS-based approach has been recognized in medical education, particularly for its role in shaping physicians' professional identity [10]. This recognition has led to a growing focus on integrating key HSS competencies into medical curricula by revising recommendations for educators, accreditation standards, national and local curricula, and didactical materials such as textbooks [11]. In contrast to more traditional approaches, medical education informed by the HSS ensures that the competencies demanded by the health system are not neglected. This approach also encourages these core competences to be integrated into curricular design and establishes a clear learning pathway for students transitioning from undergraduate studies to post graduate specialization and into the workforce. Essentially, the movement that originated in medical education fosters a cohesive framework that aligns the missions of clinical and academic education by 'cultivating the next generation of systems-minded health care professionals [11].

For decades, in Europe, nursing education was at the core of healthcare institutions, primarily within hospitals. This education, which was mainly vocational, has undergone a significant shift in several countries. It has transitioned from a hospital-based, vocational model to an academic model, bringing nursing student preparation closer to the broader higher education environment. [e.g., 12, 13, 14]. Today, nurse education typically combines theoretical education research-based content with clinical experience whereby students are placed in health care settings to develop their clinical competences where they learn from experienced, qualified nurses who act as role models in a real-world context. However, to the best of our knowledge, how the transition from a healthcare-based to an academic/higher institution-based education system has been integrated and adopted from the perspective of HSS principles as the third pillar of education has not yet been documented. Therefore, there is a critical research gap on how these two systems– academic institutions providing theoretical knowledge and healthcare institutions providing clinical experiences– work

together and integrate their efforts to optimize nursing education.

The COVID-19 pandemic caused unprecedented stress in nursing education and forced a sudden shift to online teaching of basic and clinical science in virtual environments, with a lack of or no possibility for the development of clinical competences, including being part of the interprofessional team and collaboration with its members. Innovative technology, such as high-fidelity simulations, video demonstrations, and other digital tools, has also been introduced to compensate for the limitations or absence of learning experiences in real settings. A lack of access to the clinical environment during the pandemic resulted in USA states issuing legislation allowing the substitution of clinical training with high-fidelity simulation [1]. In Europe, there was no such legislation, and UNPs in each country introduced solutions according to their own national or local regulations. A shared concern emerged among both nursing educators and students—the fear of graduates entering the workforce unprepared due to pandemic disruptions, coinciding with a critical shortage of nursing staff [4]. This staff shortage worsened during the pandemic. Nurses faced quarantine, sick leaves, or the need to stay at home with children due to school closures. This further strained the ability of clinical mentors to supervise students in clinical settings.

While numerous studies have explored the impact of the pandemic on undergraduate nursing education, most of these studies were conducted during the height of the pandemic [e.g., 1, 2, 3, 4, 15]. Fewer studies have considered the post-pandemic era in terms of changes introduced and retained, and most previous studies have reported only from the perspective of a single country [5]. Despite the increasing recognition of the importance of systems-based competencies in healthcare, little thought continues to be given to how HSS is integrated into nursing education, particularly following the structural shift from hospital to higher education. HSS advocates for the development of nurses who not only provide high quality, patient-centered care, but also understand the broader healthcare system and work collaboratively in interprofessional teams. However, the application of this concept in nursing curricula is still relatively rare. This gap underscores the need for further empirical research into how HSS principles can be meaningfully embedded into educational practice to inform the design of nursing programs that are attuned to the evolving complexity of healthcare delivery.

What is more, to our knowledge, no studies have employed a comparative education approach to investigate the changes and challenges faced in organizing undergraduate nursing education during the pandemic or the lasting changes implemented in post-pandemic Europe. This study's primary focus is to investigate the changes that occurred in undergraduate nursing education across Europe during **the** pandemic and those that have remained in place post-pandemic. We will then analyze the implications of these changes for the integration and cooperation between educational institutions and healthcare systems. The aim of the study was threefold: (a) to summarize the overall changes in UNPs during the COVID-19 pandemic; (b) to identify the changes retained in the post-pandemic era; and (c) to identify the impact of the pandemic on nursing education as perceived by nurse educators across nine European countries.

Methods

Study design

This study adopted a comparative education approach [16, 17], which provides a valuable framework for understanding the diverse strategies and methodologies employed in nursing education across different international regions. The comparative method aims to identify similarities, differences, and trends in education systems to gain insights into effective practices, areas for improvement, and strategies adaptable across contexts.

Given the aim of this research: (1) to compare academic programs in response to the COVID-19 pandemic, (2) to examine which changes were retained during the pandemic era, and (3) to explore the perceived impact of the pandemic on nursing education, the study employed comparative models defined by Bereday and Hilker [17] and the modified model by Wilcke and Budke [16]. The following steps guided the comparative process:

1. Formulating the initial research questions;
2. Defining the units of comparison;
3. Determining the variables of comparison;
4. Describing the findings; and.
5. Interpreting the findings.

Research questions

The following research questions were established: (a) What changes have been introduced as the COVID-19 pandemic has spread across nursing programs delivered in European Countries (EU)? (b) Which changes have been retained since the pandemic era? (c) What effect has the COVID-19 pandemic had on nursing education in Europe?

Setting and participants

The study was conducted within the UDINE-C network, a pan-European collaboration of HEIs established in 2007, aimed at promoting exchange and good practices in nursing research, education, and practice (udinenetwork.blogs.lincoln.ac.uk). At the time of this study, the network consisted of institutions from 18 member countries. This research group viewed the project as an opportunity

to leverage international comparative education methodology to explore and understand the changes in nurse education introduced during the COVID-19 pandemic and retained since. This comparative education approach aims to contribute to a more nuanced understanding of the current state of nursing education systems within the context of European education policy [16, 18].

