

**Pathology content selection in a Medical Imaging
Programme in New Zealand: An exploration of
lecturers' beliefs.**

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2025

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**A dissertation submitted to Auckland University of Technology in
partial fulfilment of the requirements for the degree of Master of
Education (Higher Education)**

Attestation of Authorship

“I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.”

Signature:

Date: Feb 13, 2025

Acknowledgement

I am extremely grateful to my supervisor, Dr Megan Lourie, who provided academic support to help me complete this study. I would also like to thank you for allowing me to develop my views while providing me with sufficient guidance. In addition, I want to thank you for helping me build diplomacy in the professional world while maintaining academic sharpness, especially with some excellent suggestions for expressing my views.

I would like to extend my sincere thanks to Dr Julienne Molineaux for helping me get ethical approval for this project and to lecturers at Unitec medical imaging programme for participating in the interviews. I want to thank you for spending your time assisting me while you were busy with your own teaching.

I am also grateful to my parents, who gave me the kindness, righteousness, passion for knowledge, and courage to pursue truths. I want to thank my wife and daughter for helping the family so I can concentrate on studying.

Ethics Approval

The conduct of the research reported in this thesis was approved by the Auckland University of Technology Ethics Committee (AUTEK), Reference Number 24/17, on 28/03/2024 for conducting the interviews. (Appendix A)

Abstract

This study investigated how five medical imaging lecturers at Unitec select pathology teaching content. There is no agreed-upon curriculum or standard in New Zealand (NZ) for the amount and/or range of pathology content that should be taught in Medical Imaging (MI) programmes, so lecturers tend to select what to include based on their individual experiences and beliefs. The large amount of pathology content that could be taught, and the reluctance of some MI students to engage with that content, makes it challenging to decide what to include in MI programmes. While there is a great deal of literature on pathology education in medicine, there is a lack of research about what pathology knowledge and skills could be taught to medical imaging students in New Zealand from the perspective of lecturers who are familiar with medical imaging profession and its education.

Informed by an interpretivism paradigm, this qualitative study used semi-structured interviews to investigate medical imaging lecturers beliefs about pathology content selection. The analysis of the data utilises a conceptual framework developed from a literature review, highlighting the broader aims of education, the importance of teaching content, and what counts as subject knowledge in curriculum development.

The main finding of the study is that lecturers experience great tension in pathology content selection because their decisions are influenced by several different critical considerations. As they make their decisions some of the broader aims of education sometimes collide with each other. Lecturers generally believe that adequate pathology knowledge should be covered in MI courses, including underlying pathologic changes for essential clinical presentations and imaging features. However, the lack of pathology content requirements associated with a lack of advanced practice of medical imaging technologists, as well as the reluctance of students to engage with learning they do not see as relevant, presents significant challenges.

It is hoped that the findings of this study will produce more insight into the challenges faced by both lecturers and medical imaging students in pathology teaching and learning. It is also hoped that the study will promote further discussion among medical imaging educators, practitioners, and people from regulation bodies about what pathology knowledge and skills should be taught to medical imaging students.

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Chapter 1: Introduction

1.1 The context of the study

The aim of this study was to explore the beliefs of a small group of Medical Imaging (MI) lecturers about content selection for the pathology course at the Unitec MI programme. There is no agreed-upon curriculum or standard in New Zealand (NZ) for the amount and/or range of pathology content that should be taught in MI programmes, so lecturers tend to select what to include based on their individual experiences and preferences.

1.1.1 MI education and profession

The MI programme at Unitec prepares students to become practicing medical imaging technologists (MITs) or radiographers. The programme predominantly provides two areas of theoretical education: medical sciences and radiological and imaging sciences. It also involves learning radiographic techniques (how to generate diagnostic images), understanding issues in professional practice, and doing clinical training. In terms of medical science, anatomy and pathology are the two essential subjects for MI practice. Pathology teaching to MI students comprises usual pathology topics tailored to MI practice. It also covers image-oriented underlying pathologic changes, which is critical for a better understanding of imaging features. MI training is a three-year programme at Unitec; more than half the time is designated for clinical practice. Academic teaching is usually intense and delivered in short blocks; however, the pathology course is a 15-credit year-long paper that is delivered over two semesters.

Medical imaging technologists (MITs), or radiographers, are allied health professionals working in a radiology service, either public or private. MITs produce medical images of patients' body parts to help clinicians diagnose and manage their patients using various modalities or equipment, such as X-ray, fluoroscopy, computerised tomography, ultrasound,

magnetic resonance imaging, and nuclear medicine imaging. Following the MI training, students are expected to acquire knowledge of imaging techniques, imaging technologies, equipment, and their applications; skills and traits needed for patient interaction and working with a health team; and an understanding of patient anatomy and pathology. After graduation, newly qualified MITs usually start by working in general radiography, trauma, and fluoroscopy; with some on-the-job training and postgraduate study, they can work in CT, angiography, and mammography. Formal training and postgraduate diplomas are required for MITs working in MRI, ultrasound, and nuclear medicine. Pathology is essential for MITs to understand their practice and imaging features better (radiographic findings of disorders). Although radiographers' work is closely related to patient care, up until recently, their job has been focused mainly on the technique part of MI service.

1.1.2 Pathology discipline, education, and new trend

Pathology is the study of disease. It is an essential medical science subject for both medical and allied health professionals because it provides the scientific foundation for clinical practice (Fenderson, 2005). Pathology is a complex discipline that focuses on disease mechanisms, which are often challenging for students to learn because of the amount of recall involved. Recalling information is essential in pathology education because students can apply pathology knowledge in their practice only when they have retained enough information. With a significant amount of content, recalling information demands a deep understanding of the information, and understanding of disease mechanisms requires recalling specific and detailed information. As a result, an extensive pathology curriculum is usually only seen in medical education. Accordingly, the literature on pathology education is predominantly about teaching pathology to medical students. Knowledge of anatomical pathology, including disease mechanisms, is based on descriptive facts, and usually, there are no aspects that are more difficult than others; therefore, what knowledge is included depends

on whether that information is helpful for the clinical practice of individual health professionals. Hence, more pathologic topics are often covered in medicine; however, for any piece of pathology information discussed, the knowledge is the same for both medicine and other health professions.

In the late part of the last century, pathology knowledge of many diseases and general pathologic processes was dramatically expanded due to clinical research and laboratory studies. The amount of information has made it extremely difficult to cover the traditional pathology syllabus in current medical education (Domizio, 2006), which likely impacts pathology teaching in a similar manner for other health professionals. Due to a large amount of content and the shift of medical education to being more learner-centred, there were recommendations for reducing factual knowledge learning, limiting pathology curriculum for medical students, and integrating pathology with other medical science subjects during preclinical years or into clinical training in the later years of training (Marshall et al., 2004).

Teaching strategies are a common focus of pathology education literature, potentially partly because of the hope that active learning activities can help students manage more topics successfully. Although many learning strategies have been developed to help medical students in their pathology learning, the main change is the integration of pathology teaching into a more extended curriculum. A longer curriculum is believed to improve the student learning experience by spreading pathology learning over a longer period, minimizing repetition of certain teaching among various medical science subjects, and making pathology learning more meaningful during clinical time. In the meantime, many pathology educators believe that it is critical to establish and maintain pathology teaching standards, especially in integrated medical education, in case some essential knowledge is lost during the integration (Sadofsky et al., 2014). The issues and new movements in pathology education identified in

medical literature are just as applicable to pathology teaching in other health professions because they are fundamentally associated with the features of pathology knowledge.

1.1.3 A challenging subject for MI students

Some background knowledge is required to understand pathologic changes, such as normal anatomy and physiology, basic microscopic anatomy (histology), essential human development (embryology), and basic genetics and microbiology (bacteria and viruses). In medical training, these topics are covered in other preclinical subjects or, more recently, integrated courses (Domizio, 2006). Other preclinical courses are not taught in MI education besides anatomy and physiology. Although lecturers focus on the most relevant knowledge to clinical practice, it still comprises a large number of topics because pathology covers various conditions of all body systems. Many MI programmes offer a four-year degree, while the Unitec programme has been designed on a three-year training. Due to a lack of background knowledge from students and a busy and short programme curriculum, pathology teaching to MI students is even more challenging.

As the main working partner to radiologists, MITs play an essential role in medical imaging services. MITs often need to understand the underlying pathologic changes for common pathologies to provide efficient medical imaging services and cooperate effectively with radiologists. Still, it can increase difficulties in pathology learning as well. Some students have difficulty appreciating the link between the pathologic changes and imaging features, especially when those changes are at the cellular level, which likely makes the already heavy content even worse. The discussions and debates often come back to the fundamental question of what pathology should be taught to MI students, which is closely linked to what learning experiences and graduate profiles are desired for students.

1.1.4 The importance of pathology knowledge to MI practice

In the field of MI, there is an expectation that MITs have at least some understanding of patient anatomy and pathology, but there is no consensus about how much they should know.

There is no agreed-upon curriculum that sets out what students should learn as they are learning to be MITs, so lecturers' beliefs about what to include in the pathology course are derived mainly from their understanding of the aims of pathology teaching and their experiences of teaching pathology to MI students.

Although engaging students in pathology study is challenging due to its difficulty, ironically, there is clinical demand for expanding MIT's practice, which requires a higher level of pathology knowledge. Often, radiologists, the doctors specializing in reporting on images, want MITs to put extra information about findings on the images or patient information on referrals. However, suppose they are not appropriately trained or do not have sufficient knowledge of underlying pathologic changes for imaging features or clinical presentations. In that case, MIT's comments are unlikely helpful (Neep et al., 2014) and sometimes can be misleading.

