EXPERIENCE EXCHANGE

Development and evaluation of an academia–industry collaborative recurrent education program focused on incontinence-related skin care: Bridging foundational education and clinical practice

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ABSTRACT

Background: A structural gap persists between foundational nursing education and the rapidly evolving technological landscape of clinical incontinence care in Japan. Increasing product differentiation requires healthcare professionals to exercise situational product selection, while undergraduate curricula often lag behind technological innovation. In addition, the diversification of the healthcare workforce introduces further complexity in interpreting locally optimized product logic. This report describes the development and evaluation of an academia–industry collaborative recurrent education program designed to address these structural challenges.

Methods: The program was co-developed by university faculty and an industry product development team. Theoretical sessions addressed skin pH dynamics, barrier protection mechanisms, and cleansing principles relevant to incontinence-associated dermatitis. Practical sessions incorporated visualization-based comparative demonstrations, in which simulated stool and urine were simultaneously applied to different absorbent products to externalize structural differences in absorption patterns and surface moisture conditions. The program was delivered in two separate in-person sessions at different venues in Niigata, Japan, in March 2025, with a total of 34 nursing and caregiving professionals participating across both sites, including one foreign care worker.

Results: Among respondents (n = 25), 88% reported acquisition of new knowledge and 92% recognized practical applicability. Qualitative feedback emphasized the value of hands-on visualization and expressed intentions to disseminate updated knowledge within clinical workplaces.

Conclusions: Academia–industry collaborative recurrent education may function as an adaptive interface between foundational curricula and accelerating clinical innovation. Beyond individual skill acquisition, such programs have the potential to support shared clinical reasoning across diverse professionals and contribute to regional healthcare quality assurance in technologically advancing care systems.

Key Words: Academia–industry collaboration, Caregiving professionals, Foreign care workers, Incontinence care, Nursing professionals, Recurrent education

1. INTRODUCTION

Japan faces a severe shortage of nursing and caregiving personnel due to its rapidly aging population.[1,2] Despite rapid innovation in incontinence care products through academia–industry collaboration, opportunities to incorporate newly developed products and evidence into formal

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nursing curricula remain limited, despite increasing recognition of the importance of university-based recurrent education initiatives.[3] As a result, education often focuses on generalized procedures such as standard diaper application, while clinically valuable products may be underutilized in practice.

This structural gap between research, product development, and frontline education represents a critical challenge. In recent years, technological innovation in medical and long-term care products has accelerated rapidly. Product development is increasingly evidence-driven, resulting in highly differentiated supplies designed for specific clinical conditions. While such innovation enhances individualized care, it simultaneously increases the complexity of product selection and clinical judgment in practice. However, undergraduate nursing curricula are typically revised at longer intervals and tend to emphasize standardized procedural competencies. This temporal gap between technological advancement and curricular revision may generate structural misalignment between what is taught in foundational education and what is required in contemporary clinical practice. This challenge is not unique to Japan; international scholarship has similarly identified the need to systematically bridge academia and practice as a critical priority in nursing workforce development.[4]

In the field of incontinence care, product differentiation has become particularly pronounced. Variations in absorbency, material composition, skin protection mechanisms, and stool-specific design require practitioners to make nuanced decisions beyond basic diaper application techniques. International expert consensus emphasizes the importance of pH-balanced cleansing and skin protection in preventing incontinence-associated dermatitis.[5,6] Nevertheless, such evidence and the practical logic underlying product differentiation are not always systematically incorporated into undergraduate nursing education. Previous research has also demonstrated that insufficient knowledge among nursing staff is associated with suboptimal incontinence-associated dermatitis (IAD) prevention practices.[7]

Moreover, many rapidly aging societies, including Japan, are experiencing increasing diversification of the healthcare workforce. As care systems become more multicultural, locally optimized products and practices must be communicated clearly and consistently across professionals with varied educational and cultural backgrounds. The technological diversification of locally developed products may therefore create additional complexity in clinical decision-making, particularly for internationally recruited healthcare workers.[8,9]

Against this background, recurrent education should be understood not merely as supplementary training but as a structural mechanism to bridge technological acceleration and curricular latency. The present program was developed as a pilot initiative to explore how academia–industry collaboration might contribute to building a system of continuous clinical knowledge updating.

2. METHODS

2.1 Program design and setting

The program was co-developed by faculty members of Niigata University and a product development team from a private company. It was strategically designed as a structured knowledge-updating mechanism rather than a supplementary lecture. Recognizing the temporal gap between rapid technological innovation in incontinence care products and the slower revision cycle of undergraduate nursing curricula, the educational content focused on clinical knowledge not routinely addressed in foundational education.

