Nursing Informatics Integration into Mainstream Health Informatics

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Abstract. Nursing Informatics emerged in Australia during the early 1980s and drove the Professional development and acceptance of Health Informatics. Milestones achieved include the development of a national journal, the establishment of the Health Informatics Society of Australia and the Australasian College of Health Informatics (now collectively the Australasian Institute of Digital Health), nursing participation in Health Informatics standards development activities, adoption of the HL7 messaging standard, the delivery of numerous workshops, an annual national health informatics conference since 1993, hosting international conferences, the development and delivery of Health Informatics post graduate programs and establishing a research centre where the first prototype for an archetype repository was developed. This became the openEHR Clinical Knowledge Manager. The most recent milestone was the establishment of a private company that became a Registered Training Organisation. Continuing challenges include workforce capacity building to address the poor understanding of the need for improved data and IT governance at every level, the need to comply with proven scientific and technical principles and a need to transform national and international traditional infrastructures no longer fit for purpose to enable adequately support for global sustainable digital health ecosystems. Desired personal and aggregate data supply chains must be taken seriously and be supported by the best available technologies. Our collective biggest challenge is to improve multidisciplinary and intersectoral collaboration, semantic interoperability and optimum digital support to maintain global public health.

Keywords. semantic interoperability, digital health ecosystem, professionalization, workforce planning, standards

1. Biomedical and Health Informatics (BMHI) Challenges Experienced

My nursing career commenced in 1963. An interest in computing began around 1978 when I decided to take the computing course offered by the local high school. My career in biomedical and health informatics essentially began in the early 1980s. Over the last 40 or so years I have been working towards addressing national challenges such as the adoption and governance of data and health informatics standards, building health workforce capacity in BMHI whilst experiencing numerous challenges and witnessing their subsequent impacts.

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My biggest challenge throughout was to maintain a life/work balance and obtain the funds required to meet my career objectives. Table 1 lists a summary of the challenges and obstacles encountered within the work environments encountered that have shaped my life experiences.

Table 1. Personal View of Challenges Encountered and their Impacts

Challenges	Impacts
Poor understanding of the need for improved data and IT governance at every level.	A continuing fragmented health system unable to consistently support continuous person-centred care.
Lack of understanding by the nursing profession as a whole of the importance of BMHI.	• As a policy officer for the Royal College of Nursing I was made redundant for having an information bias. • BMHI integration into a Nursing curriculum was undermined.
Lack of buy-in by Professional/Clinical Colleges.	• Enabled vendor/ICT dominance • An absence of strong clinical drivers to shape the BMHI strategic directions
Vendor/ICT community dominance influencing procurement practices, Government policies and BMHI strategic directions.	Government funding benefiting the vendor community more than 'point of care' clinicians, patients and the health system as a whole.
Poor appreciation of the need for clinical, including nursing, data, workflows, regulatory and ethical requirements by vendors, the ICT profession and decision makers.	Implemented systems unable to adequately meet clinical workplace needs resulting in numerous shadow systems.
Poor planning, coordination and continuity of BMHI related policy initiatives by Governments.	Stop, start initiatives, ad hoc funding strategies never able to make the desired or intended impacts.
Organisational restructuring, government and public service changes.	Changes in leadership and non-continuity of programs
Research infrastructure not fit to support multi-disciplinary collaborative research.	Impossible to attract external research funding to support BMHI research.
Disciplinary and gender discrimination	Limited opportunities for career advancement, not being take seriously.
Autocratic/hierarchical health service management structures and cultures.	Non-recognition of a considerable workforce talent at middle management and point of care levels which has impeded innovation.
Ego driven/narcissistic power driven people, mostly males, in leadership positions.	Stifled progress, prevented effective collaboration.
Fear of change, ignorance of what is best for the greater good	Inaction, inability to move forward, change agent ostracization.
Leaving school at 14yrs of age, being educated while working full time and supporting a family as a single parent.	• Completing my PhD at 50yrs of age. • Two very independent capable daughters. • Great life experiences informing my leadership style, professional and academic contributions.

This paper explores my research, education, international connections, professional activities and standards development key career adventures, within the context of available technologies and events at the time, that led to the revelations listed in the table above.