Collaborative healthcare, requiring the collaboration of various health professionals, has become a recent trend in patient management (Schot et al., 2019), especially in the public health sector (Hallgren et al., 2021). With the growth of collaborative practice, there is an increasing demand for the development of advanced practice in non-medical health professions, including MITs (McLaren, 2024). In advanced practice, health professionals contribute significantly to patient management in their specialized field with autonomy in decision-making, which requires much better pathology knowledge. An improved understanding of pathologic changes and disease mechanisms is becoming increasingly crucial for MI students due to the demand for advanced practice of MITs (Milner et al., 2016). Although there have been efforts to build an advanced practice in NZ, there is still no

MIT reporting, which is an essential part of the advanced practice of MITs or radiographers. The main reason for this failure is a lack of pathology teaching and inadequate pathology standards in MI education (The Royal Australian and New Zealand College of Radiologists, 2018). Simply following the imaging protocols without sufficient clinical reasoning is still a common practice of radiographers in NZ. There appears to be a lack of professional aspiration and satisfaction with routine work following the protocols (Yielder, 2014). Research suggests that MI practitioners do not feel comfortable taking the challenge of reporting or providing formal opinions on the images they have produced if opportunities are offered (Yielder et al., 2014). The lack of advanced practice and low esteem among MI professionals likely further contribute to this 'mindless' practice of merely following imaging protocols (Yielder & Davis, 2009).

1.1.5 What pathology knowledge to teach in a MI programme: a complex decision

The challenges in pathology teaching to medical students and changes in the pathology curriculum have significant implications for teaching pathology to MI students. The large amount of pathology content is also a central issue and can be incredibly challenging due to MI students' lack of background knowledge and a short and busy programme curriculum. However, a better understanding of pathology is becoming increasingly important for MI students due to the demand for developing an advanced practice of radiographers (Milner et al., 2016). There is no simple solution, but it would appear to be sensible to consider a wide range of pathology curricula.

Better pathology knowledge helps students better understand patient presentations, imaging features, and the rationale for patient management. Following the protocol without providing opinions on images means that radiographers are not very involved in patient management in their daily work. As a result, students cannot easily see the relevance of a better understanding of pathology to their clinical practice, which likely further affects students'

engagement with the learning of pathology. However, better patient care is the centre of all health professionals' practice, so it is one of the essential aims of MI education. Without sufficient pathology knowledge, MITs' contribution to patient care is limited to the technical aspect of imaging service, mainly manipulating equipment.

I am one of a team of MI lecturers at the Unitec MI programme, in Auckland, New Zealand. In recent years, we have been striving to achieve a basic but appropriate understanding of pathology among MI students, which comprises fundamental disease mechanisms for essential clinical presentations or imaging features. However, we have encountered both challenges and resistance. My colleagues and I share similar experiences of teaching pathology, finding that many students have difficulties achieving an adequate understanding of underlying pathologic changes. Similar to research findings from medical literature, our students' primary concern is the large volume of teaching content. These difficulties often cause a tremendous amount of dissatisfaction and frustration, which is detrimental to their well-being and confidence in learning. In the meantime, negative student feedback raises questions about what pathology knowledge and skills MI students should be taught.

1.2 Rationale

This study investigates five MI lecturers' beliefs about pathology content selection. Their beliefs are valuable because they know the MI profession and its education exceptionally well. The study aims to find out what they believe contributes to a better pathology learning experience for MI students and a better understanding of underlying pathologic changes. As the first study in NZ investigating what pathology knowledge and skills MI students should be taught, according to their lecturers, it is hoped the findings may encourage further discussions about pathology education, the MI profession, and its development among educators, MI practitioners, researchers, and regulation bodies. The discussion may involve people from NZ and Australia due to the close relationship between professional bodies in the

two countries, which may greatly benefit MI education and the development of the MI profession since advanced practice in this region is much behind than in some European countries (Woznitza et al., 2021).

Chapter 2: Literature Review

2.1 Introduction

This chapter reviews research literature relating to lecturers' selections of pathology content to teach MI students. Although there does not appear to be any research about lecturers' beliefs about what pathology content should be included in MI education specifically, there is a large body of literature about issues relating to pathology teaching in the field of medicine. The findings from the medical literature are applicable to the pathology teaching of MI students because the issues essentially originate from pathology as an academic field of knowledge. The chapter begins with a brief overview of the history of pathology as a subject and the features of its knowledge. This is followed by a review of the literature on pathology in medical education grouped under the following themes:

- Traditional pathology curriculum
- Issues in pathology teaching
- New trends in pathology education
- Pathology teaching strategies
- Standards of pathology teaching
- Perceptions of educators who teach pathology
- Student experiences of learning pathology

After this, I present a short discussion of advanced practice in the MI profession and issues relating to student workload. This is followed by exploring some of the aims of education more broadly because these things have profound implications in pathology content selection for MI students. Finally, I identify the research gaps that this study aims to contribute to.

2.2 Pathology as a subject

2.2.1 An essential link between medical sciences and clinical practice

Pathology is the study of disease, and for each condition, it usually covers aetiology (causes), pathogenesis (how the condition is developed), morphologic changes (gross and microscopic), and clinical presentations. By explaining the causes and mechanisms, pathology provides a scientific basis for understanding diseases (Marshall et al., 2004; Sadofsky et al., 2014). The discipline is commonly classified into general pathology and systemic pathology; the former covers pathologic changes common to all body systems, while the latter investigates the conditions of each organ (Kumar et al., 2012; Marshall et al., 2004). Pathology provides an essential link between medical sciences, such as anatomy, physiology, histology, embryology, and microbiology, and the clinical practice of medicine, including clinical diagnosis and management (Domizio, 2006; Marshall et al., 2004); it also forms the academic basis for the clinical practice of allied health professionals as a foundational medical science (Fenderson, 2005).

2.2.2 Debates on the importance of pathology learning

Based on the belief that medical practice should be guided by scientific evidence, medical training used to involve a comprehensive study of pathology (Domizio & Wilkinson, 2006). Although a basic understanding of pathologic changes is essential to clinical practice, some medical educators believe that medical training and practice should not focus exclusively on the scientific basis of medicine because medical practice involves many human elements, such as patient beliefs and expectations. They also argue that a deep understanding of disease mechanisms has not significantly improved the morbidity and mortality of many conditions (Jackson et al., 2003, as cited in Domizio, 2006). On the other hand, other medical educators insist that achieving a deep understanding of disease mechanisms is of great importance. It

assists students in communicating effectively with health professionals and explaining conditions to patients using a common language. It also helps students better understand and develop evidence-based practice, in which a comprehensive understanding of pathology is a prerequisite. Furthermore, a better understanding of disease mechanisms has resulted in advances in the management of many conditions (Wright, 2003, as cited in Domizio, 2006).

2.2.3 A discipline with a great deal of descriptive knowledge

Pathology explains how disease starts and develops to provide a foundation and guide to clinical practice (Domizio, 2006; Kumar et al., 2012). Those explanations are largely descriptive from clinical observations and scientific studies, including descriptions of disease processes, morphologic (gross and microscopic) changes, and pathophysiological (functional) changes. Traditionally, pathology is a content-heavy subject because it covers all the body systems, and pathology education commonly involves a great deal of factual knowledge learning (Domizio, 2006; Marshall et al., 2004). Some concepts of disease mechanisms or morphologic changes can be applied to various conditions; however, specific descriptive pathology information provides the most valuable guidance in clinical practice (Burton, 2005).

2.3. Pathology in medical education

2.3.1 Traditional pathology curriculum

Developed from the notion of scientific medicine in the early twenties, pathology used to have a strict curriculum as one of the many preclinical subjects (Sadofsky et al., 2014). It was commonly taught in the preclinical years, and it comprised numerous general pathology topics, such as cell injury, necrosis and apoptosis (programmed cell death), acute and chronic inflammation, oedema, thromboembolism and infarct, and neoplasia. It also covered conditions in systemic pathology, for example, atherosclerosis, liver cirrhosis, pulmonary

tuberculosis, glomerulonephritis, and rheumatoid arthritis. Learning disease mechanisms prepared medical students for studying clinical medicine disciplines and clinical training. (Domizio, 2006). Pathology teaching was primarily delivered through lectures and practical sessions of examining specimens of organs with disease and microscopic histopathological glass slides (Marshall et al., 2004).

2.3.2 Issues in pathology teaching

The pathology knowledge base has increased exponentially from clinical and scientific studies undertaken in the last few decades (Domizio, 2006; Marshall et al., 2004). It has become one of the essential drives for changing the pathology curriculum in medical education since the late last century because an overloaded curriculum is detrimental to medical education. Influenced by learner-centered teaching and constructivist learning theory, various active learning activities, especially problem-based learning, became increasingly popular in medical education, including pathology teaching, in the late twenties (Herdson, 1998; Kumar et al., 2001). However, learning strategies alone are unlikely to improve student's learning experiences because those strategies likely become less effective in dealing with heavy content. Also, some teaching activities are time-consuming, making it more challenging to cover the content (Domizio, 2006).

Domizio identified three motives behind this pathology curriculum review (2006). First, the disease patterns had changed dramatically. For example, in 1900, the major causes of death in the United States were tuberculosis, pneumonia, and diarrhoea, while heart disease, cancer, and stroke accounted for more than sixty percent of all deaths in 1997 (Cohen, 2000).

Chronic diseases have replaced infectious diseases as the leading cause of death in many parts of the world. Therefore, associated with the change in how healthcare was designed, there was a demand for medical education change, focusing more on chronic diseases and preventive medicine. Second, there was an increased expectation of doctors from the public,

which resulted in a shift in the doctor-patient relationship. Doctors were expected to manage the physical illness successfully and meet other expectations of patients at the same time to avoid being complained about due to ethical and moral issues. Third, students were overloaded with descriptive information, which damaged their pathology learning. It became apparent that it was time to decrease the student workload of learning factual information (Domizio & Wilkinson, 2006), possibly also associated with the idea that education should focus more on building skills and competency.

