



## Editorial

### Integrating Ambient Assisted Living into Nursing Education: Are We Ready for the Future of Gerontechnology?

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**Abstract:** The accelerating global shift toward ageing populations has become one of the most urgent challenges for 21st-century health systems and nursing education. As nations strive to prepare digitally competent health workforces, technologies such as simulation-based learning, virtual reality, artificial intelligence, and ambient assisted living (AAL) are redefining what it means to care for older adults with independence, dignity, and safety. AAL refers to intelligent environments and systems designed to support disability-free and independent living while enhancing the well-being of older users. Yet, the promise of AAL remains unevenly realized. While high-income countries have incorporated gerontechnology into curricula and practice, many middle-income nations, including Thailand, still rely on traditional pedagogy, leaving graduates underprepared for the realities of digital health.

This editorial argues that integrating AAL into nursing education is no longer optional but essential. It calls for a paradigm shift that positions AAL as a global core competency aligned with the United Nations Sustainable Development Goals Goal 3 (Good Health and Well-being) and Goal 4 (Quality Education) and the Universal Health Coverage (UHC) principles of efficiency, equity, and effectiveness. The readiness of today's nursing education to embrace AAL in curricula, teaching-learning, and digital infrastructure will determine not only how well future nurses are prepared for geriatric care but also how effectively health systems keep pace with the global, gerontechnology-driven transformation.

**Keywords:** Aged care, Ambient assisted living, Digital health, Nursing education, Gerontechnology

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#### Current Context

Worldwide, countries across the globe are struggling with the profound implications of population ageing defining the demographic transformation of the twenty-first century. The World Health Organization

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(WHO) estimates that by 2030, one person in six worldwide will be aged 60 years or older,<sup>1</sup> reshaping

the very foundation of health systems and professional education. Nursing is the backbone of global health care, and at the heart of this transformation. Among the countries with the fastest ageing population in Southeast Asia, Thailand, at this juncture, faces the dual challenge of providing equitable care to the fast-growing older population, while ensuring the digital literacy of its nursing workforce at the forefront of the gerontechnology era. Globally, digital innovations such as simulation-based learning, virtual reality (VR), artificial intelligence (AI),<sup>2</sup> and Ambient Assisted Living (AAL) technologies are starting to redefine elderly care and empower older adults to live with more independence, dignity, and quality of life. To support independent living and the well-being of older users, AAL systems use automated decision-making mechanisms that integrate, analyze, and interpret complex multimodal and multi-device information, focusing mainly on health monitoring and activity recognition.<sup>3</sup> The systems are not things in the future; they are already firmly entrenched in the policies of the leading economies.

Several models like Europe's Active and Assisted Living Programme, Japan's Society 5.0, and Canada's Aging in Place show how AAL can unify the healthcare, technology, and education sectors and create whole ecosystems. However, considering these international trends, nursing education in most Southeast Asian countries with low-resource settings remains behind. Traditional pedagogies support outdated curricula, with poorly-equipped graduates for digital health. Technological innovation and educational practice gaps are growing. Although the country's national health strategies promote digital transformation based on the Universal Health Coverage (UHC) principles of efficiency, equity, and effectiveness,<sup>4</sup> nursing curricula have been fragmented and reactive to the challenges. AAL-related courses are also scattered, faculty exposure to up-to-date technologies is limited, and institutional readiness for technology-enhanced learning is uneven. It demands a paradigm shift to

embed AAL as a core competency, but not just as a national matter or a global one, but one that needs to permeate nursing curricula. It would empower all nurses to deal with the widespread challenges of an ageing society, in addition to becoming recognized as a regional leader in digital health and gerontechnology. Therefore, the question is not whether AAL should be incorporated in practice; rather, it is how quickly we can act to ensure readiness for tomorrow's gerontechnology in the digital health era.