2. Early Achievements and Milestones

In 1979 I passed an entrance exam and was accepted as one of the first group of Registered Nurses able to undertake post registration tertiary studies in Australia. One of its lecturers had decided that nurses needed to learn computing, this became part of the

curriculum. That computing subject consisted of learning how to program in BASIC, making use of a main frame at the RMIT University, and how to make use of their computer based statistical analysis system (SAS). In 1982 I was asked to deliver my first lecture in computing to the Victorian Nursing Research Group.

A career change in 1980 occurred when I applied and was accepted to a new position as a work study consultant for the Health Management Services Division of the Health Commission Victoria (HCV). This progressive Division's activities centered around the development of work standards and automation. I participated in examining the feasibility of a day to day nursing dependency tool which was to contribute to a hospitals' output value for a system known as HOSPOWER [1]. This research focused activity resulted in the development of the Patient Assessment and Information System (PAIS) that later formed the foundation for my PhD.

I had access to a personal computer (TRS80) which required programming in BASIC to manage my work sampling data analysis. The 'Systems' section within this Division had introduced a State-wide computer-based staff establishment system, implemented a computer-based personnel/payroll system and provided these resources to the Hospitals Computer Service, Victoria for operational management and system development. More than 180 health care organisations were making use of eighteen computer systems managed by this service, including the Medical Information Direct Access System (MIDAS) and a system used for the collection and analysis of morbidity statistics on a State-wide basis. Reported data from these systems were pivotal to my subsequent research activities.

3. Nursing Informatics: Early Challenges and Milestones

The 38 hour week had been introduced for all hospitals during 1983, and this had resulted in a need to employ an additional 2000 nursing staff. The Health Minister, Tom Roper, established a Committee of Enquiry into Nursing in Victoria in August 1983. This Committee was requested to examine and review existing establishment numbers, roster patterns, turnover, supervision, and the effects of new technology and to develop guidelines on which basic staff requirements could be based. Its brief was extended in April 1984 to include a review of the District Nursing Service [2].

I was seconded to the Nursing section within the Hospitals Division as a senior nursing advisor in 1984, to manage the research undertaken to inform this Enquiry. I arranged the purchase of the first IBM (XT) personal computer within the nursing section. This PC used the DOS operating system and I installed Lotus 1,2,3, the new spreadsheet application which was used for all my data analysis. I was also able to use the printouts produced by the Hospitals Computer Service which provided nurse staffing data for every publicly funded hospital by staff category, budget and actual costs. A Statewide consolidated report was used to calculate cost implications of options considered and negotiated to resolve a number of nursing industrial disputes.

The enquiry's final report identified a number of specific issues including workload management, a clinical career structure, shift work problems, child care facilities, nursing education, industrial democracy and technological change [3]. This resulted in having a first ever government budget allocation to support nursing service delivery, including an increase in the number of district nurses enabling them to provide 24/7 palliative care at home, refresher courses for non-practicing nurses, the establishment of a Critical Care Course and funding to support the transfer of nursing education from

hospital based programs to Universities which required the appointment of around 2000 additional RNs to replace the student workforce.

A 'non-nursing duties' dispute in 1984 was resolved via an agreement that registered nurses and students of nursing should not be required to perform a list of 22 specified non-nursing duties. I had been a member of the Government's negotiating team. Additional resources provided by the Government allowed 900 extra staff to be allocated to public hospitals to carry out tasks delineated as comprising non-nursing duties [3]. This number of additional non nursing support staff was insufficient and not able to meet the demand, this plus continuing low wages and a desire for a nursing career structure, led to another major dispute in October 1985. This culminated into a 50 day State-wide strike in 1986, only a skeleton staff remained [4].

The Australian Nurses and Midwives Federation (ANMF) aimed to receive appropriate financial recognition of clinical contributions made by highly experienced nursing staff. It was later argued that these events were the result of nurses seeking professionalization of their discipline, which in turn resulted in their politicization during this period [5]. The ANMF also noted the potential need for nurses to undertake data entry once computers were introduced. I received approval from the State's Premier's Department to travel around the globe to assess the impact of computing on nurses. The ANMF produced a position paper in 1986 on 'Computerised Patient Data and Nursing Information Systems' based on an earlier discussion paper.