2.3.3 New trends in pathology education

With increased potential teaching topics due to the expansion of medical knowledge (Domizio, 2006; Marshall et al., 2004) and reduced teaching time (Burton, 2005), an integrated curriculum has gained its importance in facilitating pathology learning because covering enough pathologic topics is becoming more challenging with the traditional curriculum (Haspel et al., 2012; Janjua et al., 2020; Krasowski et al., 2021; Marshall et al., 2004; Yadav et al., 2022). It is hoped that an integrated curriculum can potentially improve pathology teaching by reducing the total content by preventing a repetition of contents from various previous courses (Janjua et al., 2020) or providing meaningful instruction while learning is integrated with clinical teaching (Marshall et al., 2004). Pathology integration can be horizontal with other preclinical subjects (Krasowski et al., 2021) or longitudinal with clinical courses later (Janjua et al., 2020). Although it was initially blamed for interrupting the continuity of pathology study (Marshall et al., 2004), an integrated curriculum will stay, and it can become a successful curriculum when many pathological topics are kept integral (Krasowski et al., 2021) or if the integration is carefully designed (Haspel et al., 2012). Otherwise, an integrated curriculum could lead to chaos and student complaints if not carefully designed (Janjua et al., 2020).

2.3.4 Pathology teaching strategies

Active learning strategies are essential in pathology teaching to engage students (Marshall et al., 2004). Many active learning activities have been identified in the literature of medical education, such as a new form of case seminar (Weurlander et al., 2009), pathology small groups (Krasowski et al., 2021), and using information technology (Marshall et al., 2004). Buch et al. (2014) found multiple choice questions, group work, brainstorming, and confusion technique, among other active learning methods, are effective in the pathology teaching of a medical program. In addition, flipped classroom and case-based learning help medical students better understand and apply new knowledge (Cai et al., 2022).

2.3.5 Standards of pathology teaching

Possibly associated with promoting learner-centered education and lifelong learning skills, pathology teaching hours, especially didactic lectures, have been reduced. The traditional pathology teaching in blocks, commonly associated with detailed syllabi (Dick et al., 1998; Iversen, 1997), has disappeared due to the introduction of multidisciplinary medical education (Domizio, 2006). Integrated courses, which are usually large due to integrating multiple medical science subjects among themselves and with clinical medicine, have made pathology knowledge less visible in current medical education (Sadofsky et al., 2014). However, its importance as the foundation of medical practice has not decreased (Domizio, 2006; Sadofsky et al., 2014). Sadofsky et al. (2014) suggested developing national pathology standards for medical students in the USA to ensure that the essential competencies in pathology were maintained and no basic knowledge was lost while integrating the pathology course with other medical science subjects and various clinical medicine topics.

In the proposed national standards in the USA, three fundamental pathology competencies have been identified: disease mechanisms/processes, integration of disease mechanisms into

organ system pathology, and application of pathology to diagnostic medicine (Sadofsky et al., 2014). Learning objectives and optional sub-objectives have also been established for each competency. For example, regarding inflammation as a disease mechanism, applying knowledge of cellular and molecular changes of inflammation is a learning objective, while defining different types of extracellular fluids, commonly associated with inflammation, is a sub-objective. In addition, methods for assessing the acquisition and application of essential knowledge are included in the national standards (Sadofsky et al., 2014). Medical curriculum development is usually based on the Tyler Model, comprising determining objectives, identifying learning experiences, organising teaching activities, and evaluating the purposes (Lee et al., 2013; Prideaux, 2003). These national pathology standards continue to follow the tradition, although arranging learning experiences in pathology becomes less feasible in integrated medical education.

2.3.6 Perceptions of educators who teach pathology

Pathology was traditionally taught by pathologists (a group of medical specialists); due to a shortage of pathologists and integrated medical education, there has been a decline in pathology teaching time from pathologists (Burton, 2005). What pathology knowledge and skills should be taught to medical students is a challenging decision (Burton, 2005). A group of pathologists and other clinical doctors agreed on a somewhat long list of core disease entities required for newly qualified doctors (Dick et al., 1998), while it was also believed that pathology teaching should focus on conditions common to primary care where most medical students would land after graduation (Stevens et al., 2008). With an increased level of integration of curriculum, pathology teaching becomes less visible to staff and students (Burton, 2005). Most pathologists agree that understanding disease mechanisms is essential to medical practice (Domizio & Wilkinson, 2006)

A group of pathologists in the USA has established the initial national pathology standards to ensure that medical students still acquire the essential knowledge. The pathology standards are a living document, and more pathologists are invited to contribute to developing those standards further (Sadofsky et al., 2014). Knollmann-Ritschel et al. (2017) revised the original standards by highlighting the essential knowledge and keeping pathology education up with current clinical practice. The authors also developed a bank of peer-reviewed pathology cases, which can be adapted successfully into integrated courses. Those pathology cases emphasize the foundational understanding of pathologic changes essential for clinical practice (Knollmann-Ritschel et al., 2017). Pathology is commonly known as a content-heavy course; the tension in content selection is evident when authors try hard to limit the content to fundamental and essential knowledge while still adequate in the pathology standards.

2.3.7 Student experiences of learning pathology

The importance of studying pathology is rarely found in literature because it is evident in medical practice (Marshall et al., 2004). Significant course content has been a primary concern of students in pathology education (Janjua et al., 2020; Krasowski et al., 2021; Marshall et al., 2004; Yadav et al., 2022). About 70% of medical students believe it is lengthy or difficult, according to one study about students' perspectives on the pathology subject (Yadav et al., 2022). Even focusing on the common and significant pathologies only as recommended, course content is still perceived to be heavy. (Janjua et al., 2020; Marshall et al., 2004). Too much content can significantly impact students' meaningful learning of pathology, which may lead to intense emotional reactions and unhappiness among learners (Janjua et al., 2020).

As a central component of problem-based learning, pathology cases are widely used to engage students due to their relevance to clinical practice (Maley et al., 2008). In a study on student preferences for teaching methods, significantly more students preferred modern

teaching methods, such as virtual microscopy and seminars (Herrmann et al., 2015). However, in Yadav et al.'s research (2022), while half of the candidates preferred a combination of teaching methods, including case-based learning, nearly 50% of students were satisfied with lectures using chalk and PowerPoint notes. This variation is potentially due to the difference in the culture of education between the two countries where studies were conducted. Although diligent students benefited more from blended learning, a combination of small group face-to-face tutorials and self-directed web-based online material is better suited for various learning styles (Maley et al., 2008).

2.4. Pathology-related issues in medical imaging education and practice

Pathology is one of the two essential medical sciences taught in the medical imaging program. The pathology competency is clearly required in the Medical Radiation Technologists Board Competency Standards Policy (New Zealand Medical Radiation Technologists Board, 2023):

Medical imaging practice requires practitioners to apply their knowledge of human anatomy including the pathophysiology underpinning disease and injuries affecting the human body. Knowledge of anatomical structures, injuries and pathologies of the human body are applied in dynamic, planar, sectional, and 3D images (p. 26)

However, the topics that should be taught still need to be clarified. Even with a prescribed list of conditions in medical education, what pathology topics to cover is still a complex decision (Burton, 2005; Marshall et al., 2004).

Notably, many practicing MITs do not think they have to know imaging features or imaging-related pathologic changes because their job does not involve reporting on images. This practice of generating images is believed to be mindless, as it consists of following the prescribed protocols and not paying attention to whether images have answered clinical

concerns (Yielder & Davis, 2009). This common misunderstanding is due to a lack of proper understanding of this profession, often associated with low esteem in the MI profession (Yielder et al., 2014). Although sound pathology knowledge will better prepare students for possible expansion of their practice (Blakeley et al., 2008), the focus is to help students provide better patient care, which is the centre of all health professionals (Domizio & Wilkinson, 2006), instead of purely preparing students to do reporting. It has caused many concerns in the medical imaging profession, and there is an increasing voice supporting the advanced practice of MITs because this 'mindless' practice and the notion of being 'semi-professional' (lack of its own knowledge base) will damage professional development potential (Yielder & Davis, 2009).

Advanced practitioners are practitioners of a health profession who have become clinical experts in a defined area within their scope of practice following an extraordinary development of their clinical practice and related knowledge (Nightingale & McNulty, 2016). Often, an extended practice is mistakenly believed to be an advanced one (Woznitza et al., 2021). Regarding radiography, extended practice is reported to be gaining additional skills and responsibilities from their traditionally prescribed roles (Hardy & Snaith, 2006).

Although extra duties are involved in both extended and advanced practice, "a high degree of autonomy and complex decision making" is highlighted in the definition of advanced practice in the English advanced clinical practice framework (England NHS, 2017, p.8).

In the meantime, advanced radiography practitioner roles have been well-developed in the UK, which enable qualified radiographers (MITs) to perform reporting on plain images, including chest X-rays (The College of Radiographers, 2006). Reporting on general X-rays and mammogram images are the most common advanced practices in clinical reporting, and performing fluoroscopic procedures is the most frequent procedure-only role in radiographer advanced practice (Woznitza et al., 2021). Radiographer reporting is also seen in other

European countries, such as Denmark, but it is generally less well-established than in the UK (Pedersen et al., 2024). Currently, there is a considerable gap in the advanced clinical practice of MITs between NZ and the UK (Yielder et al., 2014), although people continue to explore ways of implementing advanced practice (Woznitza et al., 2021). The predominant resistance to radiographer reporting in NZ is due to a lack of understanding of diseases in relation to their clinical presentations, imaging features, and management (The Royal Australia and New Zealand College of Radiologists, 2018).