The university component provided theoretical instruction on skin integrity and IAD. The lecture reviewed age-related changes in skin barrier function, reduced acid-neutralizing capacity, and mechanisms of percutaneous absorption. The pathophysiology of IAD, particularly maceration under alkaline conditions, was explained in relation to cleansing and barrier protection strategies. Differences between saponification-based alkaline soaps and chemically neutralized synthetic detergents were examined, with discussion of glycerin retention, oleic acid content, and implications for moisture preservation and epidermal regeneration. Live pH measurements using distilled water and tap water were conducted to illustrate impaired neutralization capacity in vulnerable skin conditions and to reinforce the rationale for appropriate cleansing selection. In addition, the session addressed the clinical implications of residual hydrophobic barrier films on the skin surface. Demonstrations were conducted to illustrate that incomplete removal of water-repellent protective agents may interfere with the absorption of subsequently applied topical medications. Participants observed that reapplication of ointments over inadequately cleansed skin surfaces does not necessarily result in effective therapeutic penetration, thereby potentially diminishing treatment efficacy.

Practical techniques for gentle yet complete removal of hydrophobic coatings were demonstrated, emphasizing cleansing strategies that minimize mechanical irritation while restoring the skin's capacity to receive therapeutic agents. This component deepened understanding of the relationship between cleansing adequacy, barrier integrity, and pharmacological effectiveness in routine incontinence care.

Building upon this theoretical framework, the industry-led session introduced technological innovations in stool-specific absorbent product design. Structural features such as anterior absorption zones aimed at targeted moisture capture under body pressure were explained in relation to rewetting prevention and reduction of prolonged skin exposure. Design elements addressing leakage in supine positions, including reinforced side barriers and back-leak prevention mechanisms, were presented alongside alignment guides intended to facilitate accurate positioning. The use of soft-contact materials to reduce friction-related irritation was discussed within the context of maintaining skin integrity.

Rather than presenting product features in isolation, both components emphasized situational clinical judgment. Demonstrations illustrated when stool-specific absorbent products may be preferable to standard diapers, particularly in cases of frequent soft stools, high moisture burden, or compromised skin barrier function. Techniques for removing hydrophobic protective agents prior to reapplication were demonstrated to highlight the importance of complete cleansing in preventing cumulative irritation.

The program consisted of two structured sessions at each site:

Theoretical session (60 minutes): Advanced skin care based on skin pH dynamics, percutaneous absorption mechanisms, and cleansing principles consistent with international recommendations for IAD prevention,[5,6] content not typically covered in basic nursing education.

Practical session (60 minutes): Demonstrations of situational product selection and absorbent performance using simulated excrement to visualize moisture distribution and absorption dynamics. During the practical session, the industry partner demonstrated not only product specifications but also the structural logic underlying product differentiation. Particular attention was given to absorbent zone design, backflow prevention mechanisms, stool-specific containment structures, alignment guides, and skin-contact materials.

Simulated materials resembling soft stool and urine were simultaneously applied to different types of absorbent products under comparable conditions (see Figure 1).

This side-by-side comparison enabled participants to observe differences in absorption speed, containment patterns, and residual surface moisture in real time. In conventional products, simulated soft stool tended to remain in prolonged contact with the surface, whereas stool-specific designs demonstrated more rapid containment and reduced surface dampness. These visible contrasts clarified how structural differences influence skin exposure conditions.

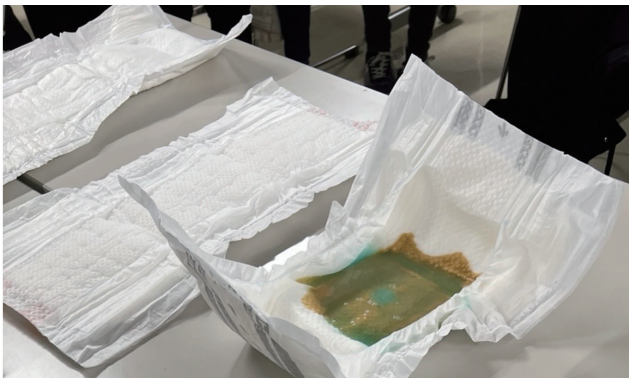

Figure 1. Side-by-side comparison of absorption patterns in conventional and stool-specific absorbent products using simulated excrement

Additional features such as center-line alignment guides and soft-contact materials were explained in relation to pressure distribution and irritation prevention. Rather than introducing products descriptively, the session emphasized the clinical rationale connecting product structure to patient condition. Through this comparative visualization process, participants were encouraged to interpret product differentiation as a basis for situational product selection.