Despite my work on developing and costing a new nursing career structure and associated disruptive events, I presented at the Seventh National Conference of the College of Nursing, Australia (now Royal College of Nursing Australia) held in Melbourne in May 1985. It had as its theme 'information processing - challenges and choices for nurses'. This conference inspired a small group of midwives, including Robyn Harvey and Joan Edgecumbe who established a group to promote improvement in nursing care through the use of information technology and to provide a forum for sharing knowledge and experiences. I attended its first meeting and became a committee member of the Nursing Computer Group (Victoria) (NCGV) in 1985 [6]. This group's textbook on Nurses Using Computers- Australian Experiences, was published in 1989 [7].

4. International Connections

Maureen Scholes, Director of Nursing Service, The London Hospital (Whitechapel) invited me in 1984 to represent Australian nurses at the newly established Nursing Informatics working group within the International Medical Informatics Association (IMIA)'s framework. This was the result of a very successful conference held in 1982 London and Harrogate, UK, on "The Impact of Computers on Nursing. Its aim was to promote Nursing Informatics as a discipline [8].

This connection assisted me to make arrangements for my 1986 around the world trip to assess the impact of hospital computerization on nurses. I met with Dr Ralph Korpman, President and Chairman of Health Data Sciences Corporation in Los Angeles, who presented me with a copy of his book [9, 10] and alerted me to the need to transform from departmental focused information systems which were prevalent at that time, to person centred electronic medical records. I later met with senior nurses from hospitals in San Francisco, Edmonton, Canada, Cleveland, New York, Washington DC and met with Dr Virginia Saba, Dr Kathleen McCormick and Dr Marion Ball over lunch in

Baltimore. I then visited places in Stoke on Trent and London in the UK, Leiden in the Netherlands and Geneva in Switzerland. I learned that we needed to plan for bedside terminals. Great conversations with many impressive nursing informatics leaders and researchers were inspiring.

Later that year I attended my first ever Medinfo (SCAMC) in Washington DC where I first learned about interoperability and the difference between 'interfacing' and 'integration' from Jack Harrington who was leading an IEEE MEDIX project at that time. An invitation pinned to the notice Board by Dr Branko Cesnik enabled me to connect with 20 other Australians who shared my interest in informatics. This became the network of founders who subsequently collaborated to establish the Health Informatics Society of Australia.

My first attendance at an IMIA WG8 invitational workshop was in Stockholm in 1987 where I was a member of a taskforce on education to define broad competency statements about nursing informatics [11]. At home I had convinced the NCVG's committee to prepare a proposal to host the 1991 IMIA WG8 international conference in Melbourne. This was presented to and accepted by the IMIA WG8 executive at that time. Preparing for this conference was an enormous challenge as the NCVG consisted of around 200 members and had around $700 in the bank. In preparation for chairing NI'91, I was invited to attend the 1988 post conference workshop on Decision Support Systems in Dublin where I was a scribe which led to me becoming the first author for a chapter in the book subsequently published [12] which won the American Nurses Association's 'Book of the Year prize [8].

During the late 1980's I undertook further study in information systems at RMIT University where I learned about database structures, entity relationship diagrams and the need for data dictionaries. I made use of this new knowledge to design the database I used to manage all speaker submissions and their reviews for the NI'91 conference. Furthermore, at the Medinfo'92 conference in Geneva I presented a paper promoting the need for a Nursing Data Dictionary and to make use of this as a reference model to assist with accurate data exchange [13].

Following the successful 1991 Melbourne conference, I became the fifth Chair of IMIA WG8 in 1997. A strategic plan was developed for the first time. The resulting new organizational structure enabled a greater number of nurses to contribute. I later chaired the IMIA Education Working Group when we explored options for sharing the delivery of specialist courses across Universities. IMIA institutional academic membership was heavily promoted with very positive results. These activities resulted in the Global Health Informatics Education text and a number of other publications [14-16].

Collectively these events were great learning opportunities for me, they provided a very significant foundation for my subsequent career in Health Informatics.