#### **Challenges and Knowledge Gaps**

Thailand could be one example in Southeast Asia that provides an instance of the promise and imperative of the use of policy, pedagogy, and technology with both opportunities and knowledge gaps to prepare nurses to be able to face the digital future of aged care.<sup>5</sup> While there is potential for transformational improvements in service delivery, AAL<sup>6-8</sup> has the power to boost the quality of nursing education for older adults. However, many obstacles lie ahead of this approach to nursing education in Thailand and other low-resource settings. These are systemic infrastructures rooted in pedagogy, technology, policy, and practice that collectively shape the readiness of the workforce for future nurses to function well in digital health.

One of the most common challenges is faculty preparedness. Across countries, nursing educators often lack sufficient exposure to digital innovations combined with pedagogical training on other technologies encompassing artificial intelligence (AI), sensor networks, and telehealth. This limitation is particularly accentuated with faculty members less likely to experience AAL, and a lack of richer contextual use or practical education equipped with AAL skills. The trained faculties are therefore significant not only for teaching assistants, but also are the strongest in integrating AAL and providing learning opportunities for students. This is similar evidence from those who use web-based technology for online teaching during COVID-19 pandemic in many countries.<sup>9-10</sup>

In addition, lack of targeted professional development leads to even the most enlightened educational policies being nothing more than hopes rather than practical solutions.

Second, curricula are not linked to global competency frameworks. Evidence from around the world, including the AACN Essentials,<sup>11</sup> UNESCO's Digital Competency Framework for Educators,<sup>12</sup> and WHO's Global Strategy on Digital Health,<sup>13</sup> indicates that simulation labs, smart homes, and blended learning modules all can contribute to developing gerontological competence, critical thinking, and ethical use of technology.<sup>14</sup> Nevertheless, many nursing programs remain heavily tied to the traditional pedagogical roots. Where AAL-related content is afoot, it is scattered and peripheral, rather than systemically integrated as a component of the theoretical and clinical program of study. This absence of provision reduces students' readiness to practice within a digitally-supported healthcare infrastructure.

Third, infrastructure disparity remains, where it lingers. Most institutions lack the money or expertise to deploy either robotics, IoRT (Internet of Robotic Things) systems, immersive virtual reality platforms, or immersive VR applications. Urban-rural digital inequality merely exacerbates disparities in learning opportunities in resource-poor areas, where students are less likely than the rest of the population to develop 21st-century skills. The AAL simulation environment is not only conducive to teaching technical skills, but has been shown to stimulate students' self-confidence, personal safety, and a readiness to work and learn across all national and international levels of study.<sup>15-16</sup> Equitable provision of infrastructure such as this remains a major challenge in both regional and national education systems.

In addition, there is also a lack of ethical and policy frameworks. While universal health coverage (UHC) themes of efficiency, equity, and effectiveness form a theoretical foundation for reform, empirical evidence about how AAL should be regulated,

appraised, or determined as sustainably financially, remains crucial, particularly in middle-income countries. Concerns about data privacy, cultural acceptance, and long-term cost effectiveness have not been resolved. Similarly, only a few longitudinal studies have addressed how AAL-related skills are maintained, implemented in nursing practice, and linked to patient outcomes.<sup>9,14</sup> These knowledge and capacity gaps demonstrate that AAL integration is structural and pedagogical, not merely technological. This includes challenges related to digital literacy, alignment of international curricula, and interdisciplinary collaboration among academia, industry, and policy. If no action is taken, AAL is bound to be a peripheral innovation debated in theory but not applied in practice. A transformative ideology for nursing education to enable equitable, technology-integrated care for older people is therefore, a big challenge.

#### **Opportunities and Suggestions**

The utilization of AAL technologies stands out as a developmental bridge in the global revolution in nursing education. Considering the aging population worldwide, the nursing professional must demonstrate coherence in caring for patients competently by integrating human care with digital information technology. Thus, AAL represents a teaching-based system of innovation linking nursing's caring essence to the innovation of care design. What international experience has shown is that AAL-based training promotes better digital literacy, critical thinking, ethics, and emotional empathy among the aged when it comes to digital literacy development. The practical use of simulation-oriented training courses, VR, and interprofessional teams enables learners to practice not only technical skills but also humanities and human concern. Those high-income countries leading in gerontechnology indicate that AAL integration enhances nurses' professional roles while easing the burden of care and mitigating physical and emotional exhaustion. Through smart-home systems

equipped with AAL, nurses can better protect patients' rights, recognize their true needs, and deliver care grounded in respect and autonomy rather than control or intrusion.<sup>6-7</sup>

To transition from global to local action in AAL integration, flexible plans should be established that adapt well to local needs and resources. It is required a strategic link between national improvements in health and international digital technologies. There is an opportunity for nursing education to emerge as a regional leader in gerontechnology, a field in which innovation, equity, and ethics intersect.