Strong evidence shows that signature pedagogies are vital in professional training (Shulman, 2005). Signature pedagogies are meant to educate students to think and act like professionals. Shulman (2005) established a conceptual framework of signature pedagogy, including a surface structure (teaching and learning of discipline knowledge), a deep structure (how discipline knowledge is better delivered), an implicit structure (beliefs about professional attitudes, values, and qualities), and what is missing in that pedagogy. Radiological-pathological correlation is commonly seen in radiology practice because radiological diagnosis needs to be confirmed by histological examination when possible. As a result, radiological-pathological correlation is widely used in radiology research and radiologist training (Filice, 2019). Bedside teaching is incorporated automatically into medical education because it best prepares students for their future clinical practice (Shulman, 2005). Similarly, teaching underlying pathologic changes for imaging features in the classroom may improve students' understanding of the pathologic changes of the selected disorders, and it may also improve adult learning by linking the relevance of current knowledge to their future practice (Collins, 2004). Although signature pedagogies commonly exist in professional training, they are often inadequately explored in many disciplines, including nursing, according to Shulman's framework (Crookes et al., 2020). Baltrinic & Wachter Morris (2020) believe that while investigating a possible signature pedagogy, we need to examine what, how, and why

this teaching strategy is unique to our professional teaching and consider the implications of this teaching practice at the professional, programme, and course levels. As Shulman suggests (2005), in terms of the journey of professional training, there are three representative temporal patterns of signature pedagogies: the pervasive initial pedagogy (foundational teaching at the start), the pervasive capstone apprenticeship (practical experience involving learning from industry professionals), and the sequenced and balanced portfolio (student work showing their development across the curriculum related to individual discipline).

2.5. Student workload

As an objective measure, student workload is most commonly interpreted as the number of hours required to complete a course, particularly the time needed for an average student to successfully finish the course (Bowyer, 2012; Kyndt et al., 2014). According to D'Eon and Yasinian (2021), this measure overly simplified student workload because it ignored students' perceptions of their workload, which could significantly impact students' learning behaviour and, subsequently, their learning experience and academic success. Many factors influence students' perceptions of their workload, such as their previous education, their effort, motivation, difficulty level of the course and assessment, etc. (D'Eon & Yasinian, 2021).

Due to the defect of objective measures, scholars have tried various subjective measurements to quantify student workload (D'Eon & Yasinian, 2021), such as mental demand, frustration level, student effort, and course performance (Hart & Staveland, 1988); subjective measures may also include students' feelings of burnout and stress (Kember, 2004). Although they help address the weakness of objective measures, subjective measurements are more complex to perform than objective ones, and the outcomes of subjective measures are often delayed until the course is completed. More importantly, the connection between student workload and many important factors is also overlooked in subjective measures, such as available resources, student effort, and course demands (D'Eon & Yasinian, 2021).

Based on the Newtonian relationship among work, effort, and distance, D'Eon and Yasinian (2021) developed a new student workload measure, in which they used 'work' instead of 'workload' and believed that student work was the product of their effort and achievement. Four domains of student effort are identified: cognitive, physical, psychological, and social. In each of these domains, resources for interventions or support can be explored (D'Eon & Yasinian, 2021). For example, cognitive resources comprise prior learning and general intellectual capability, and teachers can help students improve their attitude toward and inspire their interests in the course to meet the psychological demands of the course. Educators can help students achieve their goals by providing targeted support to make up the difference between the course requirements and resources students bring into the course (D'Eon & Yasinian, 2021).

The understanding of curriculum and its theory is also of great importance to content selection, and this will be briefly discussed in the Methodology Chapter. In terms of theories of curriculum design, the prescriptive model of curriculum development focusing more on the outcomes of a curriculum, developed based on Tyler's work, is most commonly used in the health and medical fields (Prideaux, 2003). Content, teaching and learning strategies, assessment; and evaluation are the four elements of consideration in a prescriptive curriculum (Prideaux, 2003). In curriculum development in health disciplines, it is often important to consider its dimensions of teaching content, such as scope of content, sequence of topics covered, weighting of curriculum elements (balance), continuity of curriculum components, arranging instructional elements (integration), and relating concepts in one course to those in others (articulation) (Begoray & Banister, 2005).

2.6. Aims of education

2.6.1 Biesta's three categories of aims of education

As a critique of the turn toward learning with overly emphasizing learners and their learning at the centre of education, Biesta (2015) pointed out that it was crucial to be clear about what content to learn and the purposes of learning instead of having an empty learning. Biesta (2015) has grouped the education objectives into three categories: qualification, socialization, and subjectification. The qualification domain is about knowledge, skills, and qualities, which are often related to acquiring qualifications; the socialization domain is more about everyday activities or responsibilities in a society, such as those representing cultures, traditions, and practices, while subjectification is related to the dimension of individuality, such as freedom of learners and its limit (Biesta, 2020). Clearly, education is complex because it has numerous aims to be accomplished. Like education in other countries, education in NZ has also been heavily shaped by historical, political, and economic events (Simon, 1994), further contributing to its complexity. As an example, neoliberalism has considerably impacted NZ education. However, resistance from various aspects of NZ culture has provided some protection against the extremes of the ideology (McMaster, 2013).

2.6.2 Neoliberalism's impact on developing aims of education

Neoliberalism is an economic philosophy initially associated with free-market capitalism. It resurged in the late 20th century to combat economic difficulties in various countries and was implemented in the NZ economy under the Fourth Labour Government (McMaster, 2013). It infiltrated the social welfare sector, including education, with similar ideology and practice, and education has become a trading product, often associated with outcomes, efficiency, competency, marketing, competition, choices, globalization, financial success, etc. It has not only been unsuccessful in improving education standards (Ladd & Fiske, 2003), but also

damaged teachers' professionalism (Benade, 2012). When education becomes a product, students pay tuition fees and become education customers. As a result, students are encouraged to provide free comments on their courses as a norm in higher education. Teachers are obliged to satisfy the demands and goals of students because they are scared of receiving adverse student evaluations. One belief about higher education teaching is that it should promote the development of certain qualities of mind among students, which is unlikely to be successful if teachers feel threatened by negative course feedback from students (Weithman, 2015).

2.6.3 More fundamental aims of education

As a philosopher of education, Gutmann (2015) highlighted cultivating creative understanding, mainly through integrated learning across traditional liberal arts disciplines as suggested, as an ethical aim of higher education for liberal arts students. With creative understanding, liberal arts students can achieve a more comprehensive understanding of the significant challenges in the world, such as climate change, better than any individual discipline can offer (Gutmann, 2015). Creative understanding fosters developing other aims of education, but it seems to be from a more fundamental level. By integrating knowledge of various liberal arts disciplines, higher education better prepares students to address coming challenges in their private lives, at work, or from society; it also helps students better develop critical thinking and lifelong learning skills and citizenship (Gutmann, 2015).

Similarly, from an education philosopher's point of view, it is often believed that formal education should promote autonomy. According to Weithman (2015), educators should model autonomy for students, helping them acquire the concepts of reasons for belief and ideas of logic reasoning, gain a distance between students and students' beliefs, and better understand reason and its limits. Weithman (2015) also suggested that we should encourage students to develop qualities of mind, such as open-mindedness, academic honesty, and soundness of

argument. That exercise of those qualities of mind was better carried out through subject knowledge learning (Weithman, 2015). Again, autonomy helps to develop other aims of education from a more fundamental level. Encouraging autonomy in higher education, especially by enhancing students' freedom of imagination, will help students to practise their reason through learning subject knowledge, to achieve intellectual pleasures via deepening appreciation of discipline knowledge, to respect beauty and knowledge of humankind and humanity itself through reaching a better human mind, to develop better critical thinking and lifelong learning skills, to live a good personal life, and to be an effective citizen (Weithman, 2015).

2.7. Research gap

As the scientific foundation for clinical practice, a long list of pathology topics in the traditional medical curriculum was hardly questioned for many years (Marshall et al., 2004). Later, a list of essential conditions was created, still very long, to cope with the dramatic increase in pathology knowledge from research in recent decades (Dick et al., 1998). According to the literature on pathology teaching in medicine, there has been a shift of focus in medical education in recent years, away from overly emphasizing scientific medicine, and student-centred approach has become popular in medical education. As a result, didactic lecture hours from pathologists have been reduced, and discipline-based pathology teaching is gradually replaced by integrated, systems-based education. Small group discussion associated with problem-based learning has gained its popularity, with an emphasis on self-directed learning (Domizio, 2006; Marshall et al., 2004). However, lectures are still commonly seen in pathology teaching due to limited teaching staff and an increased number of students (Herrmann et al., 2015).

Although exploring the beliefs of medical students and teachers on pathology teaching is a common study approach; for students, studies usually focus on their beliefs on certain

teaching strategies using questionnaires or surveys ((Janjua et al., 2020; Krasowski et al., 2021; Weurlander et al., 2009; Yadav et al., 2022)). For teachers, the discussions about what pathology medical students should learn have been due to, initially, a significant amount of content and later, integrated medical education (Marshall et al., 2004). With integrated education, even in medical education (Marshall et al., 2004) and postgraduate study in pathology (Fenderson, 2005), what pathology topics should be taught is often unclear and warrants further investigations. Although there is a great deal of literature about the issues involved in teaching pathology content to students, including from the perspectives of students and educators, there is little available literature specifically on pathology teaching to MI students, particularly that investigates how lecturers choose what pathology content to include in the curriculum for MI students. In addition, the use of interviews which this study uses, is rarely seen in the medical research literature about teachers and students' beliefs about pathology teaching. Because there is no standardised curriculum or consensus about what should be taught, and because MI lecturers come from a range of professional and academic backgrounds, their beliefs provide valuable insight into the current practices in MI education in NZ.

Research Question

This research is guided by the following overarching research question:

- What knowledge and skills do medical imaging lecturers believe are important to teach in a pathology course, and why do they believe this?

Chapter 3 Methodology

3.1 Introduction

This study aimed to discover MI lecturers' beliefs about what pathology knowledge and skills should be taught to MI students. Lecturers' beliefs can offer important insights because of their deep understanding of the profession and its education. These beliefs, constructed in lecturers' minds from their experiences, are used to answer the research question. This chapter describes the design of the study and its rationale.

Research question

What knowledge and skills do medical imaging lecturers believe are important to teach in a pathology course, and why do they believe this?

3.2 Research paradigm

This research project is guided by an interpretivist paradigm. The ontological position of interpretivism is that reality does not exist naturally by itself (Scotland, 2012) but is constructed by individuals (Lincoln et al., 2018; Scotland, 2012). The focus of interpretivism is on meaning-making activities associated with social phenomena (Lincoln et al., 2018) and developing in-depth meanings of the phenomena based on individuals' experiences (Alharahsheh & Pius, 2020; Creswell, 2013; Ma Junjie & Ma Yingxin, 2022). Some scholars prefer to use the term social constructivism for this research paradigm (Creswell, 2013; Newby, 2014).