5. Political Turbulence and Its Impact on my Career

Victoria was experiencing major industrial unrest amongst its nursing staff. The Health Commission of Victoria (HCV) had assumed authority for all State Government health services in 1978 following legislative changes. HCV became a Government Department which was regionalized. This change resulted in the establishment of the Health Department in 1985 consisting of Corporate and Regional Services divisions thus changing the governance dynamics. Regional Directors, one for each of the eight regions, were appointed early 1985 but Industrial negotiations undertaken to resolve the nursing

disputes continued to be undertaken centrally by the Corporate division. It was transformational!

My nursing workload management system PAIS had been used as an aid to resolve workload disputes since 1984, it was fully supported by the HCV Chair and the Health Minister who had instructed Hospital Boards to make use of this methodology to improve their nursing resource management processes.

"Patient Assessment Information Systems (PAIS) are now operating in a number of public hospitals and the program of PAIS evaluation was continued with the aim of developing a more objective approach to nursing staff requirements, patient dependency assessment and quality assurance programs" [2]

This system provided nurses with information they were able to use to control their workloads. Many hospitals had appointed nursing project officers to manage the information generated by PAIS. These project officers became members of the admission team to ensure sufficient nurses were available to service all occupied beds.

In March 1985 a new health Minister, David White, was appointed following an election which resulted in further organizational leadership changes. I was caught in the middle of these transitional governance arrangements and was essentially demoted. The new Minister decided that the use of PAIS was contrary to his policy aimed at reducing surgical waiting lists. I was prevented from providing any further educational support for PAIS users who were actively discouraged from using this nursing workload management methodology. This Minister managed to eventually remove all nursing project officer positions and I became a political liability.

The Public Service had a non-redundancy policy so they couldn't sack me. I was 'put out to pasture' and asked to work as a research officer for a Clinical Costing project in preparation for the implementation of Diagnosis Related Groups (DRGs). This required me to undertake a major literature review on nursing workloads from which to calculate nursing service weights.

I made use of this 'persona non grata' opportunity to undertake my doctoral studies and establish a private consulting business. This enabled me to continue my research activities, manage the delivery of the 1991 international conference and prepare the proceedings (17) while continuing to be paid by the Victorian Government for most of that period. I had also secured a major consulting project with the Private Hospitals Association Victoria to undertake research to develop a nursing career structure. This resulted in the Nursing Career Evaluation System (UNCES) which was incorporated in the Queensland Private Hospitals Association's industrial award [18, 19].

Meanwhile PAIS was taken up by more than 100 other hospitals in New South Wales and Queensland. The original research was validated in Queensland in 1996 [20]. The data collected from these hospitals were later used to establish nursing service weights for major national clinical costing studies that ultimately resulted in the adoption of DRG based funding in hospitals [21].

6. Professional Activities Post NI'91

The success of NI'91 resulted in a substantial financial profit which was used to collaborate with other State based Nursing Informatics groups with the objective of formalizing a new National body. One representative from each State based group was appointed to form the Australian Nursing Informatics Council in 1992 to facilitate networking and ongoing discussions to unite the groups into one national organisation.

This proved to be problematic due to differences between the State based groups regarding affiliations with other professional nursing organisations. Subsequently the Nursing Computer Group Victoria changed its name to Nursing Informatics Australia (NIA), launched a new look magazine and established a secretariat with the Symposium proceeds.

In addition, a number of other State based groups, with a medical informatics focus, had emerged with particularly strong ones in South Australia and New South Wales (NSW). The Australian Computer Society was the official IMIA representative at that time. It had supported the emergence of a special interest group managed by a GP in Western Australia who established the Australian Medical Informatics Association focused solely on doctors, more or less in competition with informatics activities being undertaken by the Royal Australasian College of General Practice since 1978.

In 1992, an interim "Council" of 22 different informatics groups came together to resolve the fractured nature of informatics in Australia. After much debating and negotiating this 'Council' led to the establishment of the Health Informatics Society of Australia (HISA) and HISA became the official IMIA representative.

I was instrumental in initiating and chairing the first national health informatics conference (HIC) in 1993 with seed funding provided by the Victorian NIA group with the agreement that the profits would be used to establish HISA. NIA then transformed into the Victorian State branch of HISA. As a consequence of these events, Nursing Informatics had become subsumed within HISA. The NIA journal became the Health Informatics Journal.