Following agreement from the UDINE-C group to participate in the research, a purposeful sampling strategy [19] was used. One nursing program per participating country was selected, based on the assumption that national-level public health regulations during the pandemic would ensure a degree of uniformity across HEIs within a given country. Ultimately, 12 countries were invited, and nine institutions participated throughout the entire study period (2020–2023). In each institution, one expert participant was designated for data collection after informed consent procedures were completed. All nine institutions with UNPs were considered well-positioned to provide informed insights reflective of national-level responses and policies, particularly given the widespread harmonization of pandemic-related public health measures during the study period. What is more, all participating programs represent both EU and non-EU countries across Western, Central, Eastern and Southern Europe, giving a broad picture of organization of undergraduate nursing education.

Data collection

Data was collected using a structured data collection grid, developed and piloted with representatives from two nursing programs (Poland and Italy). Based on their feedback, the grid was refined. Data was collected online in four rounds: (1) end of 2020; (2) end of 2021; (3) end of 2022 and (4) 2023, preceded by a face-to-face meeting. In each round, participants reviewed, updated, and harmonized the data. To ensure consistency, findings were counterchecked [20] by the research team and shared with participants for validation. Overall data covered the academic years 2019–2023, corresponding to the onset and declared end of the COVID-19 pandemic [21]. The data collection tool captured the following key variables of comparison:

(a) The main traditional (pre-pandemic) structure of the nursing program, such as the location (University, Higher Vocational School), the duration, the number of students, the number of hours dedicated to theory, clinical placements and laboratory skills; in addition, regulations at national or international level were followed.
(b) The main changes that occurred in each country during the three main waves of the pandemic: Each participant was free to name the changes in each wave without committing to exact changes (e.g. what happened in the first half of 2020, in the second half of 2020, etc.), depending on the epidemiological trends in each country. Changes were identified in several main aspects: (i) the level of responsibility for the changes introduced (at the HEIs or at national level); (ii) the specificity of the changes introduced in nursing education compared to other non-nursing students; (iii) the main changes regarding education introduced in each main pandemic wave; (iv) how the interrupted training hours were compensated; (v) the involvement of nursing students in patient care or whether they remain in a supernumerary role; and (vi) safety measures during training (e.g., immunisation, if required, or not for student nurses).
(c) identified the changes reported by participants during the pandemic and the main challenges faced by educators.
(d) The main effects of the pandemic on several important aspects of nursing student education (attractiveness of nursing and number of students) were qualitatively assessed.

Data analysis

The analysis followed a comparative and descriptive approach [22], based on the established frameworks of Bereday and Hilker and refined by the operational steps proposed by Wilcke and Budke. First, a narrative synthesis was developed by three researchers (BD, SC, AP) who conducted a thematic analysis to identify recurring patterns and divergent practices in national nursing education programs. This process involved an iterative thematization of the data guided by the research questions. Themes were collectively refined and reviewed in multiple rounds of feedback with members of the UDINE-C network to ensure clarity, depth, and analytic consistency.

In the final interpretation phase, the analysis was further elaborated through a focused exploration of how HSS concepts could be applied in nursing education. As the current literature focuses predominantly on HSS in medical training, the research team developed an operational framework to assess the presence of HSS principles such as value-based care, population health, systems thinking, and interprofessional collaboration in the participating programs. This framework also emphasized structural collaboration between higher education institutions and healthcare systems and emphasized the development of a systems thinking mindset in future nurses [11, 23].

The educational comparison methodology was applied systematically throughout: from formulating the research questions, defining the units of comparison and thematizing the data between institutions and countries, to interpreting the results in a broader educational policy

context. This enabled the study to identify both transferable strategies and locally embedded adaptations to pandemic-related challenges in nursing education.

Rigor

To ensure the validity and reliability of the findings, we used a combination of data triangulation and peer review. Data triangulation was achieved by collecting information from multiple sources in different countries, at different points in time and in different institutional contexts. This allowed us to check and compare responses for consistency and coherence. This process helped to minimize potential bias and increase the credibility of the results. In addition, the data was peer-reviewed within the research team and among the participating experts of the UDINE-C network. Each round of data collection was followed by joint discussions and validation sessions in which the preliminary analyzes were critically reviewed, refined and harmonized. This iterative feedback loop strengthened the rigor of the interpretation and ensured that the results accurately reflected the shared experiences and different contexts of the participating institutions.

Ethical considerations

Although no sensitive personal data was collected in this study, ethical principles were strictly adhered to throughout the research process. All participants were senior academic staff who volunteered to contribute information about UNPs in their respective countries at an institutional level. Prior to data collection, the objectives of the study, the voluntary nature of participation and confidentiality procedures were clearly explained. Informed consent was obtained from each participant. Given the nature and aim of the study, formal ethics committee approval was not required. Nevertheless, the study complied with the ethical standards of the Declaration of Helsinki and followed the guidelines for good practice in educational research.

Results

Characteristics of undergraduate nursing programs

Nine European UNPs participated in the study, one of which was a higher vocational school, and the remaining were universities. Seven were located within the EU, and two were outside the EU (United Kingdom and Serbia). Programs were organized in three (Croatia, Czech Republic, Italy, Poland, Serbia) or four years of the 1st cycle of the Bologna process (Ireland, Lithuania and Spain), delivered in the form of theoretical hours (from 975 to 2653), practical hours (from 1800 to 3045) and simulation/laboratories (from 40 to 400), sometimes included in theoretical education. Participating institutions typically enroll between < 50 and 200 students per year. Each program adheres to national standards for undergraduate nursing education, potentially supplemented by or other national laws, and EU directives. More detailed results are included in Table 1.