Three interlinked strategies must be constructed collectively to see this vision and bring one to encourage the other, to deliver a new vision – a new future.

First, *faculty development*. The transformation starts with educators. Ongoing professional development in digital literacy, simulation pedagogy, and gerontechnology is necessary to help faculty feel competent and confident to teach in a digital age. Research reveals that faculty self-efficacy in technology and AI is a strong predictor of students' performance.<sup>10,15</sup> We can speed up this capacity-building and create a cadre of nursing educators using the global standards required within education through more structured education programs and mentorship programs, and connections with engineers, technology specialists, and WHO Collaborating Centres.

Second, *curriculum reform*. This is needed to transform AAL from just being optional to becoming an essential aspect of a professional identity.<sup>12</sup> Curriculum needs to meet standards set out by the nursing councils at national and international levels, based on AACN<sup>11</sup> Essentials and UNESCO's Digital Competency Framework for Educators.<sup>12</sup> The incorporation of AAL within education via smart-home demonstrations, VR modules of education, and mixed-methods learning environments can make AAL education more experiential and applicable. This will help nurses shift from merely receiving information and practicing skills to actively developing competencies

Third, *policy and infrastructure investment*. The systemic investment for institutions and policymakers must come together to build smart classrooms, simulation centers, and AAL labs that bridge learning to practice in the real world. Public and private partnerships have the potential to bridge the digital divide and allow all learners, whether urban or remote, access to information. The contribution of Universal Health Coverage (UHC) could be a healthcare resource for aspirations and reach the accomplishment of the United Nations Sustainable Development Goals (SDGs) Goal 3: Good Health and Well-being, and Goal 4: Quality Education to promote lifelong learning for all.<sup>17</sup> There is evidence indicating such climates enhance technical knowledge, independence, and psychological well-being.<sup>18-19</sup>

In the end, these strategies culminate in the same dream regarding an advanced skill but humanized education in nursing. Regarding the International Council of Nurses'<sup>20</sup> Charter for Change, which presents ten policy actions, and policymakers must invest in quality nursing education not only to increase the number of nurses but also adequately prepare them for the work environment with AI-assisted tools. An investment in nursing professional development will help produce forward-thinking leaders in gerontechnology, developing not only patient care but also an ethical and intellectual foundation in nursing by incorporating AAL as a common mainstream competence throughout the world.<sup>21</sup> With intentional reengineering of how we do all this, the next generation of nurses will be able to harness and balance innovation with caring. Therefore, the movement to be used online by the healthcare sector will always carry a human narrative behind it.

## Conclusion

Ambient Assisted Living (AAL) goes beyond using 'technology'. It represents a paradigm shift that all nurses in the delivery of care need to adopt and adapt to the new living circumstances of ageing populations. While institutional challenges still loom,

including faculty readiness, curriculum integration, and infrastructure, these challenges can be turned into opportunities through strategic investments, educational leadership, and consistent policy transformations. The integration of AAL as a core competency would improve digital health capacity and serve the values of UHC (e.g., efficiency, equity, and effectiveness) in older adult services.

The impact of the shift needs to begin at the nursing level, where vision and leadership are going to steer the pace of change. With the acceptance of AAL, each country can attain and share its own leadership role in regional gerontechnology education as well as participate in global human–technology synergy endeavors. Nursing technology in the digital age may also empower it by enabling its own programs to be incorporated into clinical practice. Digital nursing is not only about the future of nursing but also about the future of the best nurse care by cultivating compassion from being invisible to invaluable in healthcare.