Whilst Australia had a thriving health informatics community, there was still no professional recognition of informatics, no training pathway, workforce development strategy, or mechanism to accredit individuals. In 2001, Dr Enrico Coiera proposed the creation of an Australian College of Health Informatics (ACHI), to fill these gaps. He had support from the Federal Government who had provided seed funding to make that happen. HISA's secretariat provided the necessary administrative support. A list of 50 individuals working in health informatics was created by a small group of senior academics, I was one of those. These 50 people were contacted and invited to nominate others, and then asked to vote for their top 20 from the total list. These 20, including me, became ACHI's Foundation Fellows, with Coiera its first President, in 2002.

By then I had been recognized as a Fellow of the Australian Computer Society (ACS) and chaired its Health Informatics Committee. I made use of the ACS Fellowship documentation, with their permission, and established such a process for ACHI to enable it to grow over time.

7. National Workforce Capacity Building Activities

In 2003 I was invited to attend the Australian Government's Health Information Workforce Capacity Think Tank held in Canberra. Its overall vision was to develop the workforce to 'enable effective use of health information and information technologies in the health sector nationally'. One of its agreed reported activities was to 'discuss with ACHI its potential interest in taking up leadership regarding the development of accreditation/credentialling guidelines'. Its report remained on the shelf due to a change of Government in 2004.

Early 2006, while preparing to host Medinfo2007 in Brisbane, I prepared a fully budgeted proposal, at the request of Joan Edgecumbe, manager of the HISA secretariat, for the HISA Board to consider:

1. Providing a webspace for a Health e-Community Centre for HISA members for the management of their lifelong learning activities
2. Establish a comprehensive Continuing Development Program (CPD) title Health Informatics Lifelong Learning (HILL learning) using 'Moodle' , open source learning management software.

This was followed with a full business plan detailing a program consisting of 'just in time' learning modules, to be developed by a consortium of world leaders in health IT from HISA members, CQU (Central Queensland University), ACHI and HL7 Australia. Perhaps we were ahead of our time as the HISA Board refused to adopt this initiative at that time.

I became ACHI's President in 2008. ACHI hosted an inaugural stakeholder workforce capacity building meeting in Sydney early 2009. Stakeholders represented were health and IT professional organisations, the medical software industry, Universities and the Australian Government who supported this initiative financially. There was a common recognition that the Health Informatics (HI) discipline was not well understood by government, industry, and academia and that the ICT industry did not understand healthcare. It was agreed that there was a need for a recognised HI career structure and pathways with generic sets of competencies for the many different roles and functions within the health industry as a whole, an agreed HI body of knowledge and education framework, a critical mass of Health Informaticians to assist in lobbying for health informatics as a discipline. There needed to be an entity to address the issues identified and assist government, academia, and industry to implement a national program to produce enough people able to do the eHealth jobs.

This initiative resulted in a signed contract between the Australian Government's Department of Health and Ageing and the Australian College of Health Informatics to undertake this challenging project which I chaired. This entity became known as the Australian Health Informatics Educational Council (AHIEC). Later that year a draft strategic workplan consisting of 12 projects was circulated to all stakeholders for comment. A budget had been prepared to formerly enable the establishment of this entity. Despite a considerable amount of discussion, there was no consensus regarding the adoption of a governance structure required to move forward despite a unanimous, in principle agreement with the ultimate goal.

A fair amount of research was undertaken resulting in a number of publications made freely available via its newly established website. One of these titled, 'AHIEC_HI_Scope_Careers_and_Competencies', has since been cited by a number of others working in this space. This initiative stalled as a result of the key HISA representative not wanting to accept that ACHI was driving this professional initiative. HISA wished to manage its continuing governance as in the HISA Chair's view that should be HISA's role as they were in a better financial position. This HISA Chair was an ACHI Fellow but failed to recognize a difference between an industry based organisation where anyone could be a member, and a Professional College providing disciplinary leadership.

As a consequence of an inability to reach consensus regarding governance, ACHI's vision of providing leadership towards workforce digital health capacity building in a collaborative professionally and educationally sound manner, with full support of the

Australian Government, was lost. A further dilution occurred in 2018 when ACHI and HISA amalgamated to become the Australasian Institute of Digital Health.