Changes during the COVID-19 pandemic

In response to the national restrictions imposed during the first wave of the COVID-19 pandemic (the suspension of face-to-face contact), all UNPs moved to holding lectures, practical classes and lab sessions online. The government restrictions were supplemented by regulations from universities, professional regulatory bodies and guidelines from healthcare institutions. Like other students, nursing students generally moved to online learning. Two UNPs (Czech Republic and Serbia) reported that they continued to teach clinical classes or classes on professional topics face-to-face while adhering to strict safety measures.

Different strategies were used for examinations, especially at the beginning of the pandemic. Online exams were generally accepted, but practical exams were either postponed (until the epidemiological situation allowed) or conducted on site under strict safety measures. In Serbia, however, exams were held exclusively on campus, under strict safety precautions, as national standards in medical education, online exams or any knowledge tests are prohibited. During the second and third wave of the COVID-19 pandemic, the organization of education changed slightly. Theoretical lessons (lectures) were held online or in hybrid form, while practical lessons are sometimes held in the clinical setting, but with a strict rationing of the number of students per clinical mentor. Compensation of (mostly clinical) hours was organized by using different methods, changing the clinical training schedule, extending the program or including the so-called 'extended internship' where students could work in the clinical setting to support qualified nursing staff (e.g. in the UK). Students could also sometimes be involved in clinical work with COVID-19 patients on a voluntary basis, mostly in testing and vaccination centers. In some cases (4 countries), students were paid for their work. Different strategies were established regarding safety measures. Most programs tested students before they entered the clinics; however, vaccinations for all nursing students were mandatory in only two UNPs in Italy and Spain. In Lithuania, unvaccinated students were required to present a valid negative test before they could begin theoretical or clinical training. Detailed information is provided in Table 2.

Challenges lived and changes retained in the post-pandemic era

The data from all nine cases showed consistency in terms of the challenges faced by nurse educators during the

Table 1 General information regarding undergraduate nursing programs (UPPs) in participating institutions

Country/type of HEI	Length of UNP, Hours [T, P, L]	Students, number/ year *	Regulation governing UNP
Croatia University	3 years T: 1820 P: 2880 L: 75 (included in T)	150–200/year	National: Croatian Law on Regulated Professions and Recognition of Foreign Professional Qualifications (2023) International: Directive 2005/36/EC (amended by Dir 2013/*55*/EU)
Czech Republic University	3 years T: 2300 P: 2300 L: 80	100–150/year	National: Country Regulations discipline the learning outcomes (2004) and minimum requirements of study programs for qualification of health care workers (2005) International: Directive 205/36/EC (amended by Dir 2013/*55*/EU)
Italy University	3 years T: 2800 P: 1800 L: 90	160/year	National: Interministerial Decree establishing the general rules of the health science education of all professions (2009) International: Directive 2005/36/EC (amended by Dir 2013/*55*/EU)
Ireland University	4 years T: 1533 P: 2300 L: -	100–150/year	National: The Nursing Board of Ireland, Standards for nurse education (2023) International: Directive 2005/36/EC (amended by Dir 2013/*55*/EU)
Lithuania University	4 years T & L: 2653 P: 2532	50–100/year	National: The Law of Nursing Practice and Midwifery Practice of The Republic of Lithuania (2001, with amendments); Ministry of Education, Science and Sports (issues Standard for Professional Education of a Nurse– 'Description of The Field of Nursing Studies' (2020); Ministry of Health of the Republic of Lithuania (issues The Standard of Practice for a Nurse that regulates the competencies of nurses) (2011, with amendments) International: Directive 2005/36/EC (amended by Dir 2013/*55*/EU)
Poland University	3 years T: 2420 P: 2300 L: 200 -included in T	150/year	National– Ministry of Health: Standards for nursing education (2021) International: Directive 2005/36/EC (amended by Dir 2013/*55*/EU)
Serbia Higher Vocational School	3 years T: 975 P: 3045 L: -	200/year	National: The Law on the National Qualifications Framework of the RS (2003, with amendments) International: Directive 2005/36/EC (amended by Dir 2013/*55*/EU)
Spain University	4 years T: min. 1533 P: 2300 L: 40 to 400 (varies in country)	< 100/year	National: Ministry of Science and Innovation, document including competencies to be acquired by all degree candidates (2008). International: Directive 2005/36/EC (amended by Dir 2013/*55*/EU)
UK University	3 years T: 2300 P: 2300 L: max of 300	150–200/year	National: The Nursing and Midwifery Council, Standards for preregistration nursing programs (2023) Some of the content in the NMC's pre-2023 program standards were underpinned by EU law– specifically an EU Directive. Since the UK left the EU, there is now more flexibility in setting preregistration program standards for nursing programs