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## การบูรณาการเทคโนโลยีช่วยการดำรงชีวิตของผู้สูงอายุในการศึกษาพยาบาล : พร้อมหรือยังสำหรับเทคโนโลยีผู้สูงอายุแห่งอนาคต?

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**บทคัดย่อ:** การเปลี่ยนผ่านของโครงสร้างประชากรโลกสู่สังคมผู้สูงอายุอย่างรวดเร็ว เป็นหนึ่งในความท้าทายสำคัญของระบบสุขภาพและการศึกษาพยาบาลในศตวรรษที่ 21 ขณะที่ประเทศต่าง ๆ เร่งพัฒนาบุคลากรสุขภาพให้มีสมรรถนะทางดิจิทัล เทคโนโลยีสมัยใหม่ เช่น การจำลองสถานการณ์ความเป็นจริงเสมือน ปัญญาประดิษฐ์ และเทคโนโลยีช่วยการดำรงชีวิตของผู้สูงอายุ (Ambient Assisted Living: AAL) ได้เข้ามามีบทบาทสำคัญในการดูแลผู้สูงอายุอย่างมีศักดิ์ศรี ปลอดภัย และเป็นอิสระ AAL หมายถึงสภาพแวดล้อมและระบบอัจฉริยะที่ออกแบบเพื่อสนับสนุนการใช้ชีวิตที่ปราศจากความพิการและเป็นอิสระ ซึ่งช่วยยกระดับความเป็นอยู่ที่ดีของผู้สูงอายุได้ แต่พบว่าการนำเทคโนโลยีช่วยการดำรงชีวิตของผู้สูงอายุมาใช้ยังมีข้อจำกัด แม้ว่าในหลายประเทศที่มีรายได้สูงจะมีการบูรณาการเทคโนโลยีช่วยการดำรงชีวิตของผู้สูงอายุในหลักสูตรและการปฏิบัติ แต่ในประเทศรายได้ปานกลางรวมทั้งประเทศไทย ที่ยังพึ่งพาการสอนแบบดั้งเดิม จึงอาจส่งผลให้บัณฑิตพยาบาลขาดความพร้อมต่อการดูแลผู้สูงอายุในยุคเทคโนโลยีสุขภาพดิจิทัล

บทบรรณาธิการฉบับนี้เสนอว่า “การบูรณาการเทคโนโลยีช่วยการดำรงชีวิตของผู้สูงอายุเข้ากับการศึกษาพยาบาล” ไม่ใช่ทางเลือกแต่เป็นความจำเป็น เพื่อยกระดับสมรรถนะพยาบาลให้สอดคล้องกับเป้าหมายการพัฒนาที่ยั่งยืน (Sustainable Development Goals: SDG 3 และ 4) และหลักประกันสุขภาพถ้วนหน้า (Universal Health Coverage: UHC) ด้านประสิทธิภาพ ความเสมอภาค และประสิทธิผล ประเทศรายได้ปานกลางจึงควรขยายโอกาสเร่งพัฒนาเพื่อลดความตึงเครียดในระดับโลกระหว่างนวัตกรรมกับการนำไปปฏิบัติ บทความนี้จึงให้ข้อเสนอแนะผู้นำทางวิชาการ ผู้กำหนดนโยบาย และผู้สอน ลงมือดำเนินการทันที ความพร้อมของการศึกษาพยาบาลในปัจจุบันที่ยอมรับ AAL ในหลักสูตร การเรียนการสอน และโครงสร้างพื้นฐานทางดิจิทัล จะเป็นตัวกำหนดไม่เพียงแต่ด้านการเตรียมพยาบาลรุ่นใหม่ให้พร้อมต่ออนาคตของการดูแลผู้สูงอายุเท่านั้น ยังรวมถึงการรู้เท่าทันต่อการเปลี่ยนผ่านและอัตราความก้าวหน้าของโลกในการเปลี่ยนแปลงระบบสุขภาพที่ขับเคลื่อนด้วยเทคโนโลยีเพื่อผู้สูงอายุ

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