The selection of pathology teaching content is complex because it involves many important considerations, some conflicting with others, such as the registration body requirements, a large amount of content, the time required for learning underlying pathologic changes for imaging features, the development of the MI profession, better patient care, students'

perspectives, and the broad aims of tertiary education. This research investigated MI lecturers' beliefs to better understand this education challenge. The interpretivist paradigm provides the theoretical foundation for this research. From this position, beliefs of pathology teaching content selection exist in lecturers' minds and are constructed from their individual experiences. Understanding the beliefs of MI lecturers, who are the main stakeholders of pathology content selection and familiar with the MI profession and its education, is essential. This is because the social phenomena under investigation can only be understood by discovering the beliefs of associated people inside the social group (Lincoln et al., 2018; Scotland, 2012).

It is equally important to realize that achieved meanings about pathology learning content for MI students are created through the interviewing process between the researcher and the participants because, in interpretivist philosophy, reality is made under specific historical and cultural contexts (Newby, 2014; Scotland, 2012), often constructed through social interactions (Merriam & Tisdell, 2015; Newby, 2014), and individually created knowledge is not fixed (Lincoln et al., 2018; Yousafzai, 2023) but can be modified with new experiences (Savin-Baden & Major, 2013). In addition, new layers of knowledge can be achieved through the researcher's further interpretation (Lincoln et al., 2018; Scotland, 2012).

The following section presents some key theoretical ideas relating to curriculum development and design, which I drew on to create a conceptual framework of pathology content selection.

3.3 Curriculum theory

Teaching content is a primary consideration in curriculum planning (Kelly, 2009), and choosing what subject matter to be taught needs to be discussed in curriculum design (Null, 2017). It is crucial to think about curriculum as a broad concept while deciding on subject content because educators need to be aware of *why* they choose particular content or

knowledge, in addition to *what* to teach and *how* to deliver it. Content decisions should be justified and based on considerations of a wide range of educational aims; those considerations are often related to the moral and educational dimensions of the curriculum (Kelly, 2009; Null, 2017). Those considerations help educators have a broad view of educational challenges and be aware of other important aspects aside from content selection while designing a curriculum.

3.3.1 What is a curriculum?

Curriculum is commonly believed to be an essential guide for educators in their teaching practice. However, the definition of curriculum is somewhat complex because the focuses of curriculum vary significantly among different curriculum theorists. Students' experiences, competencies required for being effective citizens, content at the centre of the curriculum, and curriculum as a system consisting of objectives, content, learning experiences, and evaluation methods are common themes of curriculum definitions (Coşkun & Aslan, 2021). These examples of definitions are more related to different aspects of the curriculum instead of conflicting views about the curriculum. Therefore, difficulty in achieving a clear definition indicates that there are potentially many curriculum considerations.

3.3.2 Curriculum theory is equally complex

Although curriculum theory gained more attention after Tyler's article "Toward Improved Curriculum Theory" in 1950 (Klein, 1992), it is a less understood and poorly defined concept (Coşkun & Aslan, 2021; Young, 2013). Changes in curriculum were largely unplanned before the 1960s (Kelly, 2009), with the theory more based on scientific management in the USA and more toward a liberal education in the UK (Young, 2013). After that, various ideas greatly affected the changes in curriculum theory, primarily political and economic factors (Coşkun & Aslan, 2021). Null (2017) classifies curriculum theories into five traditions:

systematic, existentialist, radical, pragmatic, and deliberative, each with strengths and weaknesses. Kelly (2009) emphasizes the importance of building overall rationales, which he calls the total curriculum, as the basis for developing a curriculum; he highlights equality and the role of the professional educator as the essential features of an educational curriculum. Null (2017) focuses on promoting a liberating curriculum, which helps students to open their ways of thinking and become the best version of themselves with all essential educational aims achieved. Null also emphasizes the importance of virtues in developing a liberating curriculum, which is more likely to be achieved through deliberation, being idealistic and pragmatic simultaneously. Based on the belief that the curriculum theory failure was due to the loss of its object, Young (2013) suggests a knowledge-based approach to the curriculum. He contends that subject knowledge is powerful because it provides specialized knowledge, generalized principles, and opportunities to be engaged with feelings.

3.3.3 Disciplinary knowledge

Specialised knowledge of each discipline has its unique conceptual structure and specific properties; discipline knowledge is also powerful because it enables people to understand the world better (Young & Muller, 2014). Based on the development of "powerful" educational knowledge, Young (2014) believed that curricula should be taken as forms of specialized knowledge, and that curriculum theory has both a critique role and a normative role in theory. According to Young (2014), a critique role in curriculum theory is about the traditions of individual disciplines, while a normative role includes general or traditional rules for curricular design and purposes of education. Deng (2021) also suggested that a powerful curriculum theory could be developed based on the German *Didaktik* (curriculum studies) tradition, in which scholarly materials (content) are decided from three aspects of consideration: purport, original discipline, and access disciplines. As discussed above and in the literature review chapter, teaching content decisions are extremely important to

curriculum development, and the purposes of those decisions are even more important. It is generally believed that tertiary education should strive to achieve a range of educational aims (Biesta, 2020). These ideas about a powerful curriculum theory and current beliefs of educational purposes form the basis of the conceptual framework for pathology content selection for MI students by emphasising the subject knowledge and aims of education.

3.4 Conceptual framework

The conceptual framework I developed for pathology content selection (see Figure 1 below) is based on three considerations: the aims of tertiary education, the properties of the pathology discipline, and the rules and norms of the curriculum (Young, 2014). Aims of tertiary education related to pathology teaching could cover a range of purposes, such as producing effective citizens, better patient care, developing skills and competencies required for working effectively in the current health system, professional registration requirements, professional development, personal aspiration and academic success, and a successful personal and professional life. Pathology discipline considerations include features of pathology knowledge and teaching of the involved subject knowledge; it also includes how pathology should be taught for the MI profession as an access discipline. When pathology teaching is tailored to MI practice, including what pathology knowledge should be covered and how that knowledge is better taught in MI education, medical imaging becomes an access discipline. Students' previous learning experiences related to pathology teaching, student workload, the scaffolding of learning, and valid and authentic assessments are examples of considerations of rules and norms of the curriculum.

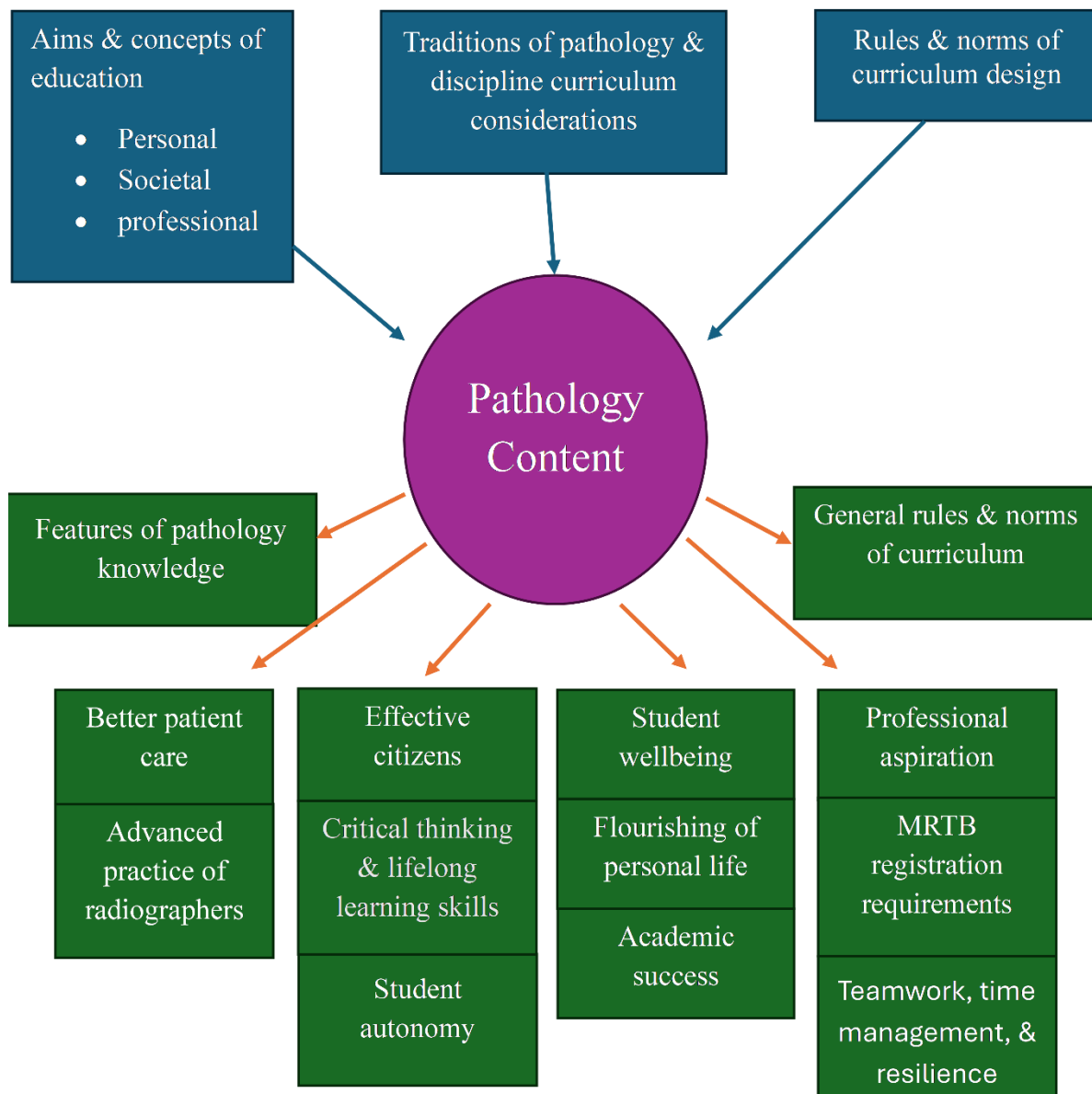


Figure 1: Conceptual framework of pathology content selection

3.5 Research design

This project is a qualitative study that used semi-structured interviews to collect data. As developed from anthropology and sociology, qualitative research is especially suitable for inquiring "about people's lives, the social and cultural contexts in which they lived, how they understood their worlds" (Merriam & Tisdell, 2015. p. 21). It is also widely applied to studying meanings from individuals' or groups' experiences associated with a social or human issue (Creswell, 2013). Qualitative methodology is appropriate for studying lecturers' beliefs about what pathology knowledge and skills MI students should be taught because the relevant understandings are constructed and exist in lecturers' minds from their unique experiences; those beliefs cannot be measured with an instrument, so a comprehensive and deep understanding of their beliefs is required (Creswell, 2013).