A couple of years following the demise of the AHIEC Australian Government supported initiative, HISA established a new education committee that made use of AHIEC's original materials as a foundation from which to develop a set of competencies. The Certified Health Informatician Australasia (CHIA) credential, administered by HISA, supported by ACHI and Health Information Management Association of Australia (HIMAA) was launched in 2013. David Rowlands [22], a management consultant specializing in health and health informatics and past HISA Chair, established the Digital Health Workforce Academy, a private company. David collaborates with HISA to develop and deliver online training courses in health informatics leading to the Certified Health Informatician Australasia (CHIA) post nominals to represent a 'credentialled digital health workforce'. CHIA is not compliant with the Australian Qualifications Framework (AQF) [23] nor does it leverage our educational regulatory requirements [24, 25]. The CHIA competency framework was evaluated and updated in 2022 [26]. No assessment guidelines are provided.

8. Contributing to National eHealth Initiatives

Australia's government established a National Health Information Management Advisory Council (NHIMAC) in 1999 to address barriers to e-health and Health Online was launched [27]. A number of sub-committees were established to advise on:

- Development of a national framework for electronic health record systems
- Health Supply Chain reform
- Development and implementation of national policies and standards aligned with clinical practice and business objectives linked to telehealth
- Provide advice on health informatics standards that should be adopted. I was a member of this group that developed a national health information standards plan for Australia.

In 2004 the Australian government was advised that the implementation of a comprehensive e health program was problematic due to the implementation of too many small, loosely coordinated e health initiatives underway across the States and territories. These were considered to be neither interoperable nor scalable [28]. An evaluation in 2005 of the subsequent HealthConnect implementations concluded that the lack of infrastructure and connectivity had limited its success. A change of Government in 2007 resulted in the adoption of new strategic directions. Late 2008 the National Health and Hospitals Reform Commission (NHHRC) reported that.

'Health care professionals were forced to practice with incomplete or incorrect patient information and up to 18 per cent of medical errors resulted from the lack of availability of adequate patient information' [29].

8.1. My Standards Development Contributions

While being employed part time as a policy officer for the Royal College of Nursing Australia I was made aware that Standards Australia was about to establish a Health Informatics Standards Development Committee (IT/14) in 1991. The College was

invited to send a representative to its inaugural meeting, and I volunteered. I continued this involvement as an academic representative following my change in employment to Central Queensland University. I also became a member of two technical committees, one for Electronic Health Records (EHR Interoperability) and the other for Health Concept Representation. I held these positions till 2007.

HL7 Australia was established in 2002 to support its user community. I accepted the invitation to take on the responsibility for education and contribute to many HL7 conferences and workshops promoting all the latest development that occurred between 2002 and 2005. These collective standards development work activities complemented and informed my academic work.

I became aware that I was usually the only nurse making a contribution. These standards development experiences alerted me to the likelihood that standards being developed for EHRs would not support nursing practice. Around 2000 I had been invited by Professor Judy Ozbolt to attend their annual Nursing Terminology Summit Conferences [These later became known as the HL7 Terminfo meetings]. These meeting attendees agreed with my risk assessment, and it was agreed that we would need to take action.

As the IMIA Chair I was able to gain support not only from all key nursing terminology developers but also from the President of the International Council of Nursing for the need to develop a Health Informatics standard on the integration of a reference terminology model for nursing [30]. Further support was gained from Professor Chris Chute who was able to get this proposal accepted by the American National Standards Institute (ANSI) who then submitted this proposal to the ISO TC215 committee, and it was approved as a work item. The resultant ISO standard was first published in 2003, reviewed and updated to represent 'categorial structures for representation of nursing diagnoses and nursing actions in terminological systems' in 2014 [31]. Its latest review has just been completed by me to represent the 'categorical structures for representation of nursing practice'. This change of title is the result of the nursing profession's desire to enable data analytics to be undertaken to document nursing contributions to patient care and outcomes, and for supporting quality improvement, research, management, reimbursement, policy and other use cases.