Legend: HEI– Higher Education Institution, T– Hours of theoretical training, P– Hours of clinical training, L– Hours of laboratory (simulation, lab skills), * Sum of different programs available at HEIs participating in the study: full-time, part-time, English programs deliver separate programs for adult, mental health, child and learning disability nursing. The data for the Adult course are included above, where the numbers are typically much larger than those in the other three fields

pandemic. Online education proved to be the most frequently cited hurdle, especially during the initial lockdown phase. Educators faced technical (adapting to a new online teaching mode, adapting teaching materials and teaching methods for online teaching and ensuring the smooth functioning of online learning platforms under high user load) and social (lack of face-to-face interaction with students, limitations in face-to-face communication, difficulties in involving students in online learning activities and providing adequate access to learning materials such as textbooks in digital format) barriers. Nurse educators across all cases consistently reported another major challenge in all cases: stress. This stress impacted both educators and students due to the pandemic itself, the unfamiliarity of online education, and the disruption of clinical education, including limited opportunities or lack of stability in clinical rotations. Data collection for final projects proved particularly problematic for final year nursing students and their supervisors. Nurse educators additionally expressed concerns about the development of students' professional competencies,

Table 2 Changes to undergraduate nursing programs (UNPs) imposed by the COVID-19 pandemic

Country	Restrictions - level and situation of NS	UNP changes (T/*P*/L, and exams)			Compensation of hours	NS' involvement in care for COVID-19 patients	Safety measures
		1st wave (first half of 2020)	2nd wave (second half of 2020)	3rd wave (first half of 2021)			
Croatia	On national level No privileges for NS	All forms of education (T, P, L): online Exams: online	T, L: online or on-site, small groups 4–6 NS/large room. P: in clinics, small groups 3–4 NS/CM. Exams: on-site	T, L: online. P: in clinics, small groups 3–4 NS/CM. Exams: on-site	P: replaced by online workshops, case studies, and problem-solving methods	Voluntary engagement of NS in help vaccinating. Part-time NS– worked with COVID-19 patients as nursing aid. Full time NS– not.	Mask, distancing, disinfection, monitoring body temperature, negative PCR/48 hours, lack of symptoms. Vaccination non mandatory for NS.
Czech Republic	On national level. Some professional subjects kept in contact for NS	T, L: online P: maintained in hospitals. Exams: online	T (lectures): online T (seminars), P: on-site in small groups. Exams: for T– online, for P– on-site	T (lectures): online T (seminars), P: on-site in small groups. Exams: for T– online, for P– on-site	Students received full practical training at the clinical units	Voluntary engagement of NS in help in COVID-19 units. Some were paid regional municipality NS trained on COVID-19 units	NS practiced on "COVID-19 units" received swabs. NS received antigen testing before hours in simulation center. Vaccination non mandatory for NS
Italy	On national level. No privileges for NS	All forms of education (T, L): online Exams: online P: postpone in summer	T, L: rationed the frequency of students (50% at home, 50% in classroom) P: rationed in the number of NS Exams: on-site/on distance	T, L: rationed the frequency of students (50% at home, 50% in classroom) P: rationed in the number of NS Exams: on-site/on distance	P: replaced by online workshops, case studies, and problem-solving methods	NS not allowed to attend clinical placements in COVID-19 units Voluntary engagement of NS in help vaccinating and tracing	Vaccination mandatory, nasal swab before the entering placement Daily declaration by NS they were asymptomatic of COVID and/or not contagious
Ireland	On national level. No privileges for NS	T, L: online P: maintained in hospitals for a short time. Exams: as continuous assessment	T, L: online P: postponed for later in semester. Exams: as continuous assessment	T, L: online P: postponed for later (summer). Exams: as continuous assessment	P: using different online platforms for education	NS work as healthcare assistance could count as placement - a piece of work could account for 2 weeks. NS volunteered for helping with mass vaccination.	Vaccination non mandatory, nasal swab before the entering placement. Daily declaration by NS they were asymptomatic of COVID
Lithuania	On national level: general rules; University level: nursing education. No privileges for NS	All forms of education (T, P,L): online. P: postponed for summer Exams: online	T, L,P: on-site (changed into online when needed) Placements: organized individually by NS Exams: online/onsite in specific cases	T: online P: in clinics, small groups 5–7 NS/CM Exams: online	P: using different online tools, teaching methods, postponing clinical training, prolonging education for particular semester	Voluntary help from NS. Longer clinical hours counted as clinical placement.	Vaccination recommended for NS. For those not vaccinated, the valid negative test requested to enter classroom or clinical placement
Poland	On national level: general rules; University level: nursing education. No privileges for NS	All forms of education (T, P, L): online. P: postponed for summer Exams: online	T (lectures): online T (seminars), L, P: on-site (changed into online/hybrid when needed) Exams: for T– online, for P– on-site	T (lectures): online T (seminars), L, P: on-site (changed into online/hybrid when needed) Exams: on-site	P: using different online tools, teaching methods, postponing clinical training, engagement in testing	Voluntary engagement of NS in help in testing, vaccinating, etc.	Vaccination non mandatory for NS. In some HCF– students were tested before entering placement

Table 2 (continued)