Examples of interpretive (qualitative) methodology include phenomenology (focusing on individual and collective experiences), hermeneutics (focusing on hidden meaning from language), and ethnography (focusing on culture groups and their cultures) (Scotland, 2012). This study uses a basic qualitative research approach (Merriam & Tisdell, 2015) because the aim is to examine lecturers' beliefs of pathology teaching content selection rather than focusing on individual and collective experiences (phenomenology). A basic qualitative study focuses on discovering and interpreting meanings created by people from their experiences with a social phenomenon; it is commonly used in applied fields of practice, including education (Merriam & Tisdell, 2015). The intention of the research was to achieve a holistic understanding of MI lecturers' beliefs on how to select pathology teaching content, with the researcher as the study instrument for collecting data and texts of lecturers' comments as the raw data (Merriam & Tisdell, 2015).

3.6 Data collection

3.6.1 Semi-structured interviews

As an effective tool for identifying views in people's minds (Patton, 2015; Savin-Baden & Major, 2013), semi-structured interviews are widely used for collecting qualitative data. Interviews are an essential method of comprehensively understanding lecturers' beliefs because their beliefs remain in their minds and cannot be observed or understood without a conversation (Merriam & Tisdell, 2015). The interviews of this research focused on meanings created by lecturers about what pathology knowledge and skills we should teach MI students instead of their experiences of the topic (Brinkmann & Kvale, 2018).

I constructed an interview protocol as a general guide for semi-structured interviews (Magaldi & Berler, 2020; Merriam & Tisdell, 2015). The semi-structured interview is less structured than a structured interview, and the wording and sequence of interview questions may vary to allow a better investigation of lecturers' beliefs. Semi-structured interviews also enable the researcher to explore interviewees' beliefs by asking clarifying questions (Newby, 2014; Savin-Baden & Major, 2013).

3.6.2 Participant recruitment

Lecturers of the medical imaging programme at Unitec were invited to participate in this study. This decision was for pragmatic reasons and due to time restraints because more time was likely required to recruit and interview MI lecturers from other institutions. In addition, the pathology curriculum is much underdeveloped in current MI education and varies significantly among MI providers in New Zealand. Some MI programmes do not have dedicated pathology courses. Due to these factors, focusing on a single MI programme seemed to be the way to make study findings more meaningful.

Because the MI programme at Unitec is small, all the lecturers were invited to limit any selection bias. This decision was based on the ethical consideration in qualitative research of preventing purposeful exclusion of certain opinions (Lincoln et al., 2018), not the research quality concern because, for qualitative studies, it is generally believed that mildly increased numbers of participants do not improve the research quality (Brinkmann & Kvale, 2018).

There are seven lecturers in total in this small MI programme. All lecturers were invited, and five of them accepted the invitation and participated in the interview.

3.6.3 Ethics

The ethical approval of this research was granted by the Auckland University of Technology Ethics Committee (AUTEC) (Application number 24/17). This research project included interviewing my adult colleagues and did not involve sharing sensitive information. I am one of the lecturers of the MI programme at Unitec, and I do not hold a leadership position, so there are no power imbalances between other MI lecturers and me. Therefore, participants were unlikely to comment to favour my views. I am not responsible for the overall design of the MI programme curriculum, so it was considered likely that other lecturers would feel able to comment freely about curriculum design.

While I hoped colleagues would want to share their views about pathology content selection, they were not expected to participate in the research. Lecturers were fully informed about the research project, including what I would do with the data, and then decided whether they wanted to contribute. Respecting people's privacy and confidentiality was another critical consideration. Participants have been given a pseudonym. Comments they made were either aggregated or not attributed to a specific person. However, the organisation this research centres on (Unitec) was named in this study. Given the small MI programme at Unitec, the research could only offer participants limited confidentiality, which was clearly indicated in both the Information Sheet and Consent Form.

Although there were no foreseen risks, precautions were implemented to ensure people's well-being, such as allowing them to change their appointments. I carefully designed and asked the questions and paid attention to my stance during the interview to ensure genuine lecturers' beliefs were produced from their individual experiences instead of favouring my views as a working colleague. Ethical considerations were necessary for the trustworthiness of this qualitative research because the study's quality and integrity depends on the ethical standards of the researcher (Creswell, 2013).

3.6.4 Interview questions

Questions are essential for producing good data and are worth careful attention (Savin-Baden & Major, 2013; Merriam & Tisdell, 2015). General open questions and a limited number of questions (seven) were included in this research, as recommended by Merriam & Tisdell (2015). This enhances lecturers' accounts of their beliefs by allowing them adequate time to consider and answer the interview questions.

According to Brinkmann & Kvale (2018), interviews should be based on a theoretical conception of the themes to be examined and contribute to the theoretical understanding of the phenomenon. The interview questions in this research (Appendix E) were constructed based on conceptual framework of pathology content selection, which I developed from a limited literature review of curriculum design and development.

3.6.5 Interview procedure

After AUTEK approved the ethical application and permission for interviewing MI lecturers was granted from Unitec, invitation letters were sent to all the MI lecturers at Unitec by email with the Information Sheet (Appendix C) and Consent Form (Appendix D). If a lecturer agreed to participate in the study, an interview was scheduled at the lecturer's convenience.

The interviews were all conducted at the Unitec campus, which was an important consideration because the site can be part of the meaning-making process (Savin-Baden & Major, 2013). A quiet room was booked to ensure interviews could be carried out as planned. Each interview took about 60 minutes, which is commonly believed to be sufficient for generating enough raw data for further analysis (Savin-Baden & Major, 2013).

I followed the interview protocol during the interview but sometimes altered the question sequence to facilitate participants as they constructed their beliefs. I asked verifying questions to ensure I understood and interpreted their comments correctly. Based on the lecturers' responses, I used probing questions to help them further develop their explanations of their beliefs by describing some of their practices or experiences. During the interview, I tried to be aware of any possibilities preventing participants from communicating their genuine beliefs and managed this accordingly (Newby, 2014). For example, I tried to build rapport with participants to encourage deep thinking during the interviews and paid attention to my positionality. I maintained a neutral response to all meanings constructed and emphasised to participants that their genuine beliefs were the most valuable data. All interviews were audio recorded on two devices. After the interview, a summary of each lecturer's comments was provided to them to verify and clarify if they wished.

3.7 Data analysis

Research findings were analysed through thematic data analysis. First, interview recordings were transcribed into texts verbatim as individual documents in Word; however, extra pauses were deleted, and errors were corrected due to mishearing and misinterpretations by Word. Linguistic features in the recordings are less important because this research focuses on the meanings constructed by lecturers (Brinkmann & Kvale, 2018). Second, I listened to the recordings and read the texts multiple times to familiarize myself with the data (Brinkmann & Kvale, 2018; Savin-Baden & Major, 2013). Then, the texts were sorted into meaningful

fragments, similar texts were labelled with codes (coding), and codes were categorized into themes, which is called 'meaning coding' by Brinkmann & Kvale (2018). Using theoretical concepts to label the themes is recommended (Merriam and Tisdell, 2015; Savin-Baden & Major, 2013). The conceptual framework of pathology content selection provided me with a meaningful guide to develop sensitizing categories (carrying the phenomenon's essential meaning) that are conceptually congruent with each other, which was helpful to data analysis (Merriam & Tisdell, 2015). The framework also helped me become more sensitive to and better understand lecturers' beliefs. In addition, it greatly helped me identify the emerging themes during the interviews, and with data analysis in the early stages (Brinkmann & Kvale, 2018; Merriam and Tisdell, 2015).

In addition to the meaning coding method, I used meaning condensation as a data analysis tool, in which constructed meanings were stated in concise, still ordinary language expressions (Brinkmann & Kvale, 2018). Following my familiarity with the lecturers' comments, I located and extracted the individual meaning texts (units) representing the lecturers' beliefs from the transcriptions. Then, I restated the dominant themes from the lecturers' original meaning units in a simple way based on my understanding of their beliefs (Brinkmann & Kvale, 2018). After the interviews, I sent a document, including a summary of the lecturer's beliefs and my short comments, where necessary, for individual participants to verify.

Although the translation of derived concepts or themes is involved in data interpretation, more importantly, it includes providing generalizations and their explanations, further explaining existing concepts or developing new concepts, providing insights or clarifying complexity, etc. (Peshkin, 1993, cited in Savin-Baden & Major, 2013). This qualitative research is predominantly inductive, and effort was taken to provide valid explanations for any generalizations made by explaining the background or experience from which lecturers'

beliefs are based and providing lecturers' accounts of their beliefs. The common themes can provide meaningful insights into the pathology education of MI students because agreements of truth can be achieved through negotiations in the community (Lincoln et al., 2018). The findings and discussion chapters will present these themes and categories under specific headings, supported by direct quotations from the data.

3.8 Authenticity and trustworthiness

Research validity is a concern in a qualitative study. I strived to have a rigorous and transparent process for data collection and analysis to ensure that research claims were made with clear information about the significance of evidence (Newby, 2014). According to Lincoln et al. (2018), validity is not about objectivity, and better descriptions of qualitative research are authenticity and trustworthiness. Paying attention to the values I brought into the research and my positionality during the interview, adhering to ethical standards, being fair and including all participants' beliefs, and providing justifiable accounts of participants' beliefs are the ways I ensured the authenticity of my research (Lincoln et al., 2018).