Participants were recruited within each regional medical area. To enhance accessibility, the same program was delivered separately at two distinct venues in different medical districts in March 2025, allowing professionals from facilities without direct university affiliation to participate. Each session accommodated approximately 30 participants, with different participants attending each venue.

2.2 Participants

A total of 34 nursing and caregiving professionals participated across the two sites, including one foreign care worker. To ensure comprehensive regional representation, formal invitation letters were distributed to all medical institutions and long-term care facilities within the targeted secondary medical district in Niigata. Participants were recruited through these official channels to minimize selection bias and to assess the broader regional demand for specialized incontinence care education.

2.3 Evaluation

Anonymous questionnaires were distributed at each venue immediately after the program and collected on-site. Participation in the survey was voluntary.

The questionnaire included Likert-scale items assessing perceived knowledge acquisition and practical applicability across two content domains (skin care and absorbent products), as well as one open-ended item inviting general im-

pressions and opinions ('Please share your impressions and opinions from today's session'). Descriptive statistics were calculated using simple frequency analysis.

Responses to the open-ended questions were analyzed using descriptive thematic analysis. Comments were reviewed, coded, and grouped into recurring themes to summarize participants' perspectives. Twenty-five valid responses were obtained (response rate: 73.5%).

2.4 Ethical considerations

This report describes an educational practice initiative and does not constitute human subjects research; therefore, formal institutional ethical review was not required. Prior to questionnaire administration, participants were verbally informed of the voluntary nature of participation, the anonymous handling of all responses, and the potential use of aggregated data for publication purposes. Informed consent was obtained from all participants before data collection.

3. Results

Among respondents (n = 25), 84% rated the duration of the program as appropriate, suggesting that the overall time allocation was acceptable for most participants. A small proportion indicated a preference for longer sessions, particularly for the practical component, implying a demand for extended experiential learning.

Eighty-eight percent reported gaining new knowledge from the program, and 92% recognized practical learning effects. These findings suggest that the content exceeded routine workplace knowledge and was perceived as directly applicable to clinical practice. No respondents reported that the level of instruction was excessively difficult or overly simplistic, indicating that the program achieved an appropriate balance for a heterogeneous professional audience.

Participants reported improved understanding through hands-on exposure and expressed intentions to share the knowledge with colleagues. The participating foreign professional reported no linguistic or practical difficulties during the session, suggesting that the demonstration-based format may have supported inclusive comprehension.

Open-ended responses were descriptively categorized into four recurring themes: (1) perceived usefulness of hands-on practice, (2) updating of evidence-based knowledge, (3) intention to disseminate learning within the workplace, and (4) requests for extended practical session time. Many participants indicated that direct exposure to actual products enhanced their understanding beyond what could be achieved through lecture alone. Several respondents also expressed motivation to share newly acquired knowledge with colleagues, suggesting potential ripple effects within clinical settings. Collectively, these qualitative responses reinforce the quantitative findings and highlight the perceived value of integrating theoretical clarification with experiential demonstration. Quantitative results for the two content domains are also reported in the Results section: 88% of respondents reported gaining new knowledge from the skin care session, and 92% recognized practical learning effects from the absorbent product session. These findings are particularly noteworthy given that all participants were practicing professionals who had completed foundational education. The high rates of new knowledge acquisition suggest that recurrent education addresses a genuine gap between initial training and the demands of current clinical practice.

Participant occupational information was not collected at registration to minimize burden and protect privacy. However, professional background data were available from the anonymous post-program questionnaire, which indicated that among the 25 respondents, seven were nursing professionals (28%), 17 were care workers (68%), and one indicated another professional background (4%), reflecting the diverse workforce composition of the participating facilities.

During the interactive sessions, the care workers demonstrated exceptional engagement, frequently noting that while they are responsible for the majority of daily diaper changes and skin observations, they had rarely received formal training on the physical and chemical logic of absorbent materials. The qualitative feedback reflected a strong desire for 'scientific empowerment.' Many participants remarked that the visualization-based demonstrations provided them, for the first time, with a clear 'reason why' behind product selection, moving beyond the procedural routines often taught in basic caregiver training. The high attendance rate from the caregiving sector, despite the program being hosted by a university-led initiative, underscores a substantial unmet need for evidence-based practice in the frontline of community and residential care.

4. Discussion

The present findings suggest that recurrent education may function as an adaptive interface between foundational curricula and accelerating clinical innovation. While undergraduate education provides essential standardized competencies, it cannot always synchronize with the rapid diversification of evidence-based clinical technologies. This discrepancy does not indicate a deficiency in basic education itself; rather, it reflects a structural latency inherent in curricular revision processes. In technologically advancing care environments, such latency may contribute to the underutilization of clinically meaningful innovations.