Country	Restrictions - level and situation of NS	UNP changes (T/P/L, and exams)			Compensation of hours	NS' involvement in care for COVID-19 patients	Safety measures
		1st wave (first half of 2020)	2nd wave (second half of 2020)	3rd wave (first half of 2021)			
Serbia	On national level: general rules; Academy level: nursing education. Some clinical classes kept in contact for NS	T: online P: postponed for summer Exams: on-site	T: online, part on-site in small groups up to 5 NS. P: organized in school, by CM, with different methods Exams: on-site	T: hybrid. P: organized in school, by CM, with different methods Exams: on-site	P: changes in the practical training schedule. Education prolonged	NS were offered to get involved in working with COVID-19 patients, when vaccinations began. NS were paid	Mask, distancing, disinfection, monitoring body temperature. Vaccination non mandatory for NS
Spain	On national level: general rules; University and healthcare facilities level: nursing education. No privileges for NS	All forms of education (T, P,L): online Exams: for T– online, for P– on-site	T: online L: on-site in small groups P: NS work/help in hospitals was accepted Exams: on-site	Hybrid education: 30% of students in classrooms, 70% were in virtual space. P: NS work/help in hospitals was accepted Exams: on-site	P: clinical hours supplied by seminars	Voluntary work of NS (3rd, 4th year) in HCF as health technician. NS were paid for this work	Vaccination mandatory for all of nursing students for continuation practical training
UK	On national level: general rules; NMC and healthcare facilities level: nursing education. No privileges for NS	T: online L: on-site in very small groups P: different activities to compensate for clinical hours Exams: online	T, L: online P: different activities to compensate for clinical hours Exams: online	T, L: online P: different activities to compensate for clinical hours Exams: online	Placing students in testing and vaccination centers. Moving clinical hours to the next year of study	NS helped in vaccination/testing centers. 3rd year NS– allowed extended placements. Paid for this work	Vaccination non mandatory for NS. Vaccination was going to be mandatory– but the government did a U turn at the last minute

Legend: NS– nursing students, NMC– Nursing and Midwifery Council, CM– clinical mentor, T– hours of theoretical training, P– hours of practical training, L– hours of laboratory (simulation, lab skills), HCF– healthcare facility

particularly clinical skills and soft skills, due to limited social interaction during online learning (Table 3).

Some changes introduced to UNPs during the pandemic have since been maintained. Some forms of education are now regularly delivered online, e.g. lectures (Poland– with some restrictions due to national standards), other forms of didactic activities (Italy– max. 10%), research seminars (UK), meetings (e.g. with tutors during clinical training), consultations and examinations (online tests). There has been a growing preference for hybrid learning models that combine online and face-to-face elements. According to the data, Serbia is the only country that has fully returned to its pre-pandemic education structure. In addition, some programs have integrated new areas of healthcare into clinical rotations to provide students with a greater variety of clinical settings (Table 3).

Effects of the pandemic on nursing education as perceived by nurse educators

In our cases, the number of candidates initially rose in Italy, the Czech Republic, Ireland, Serbia, Spain and the United Kingdom, only to fall again towards the end of the pandemic. At the same time, only in Italy and Serbia did the number of places for student nurses increase. In addition, seven of the UNPs surveyed reported problems with the mental wellbeing of their students. Students were generally satisfied with online education but were frustrated by the lack of information and stability in the clinical setting. The impact of the pandemic on students' competencies was primarily related to soft skills, particularly social interaction. Reports from Italy highlighted communication difficulties with family members, while similar problems were observed in Poland when communicating with patients. Teamwork skills also showed signs of decline in a limited number of cases. More than half of our UNPs reported problems in assigning students to clinical placements (Table 4).

Discussion

The aim of this study was to investigate how nursing programs across Europe adapted during and after COVID-19 and what changes were maintained after the pandemic. We analyzed these changes through the lens of HSS, focusing on integration and collaboration between educational institutions and healthcare systems. In our study, which was conducted over a three-year period with longitudinal data collection, all but one of the

Table 3 Challenges experienced during the COVID-19 pandemic and the changes retained in the post-pandemic era

Country	Challenges experienced by nurse educator	Changes retained in the post pandemic era
Croatia	♣ risk of not achieving learning outcomes (knowledge, skills, independence, and responsibility) ♣ breaks in clinical training because of occasional closure of hospitals due to the COVID-19 outbreak	♣ classroom and clinical teaching take place mainly as before the pandemic ♣ the hybrid form of teaching to be an option in situations that limit/prevent contact teaching
Czech Republic	♣ to adapt quickly to new external circumstances ♣ deficits in the formation of social bonds - an impact on the deterioration of communication skills ♣ kind of barrier between teachers and students because of online teaching	♣ selected forms of distance learning (e.g., more intensive work with e-learning, online consultations and group meetings, electronic submission of assignments) are integrated into the curriculum ♣ topics related to the nurse's role in the pandemic era, more epidemiology - included in education ♣ in communication teaching more emphasis on empathy
Italy	♣ at the beginning– lack of online education organization and competence/experience in delivering online teaching. ♣ assessing knowledge and competences via online ♣ some difficulties in engaging students (video camera off) ♣ keeping engaged students, promoting their wellness especially those coming from other regions ♣ ensuring connectivity to some students living in remote areas ♣ motivating students because Hospitals did not allow their clinical rotations	♣ some didactical activities (not more than 10%) may be delivered online as in the pre-pandemic era ♣ individual supervision and contacts may be offered online ♣ rationed the clinical rotations by expanding them in new units in order to reduce the number of students. ♣ collegial meetings of academic members and representatives of students may be held online
Ireland	♣ lack of engagement by students: black screens, cameras off, no one answering questions ♣ difficult to assess if students understand, listen to, learn ♣ Wi-Fi and technical issues ♣ difficulty in switching modalities ♣ students fear of online forum ♣ big students stress not dealt properly	♣ better digital skills of teachers and students that can be used in education
Lithuania	♣ 100% of online teaching ♣ Long hours in front of the computer ♣ limited access for students and teachers to the textbooks as the library was closed (at the beginning) ♣ issues in some behavior e.g., cameras off ♣ problems in data collection for theses ♣ BSc nursing students defense organization online	♣ teachers online teaching skills improved. ♣ for part time BSc nursing students, the online teaching is used with balanced proportion. ♣ the online teaching and assessment strategies are wider implemented ♣ the online research data collection mean for bachelor's and master's degree students is more often applied
Poland	♣ at the beginning– lack of online education organization and experience ♣ long hours in front of the computer; Problem in online behavior– cameras off ♣ no time limits in organizing online meetings (until very late) ♣ risk of not achieving learning outcomes included in standards ♣ breaks in clinical training because of occasional closure of hospitals due to the COVID-19 outbreak	♣ teaching skills improved ♣ lectures are organized online, but with limits set out in the education standards ♣ online consultations and group meetings are accepted ♣ new clinical units have been identified for students clinical training to increase the range of options ♣ different task force meetings are online ♣ PhD defenses– online or hybrid
Serbia	♣ At the beginning– lack of harmonization of instruction from different governmental bodies ♣ teachers were significantly more engaged in the teaching process through individual consultative work with students and adjusting teaching methods and resources to classroom teaching	♣ education back to pre-pandemic organization with no changes retained
Spain	♣ lack of engagement by students: black screens, cameras off, no one answering questions ♣ complicated for teachers to adapt new methodologies and has been difficult to motivate students ♣ to return to a new normality in nursing education ♣ to achieve soft skills that are very important for nursing students	♣ hybrid model, which continues to be utilized, particularly in team meetings with faculty members facing difficulties in attending in person ♣ In the realm of research, the virtual model persists in work meetings. ♣ face-to-face education is even more valued ♣ for individual thesis advising sessions, a virtual option is permitted but only in exceptional circumstances
UK	♣ Stress– among staff and students. ♣ Making up clinical hours in some cases	♣ the delivery of research seminars and examining of doctoral students, PhD defenses– online/hybrid ♣ lectures for big groups of students– online ♣ online recruitment processes for potential candidates prior to being accepted into nurse education programs ♣ Individual and group tutor meetings ♣ Staff and management meetings