Chapter 4: Findings

4.1 Introduction

This chapter presents the findings of the research. These are organised under headings reflecting the key themes that emerged from the participants' narratives. The first main theme is that - participants believe that thinking ahead of clinical practice is the primary consideration in pathology content selection. The second theme is resonant with the MI lecturers' striking experience: tension in pathology content selection. The third theme is that participants' experiences of student perspectives on pathology learning influence their content selection. This includes, consideration of the heavy student workload, students' future practice and curiosity, and student feedback. Another theme is lecturers' beliefs about the purposes of pathology teaching and tertiary education more generally affects their content selection. The last theme is lecturers' own understanding of pathology knowledge and experience of teaching that knowledge to MI students.

4.2 Clinical practice is the primary consideration in choosing pathology content

4.2.1 A basic understanding of common diseases, including disease mechanisms

Although pathology content selection requires considering many issues associated with pathology education, all the participants highlighted the MI clinical practice as the first and foremost consideration of their decisions when asked how they selected pathology teaching content for MI students in a body system they were familiar with. Participants believed that pathology teaching content should focus on the common and essential pathologies of the MI practice; as Participant B commented, "I think it's really having an understanding of what those most common ones are and making sure that we at least allude to those during the pathology process (teaching)." Participant A highlighted the importance of "focusing on the areas that are most commonly imaged, such as chest X-rays, CT brain, & (bone and joint X-

rays), but more specifically, all those sorts of things (pathologies) we see that commonly crop up on radiology referral forms."

All the lecturers agreed that certain levels of understanding of pathologic changes should be maintained for the common conditions to MI practice. Participant A emphasized that students should spend more time studying pathologies commonly seen on the referrals and understanding basic underlying pathologic changes for imaging features and clinical presentations of those patients and the difference between those familiar conditions.

I think any sort of chest pathology is quite important and relevant. There's a lot going on in the chest and the heart. But a better understanding of pneumonia, heart failure, all those sorts of things...I think would be really beneficial. I would think spending more time on those...When I was a student, when I was a radiographer, I found it hard to recognise not just the radiographic changes, but what was actually happening to the person and the difference between when they talk about consolidation, pleural effusion, pneumonia, congestive heart failure. (Participant A)

4.2.2 General radiography domain

Participants also believed that pathology teaching should be aligned more with general scope, including general and trauma radiography, mobile radiography, theatre imaging, fluoroscopy, angiography, and computerised tomography (CT). Pathologies commonly seen in the general scope are more relevant to students' future practice because most students will work in the general scope after being qualified. Participant A described this as follows:

I'd look at general X-rays first, and then I'd probably look at the general scope modalities...ultrasound and MRI, they're the least relevant, right? Because any student that's going to be doing them (will do them in a) minimum two years from now. So they will relearn. I'd start with general, and then go to CT, but I (also) think CT Cath lab.

Maybe a little bit of Angio. There's a lot of overlap there, right? With the blood vessels and stuff. And then look at what's most common one, CT brain. Xray chest...If I were teaching, I'd map it and say this is what's the most common, and this is.

In particular, pathology teaching to MI students should be aligned with specific X-ray views in general radiography; for example, if an X-ray projection is used to demonstrate radiographic signs of certain conditions, those diseases must be discussed in pathology teaching. Linking radiographic views with pathologic changes of essential conditions will help students appreciate how MI can contribute to patient management. As Participant D noted,

I focus on the most common pathologies. So, we talk about the presentation of osteoarthritis and the signs of advancement of osteoarthritis. There are some views, for example, where there are non-typical signs of osteoarthritis, but that view was done purely to look for that initial sign, like the Rosenberg view and the lateral subluxation, for example. So anytime that I have a view that links very closely to a pathology, then the whole justification is around that.

4.2.3 Importance of learning underlying pathologic changes

Lecturers believed that a fundamental understanding of underlying pathologic changes, as well as basic cellular changes, could help students in their future clinical practice in many ways. First, it improves their knowledge of those common conditions' clinical presentations and imaging features. For example, Participant B believed that students "do need that foundational knowledge to fully understand how these symptoms have manifested (clinically)...it's (also) for them to understand how that disease may manifest itself radiographically"; similarly, Participant C stated that learning disease mechanisms could help students appreciate "how this pathophysiology will affect the human being; later on, this

mechanism will be reflected as a clinical feature on the body" and "recognize (the disease in) different patients, with (a) better understanding of imaging features as well." Participant E added that it helped students "have a better understanding (of) the whole process and different stages of the disease" and "image difference (between related pathologies)."

Second, learning disease mechanisms assists students in understanding the imaging protocols better and applying them more appropriately. As Participant B commented,

I think it's also important for them to understand it in terms of the protocols that they need to follow, like whether the protocol is appropriate or not or whether they need to make adjustments to get the best diagnostic outcomes for the patients.

Third, it encourages students to develop deep learning capabilities. As Participant B mentioned, "What I don't want us to encourage anywhere across the programme is a surface learning approach. I want them to have that deep knowledge, and I think to do that, you've gotta have that foundational understanding." Participants D and E believed that a good and comprehensive understanding of important topics was essential to pathology learning, especially for retaining critical knowledge. "I often can't remember something unless I understand it fully, and then it really bids down, so maybe and helping generate that full understanding, it will build a full picture for the student." (Participant D)

Next, understanding underlying pathologic changes helps them to work more effectively in clinical environments through collaboration with other professionals and effective communication of patient conditions. As Participant B indicated,

qualified MITs are expected to work collegiately and collaboratively with other staff...you need to be able to articulate something on an image, whether that's to the referring clinician, because the patient needs to be seen urgently or whether it's to the radiologist that they need an urgent report.

Participant D highlighted the importance of pathology knowledge and being able to communicate clinically using pathology terminologies:

I just can't imagine practising without having any pathological knowledge. I think the first thing you know that comes to mind is. If you, you know we're in a healthcare profession, we are working with high skilled other health, you know physicians and. We need to be able to speak that same language.

In addition, according to the participants in this study, knowing underlying pathologic changes would help students better understand the imaging features and appreciate that poor images may mimic pathologies. This may improve patient management with better images by repeating the X-rays. As Participant D noted,

I think that the time that that becomes an issue is when they haven't been able to take a good enough chest x-rays. And say, for example, the patient is obese or the patients sitting in a, you know, in a erect AP position, often they get that increased density at the lower area of the lungs, so I think it is important for students to understand that sometimes poor imaging of the chest can actually appear in the same similar manner as pathology.

Last, one benefit of a better understanding of underlying pathologic changes is that it can increase students' feelings of belonging in the hospital. It helps them to build authentic empathy with patients, especially when patients are in agony, but no apparent bone fractures are present on the X-ray images. As commented by lecturers,

I think- what's actually going on here and what's going on for this patient, they actually understand the context of what's going on for that patient...then they can also have conversations with nurses and doctors in the hospital if necessary around that patient-if they can understand what might happen for that patient. (Participant A)

I think what it can do is help students build empathy. In the way in their understanding of the patients' experience coming up to. And patients can often have those symptoms and have nothing. No bony radiographically apparent injury. I think that changes the way that you then go back in and approach the patient mid-course in your exam.

(Participant D)

4.2.4 Overall understanding of pathology in body systems

In the meantime, participants agreed that it is essential to cover pathology topics adequately, including diseases or pathologic changes not directly associated with general radiography, to improve students' overall understanding of the pathology of all the body systems and within the individual systems, which could help students better understand the common pathologies. Glomerulonephritis, inflammation of the glomeruli (functional units of the kidney for making urine), is usually not related to general radiography. However, as a major component of kidney disease, lecturers believed that a basic understanding of glomerulonephritis is essential for a better overall understanding of kidney conditions, including kidney complications of diseases of other body systems, such as diabetes or hypertension. Impaired renal function in patients with diabetes or hypertension is usually due to damage to glomeruli or glomerulonephritis. Also, with potential chronic damage to the kidneys, those patients are more prone to acute renal impairment from contrast media use during some radiological procedures. As lecturers commented,

If we're talking about the pathology, so we need to cover the whole organ system. So we can't deny that. Very important system, which is the kidney here. So we're talking about glomerulonephritis (a major group of diseases in the urinary system) ...as an organ system and pathology (study), you need to learn (the basics of) it. If you have a patient, for example, with hypertension. This patient has hypertension affecting the kidney; we

need to understand what's happening to the kidney and why the kidney is failure here.

(Participant C)

I was just thinking about, you know, how many patients do we see in renal disease because of diabetes, you know, it's not uncommon. So they're gonna be imaging patients potentially who've got that situation...they need to have an understanding of what glomerulonephritis is and what it means and what it might look like clinically...if they stick this contrast media into a patient. (Participant B)

As a condition not closely related to general radiography, according to the participants, a basic understanding of glomerulonephritis will help students contribute to the early detection of acute renal impairment in elderly patients and patients with diabetes and chronic hypertension when intravenous use of contrast media is required.

So again, there is an expectation that, more and more obviously, MI staff can cannulate patients that introducing the contrast media...But you do have to notify because it could have devastating consequences for the patient. The other thing is like being part of a team is recognising for the patients on fluids or not, they should be on fluids. They're having contrast media, you know, like not that you're gonna tell anybody, but it's just like recognising that. Oh, they're not on board. You might maybe go and chat to some other nurses and say like, had they have diabetes, they need to be included. You know, like you can contribute, right. You can better look after the patient. (Participant B)

Participants also believe overall pathology comprehension helps students appreciate that some conditions can affect multiple organs, which likely contributes to better patient care. This is because students can better understand patients and meet their needs and a positive experience in healthcare will encourage patients to be attached to the health system in their diagnostic pathway. As Participant D commented,

I was also thinking about how so like emphysema has a, you know, slowly impacts the cardiac system as well. Yeah, so that it's that that interconnection between (organs or systems)...although a patient may present with a very narrow request on the form. That very narrow request may actually have a series of consequences throughout the body that the patient may also be experiencing, and that builds their patient pathway and their experience of healthcare...in order for students to be able to see beyond the exam and see how the exam fits in the patients care pathway and diagnostic pathway if you understand more about the patient's body and about what they might be experiencing. Then, it makes you care for them better and makes you think about their needs better.