In the field of incontinence care, product differentiation has expanded beyond basic absorbency to include stool-specific design, advanced material engineering, and skin protection mechanisms aimed at minimizing dermatitis risk. Undergraduate training typically emphasizes standardized diaper application and general skin care principles; however, clinical practice increasingly requires nuanced situational judgment based on stool consistency, skin condition, and individual patient needs. Without systematic opportunities to update product literacy, healthcare professionals may rely on generalized techniques despite the availability of more targeted and evidence-informed solutions.

Japan's rapidly aging society has fostered a highly diversified and technologically advanced incontinence care market.[1,2] The evolution of absorbent products in the Japanese market has been particularly rapid, with increasing differentiation not only according to activities of daily living (ADL) levels but also in relation to urinary frequency, stool consistency, and moisture load. Such advanced product segmentation reflects significant technological innovation and contributes to individualized care.

However, this high degree of product differentiation simultaneously generates a new cognitive demand on healthcare professionals. Clinical staff are now required to exercise situational product selection—an advanced form of clinical judgment that integrates patient condition, excretory characteristics, and product-specific structural features. Without structured educational support, this increased complexity may lead to underutilization or inappropriate selection of available innovations. Although such innovation enhances individualized care, it simultaneously increases the cognitive complexity of product selection. The high levels of perceived knowledge acquisition and practical applicability observed in this program suggest that structured recurrent education—particularly when incorporating visualized demonstration of product logic—can reduce this cognitive burden and facilitate more evidence-aligned decision-making.

Although only one foreign care worker participated, this unexpected inclusion highlighted an additional dimension of contemporary care systems. As Japan increasingly accepts foreign care workers into long-term care settings,[9] the logic underlying locally optimized products may not be intuitively understood by professionals trained in different healthcare environments. Demonstration-based and context-sensitive educational approaches may therefore support not only skill acquisition but also professional integration.

Beyond individual adaptation, the increasing multiculturalization of the healthcare workforce introduces a structural consideration. As product technologies become more specialized and context-dependent, implicit local knowledge may no longer be sufficient to ensure consistent care practices across culturally and educationally diverse professionals.

Demonstration-based and visualization-oriented education can function as a shared cognitive platform that externalizes tacit product logic, thereby reducing reliance on culturally embedded assumptions. In this sense, recurrent education contributes not only to knowledge updating but also to the stabilization of clinical reasoning across heterogeneous professional backgrounds. Rather than positioning multicultural participation as exceptional, such programs may serve as integrative mechanisms that support alignment of professional standards within increasingly diverse care systems. Interprofessional education has been consistently shown to enhance teamwork competencies and role clarity across diverse health professions, though logistical challenges remain.[10]

This approach is consistent with adult learning theory, which emphasizes contextualized, experience-based learning with immediate practical applicability.[11] However, beyond individual learning theory, the findings point toward a broader structural consideration. In rapidly aging and technologically advancing societies, maintaining professional competence depends not solely on initial education but on the existence of structured and continuously adaptive updating mechanisms.

The structural implications of recurrent education also extend to regional healthcare systems. Access to university-based continuing education opportunities may not be evenly distributed across geographic areas, particularly in rural or less urbanized regions. In such settings, healthcare professionals may have limited exposure to systematic updates on rapidly evolving clinical technologies and product innovations. Consequently, knowledge updating may become dependent on institutional affiliation or personal initiative rather than on structured regional support.

The participation pattern observed in this program further illustrates this concern. Several facilities sent multiple staff members and treated participation as official work time rather than requiring personal leave. Such institutional endorsement suggests that certain organizations recognize recurrent education as an element of structured quality management and anticipate internal knowledge dissemination following participation. In contrast, some facilities were not represented. This uneven engagement indicates that access to updated clinical knowledge may depend on institutional culture, leadership priorities, and resource allocation.

If recurrent education remains voluntary and institution-dependent, variability in product literacy and evidence-based

practice may persist across facilities within the same region. From a regional healthcare governance perspective, broader institutional endorsement and coordinated participation frameworks may be necessary to translate individual educational gains into system-level quality assurance. Embedding academia–industry collaborative programs within regional healthcare networks may therefore contribute not only to interprofessional communication but also to the stabilization and elevation of regional care quality.

Thus, recurrent education should be conceptualized not merely as supplementary training but as a system-level infrastructure that supports sustainable professional competence in technologically accelerating care environments. The present initiative may be understood as an exploratory step toward designing such a structured and adaptive updating mechanism within the context of regional healthcare systems.