Table 4 Effects of the pandemic on unps

Country	Capacity to attract candidates	Change in NS numbers/ places	Mental wellbeing or other concerns	Satisfaction from education	Effects on education (competences, grades)	Effects on Student's community and teamwork	Differences in placements acceptance
Croatia	Remains high	No	Sporadic occurrence of individual difficulties related to self-isolation measures Sporadic cases of increased levels of nervousness associated with pandemic	Less satisfaction with online/hybrid teaching compared to face-to-face classroom and clinical teaching	No significant changes	No difference	No difference
Czech Republic	More interest/applicants	No	No significant concerns Tiredness with pandemic	Less satisfaction with online education Students are more interested and feel the need for empathy and communication	No significant changes: but poorer expressive/ communication skills were noted	Yes - teamwork was impaired	No difference
Italy	More interest/applicants in 2022 Decreased interest in 2023	Yes	Yes, mental health concerns– frailty, social isolation	Less satisfaction with online/hybrid teaching compared to face-to-face classroom and clinical teaching.	Better grades– an issue of online assessment Some competences are not completely achieved (e.g. being in relationship with relatives, due to COVID-19 family restrictions visits)	Yes - teamwork was impaired	Decreased, need to have more units and hospitals in the network. Some facilities with vulnerable clients were reluctant to take students back
Ireland	More interest/applicants	No	Yes, mental health in concern– social isolation	Students are satisfied with education, but miss being in college and reporting high incidence of anxiety	Poorer outcomes for some students	Better when face to face	Yes, some facilities with more vulnerable clients were reluctant to take students back
Lithuania	No	No	Yes, caused by misinformation, lack of continuity of clinical training	Students are satisfied with education mode, but dissatisfied with extension of studies period	Better grades– an issue of online assessment	Better when occasion to meet face-to-face	Some variations in acceptance conditions for students were experienced
Poland	No	No	Yes, mental health in concern– social isolation	Dissatisfaction connected with lack of stability in clinical environment (e.g., closing it in case of high % of infections)	Better grades– an issue of online assessment Problems with communication with patients when back to clinics	No difference	Yes, problems in students' allocation
Serbia	Yes, more interest	Yes	Yes, mental health in concern– social isolation	Students are satisfied with education mode Lack of confidence in the acquired skills	No difference	No difference	Yes, some institutions accepted medical students, but not nursing students

Table 4 (continued)

Country	Capacity to attract candidates	Change in NS numbers/ places	Mental wellbeing or other concerns	Satisfaction from education	Effects on education (competences, grades)	Effects on Student's community and teamwork	Differences in placements acceptance
Spain	Yes, more interest	No	Yes, increased level of stress in students	It was difficult to adjust to online education and lack of space	No difference	No difference	Yes, at the beginning of pandemic
UK	Yes, immediately raised	No	Yes, stress/ anxiety, social isolation	Students' frustration regarding lack of information	No difference	No difference	No difference

participating UNPs offered nursing education in HEIs. Despite the European guidelines [6], there are still major differences in terms of duration (in years), the number of hours dedicated to theoretical and practical education, as well as the visibility of laboratory skills in the curriculum and the number of learning hours dedicated to simulations in a protected environment [24, 25]. Nursing education is based on the responsibilities assigned to nurses and the needs of the healthcare system. However, efforts are needed to harmonize their main structure (e.g. duration, learning load) in different countries.