9. Australia's Health Informatics Research & Education Evolution

The first research and education unit for medical informatics in Australia began under the leadership of Dr Branko Cesnik in 1988 at Monash University, he represented the first IMIA Institutional academic member. This was followed by Hovenga's group at Central Queensland University (CQU) in 1992. Dr Coiera was appointed as the first Chair in Medical Informatics in Australia, in the Medical Faculty of the University of New South Wales (UNSW) and co-founded the Centre for Health Informatics in 1999, the same year Dr Yellowlees established the Centre for Online Health at the University of Queensland. Bernie Crowe and Peter Yellowlees were early pioneers of Telemedicine following the Australian Government's Health Online initiative [32]. Celler, co-founder of the UNSW Research Centre, pioneered the use of telehealth for the management of chronic disease in the home. The UNSW Centre transferred to Macquarie University some years later.

9.1. My Academic Career

One of the attendees at the NI'91 conference I hosted was Dr Amy Zelmer who had been appointed as the Dean of Health Science at Central Queensland University (CQU), to establish a new nursing degree program designed to facilitate the transfer of nurse education from hospital based programs in that State to this University. Dr Zelmer invited me to work with the newly appointed Associate Professor of Information Systems from the Business Faculty, Dr Greg Whymark, to develop their first Graduate Diploma of Health Administration and Information Systems. My academic career began by working from home, remotely (2000km + distance) from CQU, using my 96kb modem and IBM XT computer for the first 12 months.

The new course we developed became a success and was later expanded to become a Master's program. My academic career progressed to being appointed as the first Professor of Health Informatics in Australia [33,34]. Whilst working from the Health Science Faculty I was also given the responsibility of overseeing the management of this Faculty's local area network, and the research underway into the development of multimedia prior to the availability of web technologies [35]. This position resulted in me being a member of the University IT committee.

CQU had evolved with a strong focus on distance education, it had multiple campuses hundreds of kilometers apart. As a result of a desire to link communications between campuses the University had received a grant to establish its own microwave network. [This was in the days when the only alternative was to make use of the ISDN telecommunications network which was expensive]. We designed a technical infrastructure able to facilitate students in one campus to activate a microphone and camera to ask questions of the lecturer based in another campus via a video conference arrangement. Lecturers were also able to show their slide presentations at multiple campuses simultaneously [35].

A change of Dean following Dr Zelmer's retirement, a lack of support for my health informatics curriculum integration agenda from my nursing colleagues and a University wide restructure, provided me with the opportunity to be employed within the newly established Informatics Faculty. This Faculty's funding and research agenda was a big improvement; it enabled me to establish a Health Informatics Research Centre, a free access peer reviewed online journal [eJHI], accept exchange students, employ some research staff, two post-doctoral positions and several adjunct Professors.

My international connections and my participation in standards development provided additional opportunities. Our team was appointed to provide workshops and deliver a series of lectures for the Ministry of Health in Chile. Professor John Mantas invited me, along with Dr Virginia Saba, as an international advisor to the EU funded NIGHTINGALE project (36). During those years we were also able to contribute to the EU funded TeleNurse project [37] and the development of the International Classification of Nursing Practice terminology [38].

Participating in the Standards Australia IT/14 EHR technical committee had introduced me to the openEHR specifications. My post-doc fellow Dr Sebastian Garde and I pondered how to teach archetype development which led to the realization that once archetypes were developed, we would need a repository. We developed the first ontology based prototype in 2004 [39] for what has since become the international openEHR Clinical Knowledge Manager [40] supported by an extensive multidisciplinary community of 2885 users from over 100 countries [41]. I later worked with the HISA

secretariat to develop the successful proposal to host Medinfo2007 in Brisbane and I chaired that conference.

9.2. Retirement?

Central Queensland University decided to close its Health Informatics program and research centre at the end of 2007. I was of retirement age so accepted a redundancy. Following Medinfo2007, the HISA Board asked Joan Edgecumbe to retire. Joan was angry for the Board's failure to support our proposed HILL project and convinced me to establish a private company to effectively implement this project; Heather Grain agreed to join us and eHealth Education Pty Ltd (eHE) [www.ehe.edu.au] was born.