Although the present program focused specifically on incontinence care, the structural issues identified are not confined to this domain. Rapid technological evolution, evidence-based product differentiation, and curricular latency are observable across multiple areas of nursing practice, including wound management, medical device utilization, and symptom management. The model presented in this report may therefore be conceptualized as a prototype for a broader, systematized framework of recurrent education.

By establishing structured collaboration between academia and industry, clinical innovations can be translated into practice-oriented knowledge in a timely and evidence-aligned manner. In technologically accelerating care environments, the sustainability of professional competence cannot be secured by initial education alone; it depends on the presence of structured and continuously adaptive updating mechanisms. The present initiative may be understood as an initial step toward conceptualizing such a mechanism within the context of academia–industry collaboration.

The findings of this report challenge the traditional assumption that specialized clinical education should primarily target nursing staff. In the reality of Japan's aging society, the burden of managing complex skin health and incontinence has shifted heavily onto care workers, who often lack the foundational physiology and material science education provided in nursing curricula. Our results suggest that care workers are not only willing but eager to adopt evidence-based methodologies when presented through intuitive, visual formats.

This 'educational thirst' among caregivers highlights the necessity of academia–industry partnerships to act as knowledge translators. Traditional academic lectures may inadvertently exclude non-medical staff through overly technical jargon, but the visualization of simulated stool and urine absorption transcends these barriers. By empowering care workers with the ability to interpret product performance scientifically, we can promote a more proactive and specialized care culture in long-term care facilities. This shift is essential for reducing the incidence of incontinence-associated dermatitis and improving the quality of life for the elderly. Therefore, future recurrent education models must prioritize the accessibility of 'visible evidence' for the caregiving workforce to ensure the resilience of regional healthcare systems.

The predominance of care workers among respondents, despite formal invitations being distributed to all medical and long-term care institutions within the secondary medical district, underscores a critical disparity in educational engagement. While nursing professionals often have access to structured clinical ladder programs within their institutions, care workers in the region appear to be experiencing a 'pedagogical vacuum.' The strong response from the caregiving sector highlights their urgent, unmet need for evidence-based knowledge. Future recurrent education programs should prioritize accessible and inclusive formats to ensure the quality and resilience of regional healthcare systems.

5. Conclusions

This study demonstrates that academia–industry collaborative recurrent education can function as a structured mechanism for bridging the gap between foundational nursing curricula and rapidly evolving clinical technologies. In the context of increasingly differentiated incontinence care products, healthcare professionals are required to exercise situational product selection based on patient condition and product-specific design logic. Without systematic updating mechanisms, such complexity may lead to variability in practice and underutilization of evidence-informed innovations.

The present initiative illustrates how visualization-based demonstrations and theory-integrated practical sessions can externalize tacit product knowledge and support shared clinical reasoning across diverse professional backgrounds. Beyond individual skill acquisition, recurrent education may serve as a component of regional healthcare quality assurance infrastructure. Establishing structured, periodically implemented collaborative programs may contribute to sustainable professional competence in technologically accelerating and increasingly multicultural care environments.

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Limitations

This report describes a limited number of sessions conducted within a single prefecture, and long-term behavioral or clinical outcome measures were not evaluated. The findings therefore primarily reflect immediate educational perceptions rather than sustained changes in practice.

In addition, the industry collaboration involved a single company, and comparative evaluation with products from multiple manufacturers was not undertaken. Although the educational focus emphasized structural logic and clinical reasoning rather than brand-specific promotion, broader comparative frameworks would strengthen generalizability and reduce potential concerns regarding product specificity.

Furthermore, participation was voluntary and based on self-selection, which may have resulted in the inclusion of highly motivated professionals. Future research should examine multi-site implementation, incorporate objective clinical indicators, and explore long-term effects on care quality and professional decision-making. Future investigations should also examine how recurrent education programs can be systematically embedded within regional governance frameworks rather than relying solely on voluntary participation. Institutionalizing periodic knowledge-updating mechanisms may reduce disparities in product literacy and support more uniform standards of care across facilities. Exploring policy-level integration of academia–industry educational partnerships may therefore represent an important direction for sustainable regional healthcare development.

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AUTHORS CONTRIBUTIONS

The author (N.K.) was solely responsible for the conception, design, data collection, analysis, and drafting of this manuscript. The author read and approved the final manuscript.

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CONFLICTS OF INTEREST DISCLOSURE

The author declares that there are no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

INFORMED CONSENT

Obtained.

ETHICS APPROVAL

The Publication Ethics Committee of the Association for Health Sciences and Education. The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

DATA SHARING STATEMENT

No additional data are available.

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