No privileges: nursing students are the same as other students

Nursing students during the pandemic were considered nearly in all surveyed UNPs to be general university students; thus, they avoided (in the beginning) and were later restricted in being present in all settings (classrooms, laboratories, clinical settings), despite their competences (e.g. preventing the spread of infection), their need to develop clinical competences and their future role. However, there were some exceptions to this. During the first peak, students from England and Scotland were given the choice to 'opt-in' to a paid placement. In doing so, students forfeit their supernumerary status in return for monthly payments [26, 27]. This trend was also visible in some other countries, where last year nursing or medicine students were transitioned to the health care system to work at the patient's bedside, which often was done suddenly, without prior preparation [28]. However, in many cases healthcare facilities issue guidelines limiting students' access to clinical settings. To ensure education, surrogate (e.g., online) sessions of education replacing the clinical experience in the beginning, up to a rationed number of students allowed to enter in the units/wards, have been adopted– rendering students and their UNPs extraneous to the pandemic scenario. When involved in clinical practice, students were recruited voluntarily– and mainly for the large-scale roll out of public health interventions (vaccinations and testing) not for other clinical purposes, such as taking care of patients at the bedside. The pandemic disrupted the intended integration of healthcare simulation into the curriculum, hindering the development of valuable skills. Additionally, the reciprocal commitment to educating nurses was compromised, as students were treated no differently from those in nonhealthcare fields.

Treating nursing students, like all other nonhealthcare students, disregards the unique nature of their education. This one-size-fits-all approach undermines the crucial hands-on training and clinical exposure essential for preparing future nurses. Nursing students have been considered in the past as members of the team, also compensating for shortages and only in relatively recent decades as supernumerary, which has its pros and cons [29]. Consequently, being part of the team, they had seen part of the health care system and their education well integrated with this system. Unlike other university students, nursing students receive specific training in infection prevention, making them well equipped to handle crisis situations. Categorizing them as unprepared potentially undervalued their specialized skills. Additionally, primary university-managed education often lacks close contact with clinical facilities. This missed opportunity to integrate healthcare system perspectives could have better prepared them for the unprecedented challenges encountered during the pandemic.

Expanding the educational capacity by surrogating the health care system, returning to normality at the end

The difficult times of the pandemic posed several challenges, mainly characterized by the digital transition of education and strategies to compensate for the lack of clinical training, both affecting the mind set and the competences of students. In the context of a lack of European strategies regarding hours, compensation, and simulation, each UNP dealt with the situation individually, following country-specific rules, especially in the first year of the pandemic. Surrogates were designed and managed by universities as a temporary solution: universities amplified their capacity to provide education by also absorbing that usually provided by health care facilities; on the other hand, the health care system seems to have abdicated its educational role mostly in the first wave but also later. The uncertainty and instability introduced by the pandemic, from online to onsite

and online to hybrid– depending on the epidemiological situation required continuing adaptation in the mode of education [15, 30]. However, according to the findings, at the end, routines in education were mainly restabilized [31]. Evidence [32] suggests that newly graduated nurses may have achieved competences like those before the pandemic, raising the possibility of streamlining practical training hours. However, the continued use of online education necessitates clear regulations regarding the number of permissible online hours and the types of courses suitable for this format. Standardizing online education across Europe is crucial, considering the current variations, which range from entirely online programs to limited online components.

The sustainability crisis of nursing education

Nurse education was generally based at university and not in the clinical setting, losing some integration with the healthcare system. This was particularly true for more junior students and in the first half of the pandemic. From a pre-pandemic, previously very integrated model, a disintegrated or distant model (during the pandemic) emerged across Europe. During this phase teachers/professors largely delivered all the education content, and this had two key potential implications: first, they shaped education outside of the clinical context, resulting in misaligned competences; second, many did not directly personally experience what was happening in the health care system due to being kept at a distance. At the end of the pandemic, all surveyed UNPs returned to their previous levels of integration with clinical practice, where some issues in placing students in their rotations remained. Prior to the pandemic, nursing education has always been considered sustainable, possibly in all health care settings. With the disruption of cooperation between the clinical and education sectors, the pandemic has challenged the sustainability of nursing education in several ways, first in its basic principles, as clinical competences must be acquired in simulated environments and in real settings—as also established by the EU Directives. The historical cooperation between the healthcare system and universities has also been brutally interrupted. The same capacity to welcome students by hospitals and community health care settings while living in a storm has been challenged, introducing likelihood for the first time in European history that education in nurses may be exposed to dramatic changes where the clinical places, hours, or other educational opportunities may be limited or refused by the health care system.

A health service world-environment without students

It is worth considering an important aspect of the HSS: during the pandemic, treatment and care were generally provided without students, which means that their clinical teaching, clinical teamwork experience and day-to-day presence at the patient's bedside were limited. In some countries, the pandemic's impact on healthcare student education is a double-edged sword. While the virtual learning environment ensures safety, it also limits students' exposure to the dramatic realities of a public health crisis. This potentially hindered their understanding of the crucial adaptations healthcare professionals made and the innovative, sustainable delivery of treatments under immense pressure. On the other hand, universities have adopted general rules, effectively neglecting the important role of interconnection with health services in all countries. Students were generally satisfied with their online education, but they were frustrated with a lack of information and stability in the clinical environment. Among the effects of the pandemic on competences, mostly soft, social skills were reported as poor (in Italy, problems of communication with family members, and in Poland, problems with communication with patients), which is also visible in other studies [15]. Additionally, teamwork impairment was observed in a few cases.