Since 2008 we've become a Registered Training Organisation specializing in enabling the delivery of a variety of digital health courses, including clinical coding, ICD-10-AM, and SNOMED CT. The Moodle LMS turned out to be cumbersome to use for that purpose. We established a not-for-profit company, Global eHealth Collaborative (GeHCo) [https://gehco.org/], which enabled us to work with Governments. The Victorian Government funded us to collaboratively with one other vocational educational organization and a health facility, develop a simulation system designed to improve the quality of clinical coding education. Its design was based on our prior experience with using a Moodle, Canvas and Blackboard LMS. The result was a system now known as eHRoL [Electronic Health Record Online Learning - https://gehco.org/ehrol/], which now contains thousands of real de-identified medical records. eHRoL is available to others via licensing arrangements and is now being extended to include a full EHR functionality based on the openEHR platform and CKM simulation for educational use. Our business continues to grow with an increasing number of digital health related courses on offer.

The Australian Catholic University invited me to work with them to integrate digital health informatics into their programs in 2020. GeHCo/eHe and ACU now have a formal arrangement to continue our joint digital health education initiatives collaboratively.

9.3. My career drivers

An early understanding of the importance of health data exchange and database structures have driven my research interests over the years. This has resulted in a better understanding of the key factors necessary to achieve semantic interoperability.

My learnings over the last 40 years made it apparent that a failure by decision makers and many others to understand foundational scientific and technical key concepts, has resulted in numerous failures to meet desired strategic outcome objectives [42-44]. We must ensure that this foundational knowledge is adequately covered in curricula designed to upskill the existing workforce and to prepare future generations. Agreed BMHI competencies need to be de-composed to identify their key knowledge and skills.

My final career outcomes were recognized by being awarded one of twenty-five Brilliant Women in Digital Health by Telstra Health in 2021 [45] plus the publication of two recent textbooks [46, 47]. Transformations are urgently needed at every level to ensure we all have access to well-connected digital health ecosystems. Now it's over to the next generation.

10. Conclusions

Australia has played a significant role in the development of informatics standards internationally. Peter Schloeffel, and Sam Heard were instrumental in shaping several ISO standards for EHRs, as well as OpenEHR. Tom Beale is the originator of the two level modelling approach that is central to the openEHR specifications. Heather Leslie, contributed to the openEHR Foundation's further development of the Clinical Knowledge Manager, Grahame Grieve was the instigator of what is now known as HL7 FHIR, (Fast Health Interoperability Resources). Heather Grain contributed to many standards adopted by the ISO TC215 technical committee and continues to Chair Working Group (WG)3 Semantic Content [https://www.iso.org/committee/54960.html].

My career path started in nursing, but over the years the division between nursing and health care generally became somewhat blurred. Nursing Informatics in Australia was very strong in Victoria in the early days, but this group surrendered to the governance power of others and lost its influence. Being a woman and a nurse has often resulted in double jeopardy. Some of my past work environments have exhibited covert, insidious discrimination and bias, positive contributions made were not always rewarded. When working for Governments, I found that expert advice and committee reports were frequently ignored or severely modified or recommendations made were not implemented by a leader with the right talent, resulting in less than optimum results. Despite the many obstacles I am proud of the achievements and contributions made.

On a positive note, I am indebted to many national and international colleagues for believing in me, supporting me and for inviting me to work with them and for providing career advancing opportunities. It is with this gratitude that I list the following key career milestones:

- National and International nursing and health informatics leadership activities
    - The development of the PAIS and UNCES methodologies.
    - Chairing NI'91, Medinfo2007, IMIA NI, IMIA Education.
    - Enabling the establishment of a growing national digital health organization, now known as the Australasian Institute of Digital Health (AIDH).
    - Contributing to the European NIGHTINGALE, Telenurse and ICNP projects.
    - Addressing large nursing and health professional audiences as an invited keynote speaker in many countries.
    - The many publications, journal articles, book chapters and books.
    - Health and Nursing Informatics education and research.

- Contributions to National and International Governmental digital health initiatives and Health Informatics Standards developments especially:
    - The ISO Nursing Practice standard [31].

I have found that effective collaboration across disciplines, sectors and cultures, when working towards achieving a common goal, is extremely valuable and rewarding. Integrity, transparency, and ethical behaviour are paramount to success. I overcame the many and varied obstacles along my life journey by identifying and embracing new opportunities, accepting what I could not control and forging new pathways with persistence and passion.

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