Attractiveness of the nursing profession in times of crisis

One of the positive effects observed after the difficult time of the COVID-19 pandemic was that six out of the nine UNPs surveyed reported an initial increase in the number of candidates applying to nursing programs. Due to this trend, the number of nursing students in some universities has increased to anticipate the changes in staffing that will occur in the future. Considering the large shortage of nursing professionals across the world's health care systems [33], it is important to observe this trend longitudinally. Additionally, this trend may suggest a strategy for promoting the nursing profession across countries.

Limitations

This comparative study has several limitations. First, while the inclusion of EU and non-EU Member States was intended to provide a broad and diverse perspective on nursing education, it also allowed for differences related to different national education systems and health policy frameworks. This diversity may limit the direct comparability of some results. Nonetheless, the selection was deliberate to enable inclusion of all and to allow for cross-contextual learning. Second, the study relied on a purposive sampling strategy in which one UNP per participating country was selected through the UDINE-C network. Although these institutions were selected for their expertise and long-standing commitment to international nursing education, this approach may introduce selection bias, and the limited number of institutions limits the generalizability of the results. The assumption that

the selected UNPs could reflect educational interventions at the national level during the pandemic based on the nationwide implementation of health and education policies should be taken with caution. Third, it proved difficult to ensure full participation of all initially invited institutions, although the study had a longitudinal qualitative design that included four rounds of data collection over a three-year period. Two programs did not participated in the follow up and had to be excluded from the final comparative analysis, which may have affected the completeness and continuity of the data. Fourth, the lack of quantitative data prevents statistical analysis of associations between variables or trends between countries. While the qualitative, descriptive approach was appropriate for examining complex and context-specific changes in education, future research could benefit from the inclusion of mixed methods to allow for both statistical and thematic comparison. Fifth, the data were collected solely by academic representatives, without the direct involvement of students, clinical educators, or healthcare system stakeholders. This academic perspective may have missed important operational or experiential insights from other key stakeholders involved in nursing education during the pandemic. Including these voices in future research would contribute to a more comprehensive understanding. Finally, while the integration of the HSS framework has enriched the analysis, the operationalization of HSS principles in nursing education remains an emerging area. Therefore, the study's framework should be considered exploratory, and further empirical validation is needed to assess its applicability in different national and institutional contexts.

Conclusion

This study examined the impact of the COVID-19 pandemic on undergraduate nursing education across in Europe, with a particular focus on the changes introduced during the crisis, the continuities that followed, and the evolving relationship between educational institutions and healthcare systems. The findings revealed that the pandemic significantly disrupted collaboration between universities and clinical settings. As clinical areas focused on acute care delivery, much of the responsibility for nurse training shifted to universities. This separation weakened the integration between academic and clinical education and underscored the urgent need to rebuild and reinforce these partnerships.

We conclude that strengthening the integration between educational institutions and health systems is crucial to ensure that future nurses are prepared to face the challenges of the 21st century. To implement this, we recommend that educational institutions and health systems create formal partnerships, develop joint training programs, and revise nursing curricula to include content on HSS. The COVID-19 pandemic represented an unprecedented challenge for nursing education, but it also offered an opportunity to rethink how we train future nurses. By promoting HSS and fostering strong cooperation between academia and practice, we can ensure that nurses are equipped to deliver high-quality, systems-informed care. Additionally, the shift toward online learning, alongside traditional classroom instruction, simulation centers, and clinical placements, demands a re-evaluation of nursing curricula, especially regarding the balance and credit allocation for theoretical versus clinical components. The concept of the "fourth space" in nursing education invites further research into how digital and simulation-based methods contribute to competency development and student readiness.

The exclusion of nursing students from the clinical environment during the pandemic was a missed opportunity to support their professional identity formation and familiarise them with the real complexities of the healthcare system. A collaborative strategy between universities and healthcare systems is needed to ensure that students are meaningfully integrated into care settings, even during emergencies. In addition, the challenges of securing clinical placements post-pandemic, exacerbated by workforce shortages, burnout and supervisory restrictions, point to systemic constraints that must be addressed collaboratively. Greater coordination between education providers and health services can facilitate joint planning of essential skills, placement capacity and workforce readiness. Finally, the increased interest in the nursing profession observed in some countries following the pandemic demonstrates the need for governments and professional organisations to take proactive measures to attract and retain new entrants to the profession. Sustained investment in nursing education and strong academic-clinical partnerships are essential to meet future healthcare needs.

Abbreviations

COVID–19	Coronavirus-19
EU	European Union
HSSs	Health sector skills
HSS	Health Systems Science
HEI	Higher Education Institution
UNPs	Undergraduate Nursing Programs
the UDINE–C	Understanding Developmental Issues for Nurse Educator Careers
UK	United Kingdom

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Author contributions

BD. and AP.– conception of the study and design; B.D, E.C., I.Ch., R.K., S.K., R.L., S.S., O.R., and A.P. - coordinated the data collection; B.D. and A.P. - prepared the data grid; B.D., S.C., and A.P. performed the data analysis; B.D., S.C., and A.P.

drafted the first version of the manuscript. All authors revised the manuscript and approved its final version.

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All data generated or analyzed during this study are included in this published article.

Declarations

Ethics approval and consent to participate
Each expert invited to the study was informed about the aim of the study and the data collection process. The data collection included information on the organization of the nursing study program during the COVID-19 pandemic, with no personal data collected. Informed consent was obtained from each expert participating in the study, and experts were able to terminate their participation in the study at any stage of the study.

Consent for publication
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Competing interests
The authors declare no competing interests.

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