4.3 Tension in pathology content selection

Participants highlighted the importance of maintaining the academic standards of pathology teaching as an academic medical science course or aiming to contribute to the radiographic diagnosis; as Participant A commented, "*Obviously, you have learning outcomes that you need to meet, and you have certain standards you have to bring a student up to, and I totally understand that,*" and as Participant C believed,

(This is) a bachelor's degree of Health Science with particular medical imaging. So, students must have a Health Science background, which means that they understand anatomy and pathology...so we need to equip our students (with) basic medical anatomy and pathology to interpret the image and to be able to at least they can help...We are already behind, so we don't like to cut the students and become less qualified rather than if we compete with other MI programmes, including internationally.

In the meantime, they realized that MI students were overwhelmed by the volume of teaching content. During the interviews, the tension in pathology content selection is obvious. As Participant A mentioned,

It's finding that balance between what's useful and clinical (practice) and what pathological changes they need to know. And I guess combining the twos...sometimes, it is quite difficult to decide (what topics are more important). I get like, you can't just miss stuff out. Obviously, there's still, you know, you still have to cover the liver, I guess, for example.

Also, as Participant D indicated, finding a delicate balance between what is taught and student understanding and their workload is challenging but essential.

You want you want the students to remember what matters. But then you also want them to have the certain level of understanding. I mean, that's what we do as teachers, right? That's our job is to figure out where the sweet spot is. To try and refine that.
(Participant D)

Lecturers also emphasized teaching underlying pathologic changes for essential clinical manifestations and imaging features, including changes at the cellular level, should "have a light level of knowledge (underlying pathologic changes) about the way that it's formed...the keyword is basic. I agree, but I think it needs to be limited." (Participant D) They are also cautious about the level of pathology teaching to MI students, as commented by Participant A,

And it's like how deep into the why do you go? Before you say, OK, now we're getting into medicine, because once you get down to what a doctor needs to know, it's probably too advanced for a radiographer what is to advance.

In the meantime, participants agreed that the MI profession was very much less developed; as Participant D commented,

(we're a) group of people who are shove into the most like, you know, oppressed profession. It's bizarre, and all they heard was that we had 500 applicants,,And sad,

you know, I was really trying to say like, like there's untapped potential and skill sharing is such a global topic like and how you know, skills translation and skills sharing and why are we doing more? We could be doing more.

Lecturers also agreed that better pathology knowledge is essential for establishing advanced practice and achieving better patient care as an educational aim of health professionals.

4.4 Student perspectives

Heavy student workload

Lecturers believed that pathology content should be carefully selected due to its heavy content; as Participant D noted, "The students have a huge workload, and I have a great deal of, I think sort of empathy for them and their learning." Too much content could also damage student pathology learning; as Participant D pointed out,

if you put in too much, some of the good stuff might not make it, you know, and I think the most important thing is that the key messages get across to the student by the time they finish the course.

Students' future practice and curiosity

Considering the students' perspectives, lecturers believed that pathology topics should be relevant to students' future practice and suit their curiosity, which would better engage students and help them retain essential information; as Participant A mentioned,

I guess if you can really touch on things that are super relevant to that student. Then they'll be fascinated by them and it's the same with any type of pathology... That's what a student always comes. So they're seeing that reflected back in clinical then that will, that will resonate with them from a student point of view... Follow their curiosity a little bit and find out what they want to learn about. They will get really engaged in

something if they're curious...you if you can pick their interest in something and you can follow their like what they're fascinated by, some of them will remember stuff.

Student feedback

Or lecturers could follow student feedback, as Participant C commented,

I do like to select the contents based on the students' feedback. Select the contents of student's feedback in the course contents the always looking for the course feedback from the students and always looking for development based on the students' feedback. And from this my colleagues as well.

Resources available

As Participant B noted, heavy content was the main concern of students, but some students achieved a deep understanding of essential pathologies despite all the challenges. They could not provide one-to-one pathology teaching due to the resources available. It would be inappropriate to reduce the content of important conditions to satisfy students who struggle with pathology learning.

I think they just get overwhelmed with the volume...So short of changing the programme design. I don't know what else we can do because as you said, there are some students who fly and they do really well and then you got your middle of the road students and then you got others who struggle... no educational institution has the ability to have one to one teaching between a lecturer and a student. You know, we just can't. And so we have to do the best. We can the resources we've got and for some students to work with others, it will be a little bit more problematic...you can't dumb the content down to meet the requirements of the students that are struggling because that would not be appropriate. (Participant B)

4.5. Purposes of pathology education and aims of tertiary education

Lecturers identified a range of aims of pathology education for MI students. First, there was an agreement that pathology teaching should aim to satisfy the MRTB registration requirements and NZQA course requirements for a health degree programme, producing competent and safe practitioners. For instance, as Participant B mentioned,

aiming to produce practitioners who are, I wish I'd say, excellent, but they are obviously clinically competent and safe and meet our requirements as far as registration is concerned...also overseas legislation where appropriate in terms of tertiary education. OK, we are not training students to go and work overseas, but inevitably, a number of them do go and work overseas to the UK, to Australia, to Ireland particularly...Overall, I think particularly with the degree programme you are looking to develop (including making Unitec students eligible for working in those countries). And a healthcare degree programme.

Next, pathology teaching should enable MI students to work collaboratively with other health professionals in clinical practice by communicating effectively using proper pathology terminologies, as Participant A commented,

that classic, more radiographic pathology question of they need to be able to recognise abnormal from normal on an image...(when to)get a radiologist and say, hey, we need more of do we need more X-rays of this or do we need more of that.

Or, as Participant B pointed out,

qualified MITs need to be able to articulate something on an image...They were good at identifying there was an abnormality, but being able to articulate it, they weren't able to do that, and they weren't always...(We may cause) the profession a disservice if we don't cover this content.

In addition, pathology education should strive for better patient care, and better pathology knowledge could contribute to it from various aspects, such as understanding better imaging features and patient positioning and protocols, communicating effectively with clinicians, and being reflective practitioners. As Participant B indicated,

Better patient care have an understanding of how disease may manifest itself radiographically so that they can make sure that they again person-centred, patient centred care so they can modify their technique if necessary. Understand the patient positioning and the protocols that are needed for the patient...be able to articulate their potential findings effectively to a clinician if necessary...I think you are wanting to develop practitioners who are reflective.

Furthermore, one participant believed that tertiary education, including pathology teaching to MI students, should focus more on their clinical practice, emphasizing learning through practice, as Participant C mentioned,

Tertiary education context is very big and the very extensive, so my mind or my imagination for tertiary education is not education per se. I would say it's an education with practice. So the main aim here is to prepare the students for work rather than to learn. it's education and application, which means that you start your journey in the tertiary education by learning, but you learn by practise. So practising what based on your qualification based on your what you learn. So you learn and practise. So it's very important point tertiary education.

Regarding tertiary education, lecturers acknowledged multiple educational aims. Apart from the purpose of qualifications, the findings reflect that lecturers considered two other purposes of education: individual development and contributing to a better community. Participant A summarised many educational aims for personal growth, including helping students develop a

broad view, achieving a successful life, becoming effective citizens, having the courage to speak up, being inquisitive, and following their curiosity and creativity.

Education has given people sort of that broad, you know, don't want a tunnel vision and it's not an apprenticeship. So I understand that, and that's why I do think understanding the underlying features of certain diseases is really important...So education has now moved away from information presenting, I think- you can teach yourself a skill or how to do something, or you can read about something in great depth online...education is about helping people to belong and succeed in the world...people who are engaged citizens...our other role is to empower students to speak out when they see something wrong, to speak up for things they think are wrong. To engage with other people, to grow and confidence and become these like you know, intelligent, inquisitive beings... Go with what they want to do. A lot of the time, you know, follow their curiosity and their creativity, and I think it's essentially education is just about trying to get the best out of people. (Participant A)

Similarly, Participant D identified many educational aims for personal development, such as being interested and engaged in MI practice, with creativity and lifelong learning skills, being dedicated to improving patient health, and creating a work culture for better patient care.

The focus is to get people interested in the profession to get them engaged in a profession and to create. I think we should be creating lifelong learners. I think that's the most important thing because if you have an attitude of learning, you will go so far for yourself and for your patient...I think I'll draw this is to create excellent health professionals, people who are deeply caring others. People who know what it is that they're doing, I think setting expectations of the profession is really important. I think we one thing that I do also in my job I think, is to encourage students to create a

working culture within health that improves on the previous culture. That is more focused on what actually matters in terms of patient care. (Participant D)

Participants believed critical thinking and empathy in the community are important aims for a better community or society. Critical thinking skills can help students understand each other better, and creating empathy in the community can be fostered by students spending time in education; as Participant A commented,

people who can critically analyse information, not just pathology or radiography, but they can read an article in a website and analyse whether that is actually. Hopefully seeing things from multiple point of view... Creating empathy in community, I think a big part of history of education, is just people making friends. they turn up to be with each other and to spend time with us and to have interesting and intelligent conversations around staff.

According to Participant B, tertiary education could have economic benefits for the community in addition to students themselves.

you could argue that you are developing individuals who will have an economic benefit themselves if they've undergone a degree, so they've got because people with degrees tend to earn better than people who don't, but I think it also supports the economic growth of the individual countries. (Participant B)

Lecturers also agreed that they could help students better develop skills, such as clinical debriefing, teamwork, active listening, models of learning, and providing opinions, through subject knowledge learning, including pathology; as Participant D pointed out,

something that I have been doing with the students is teaching them how to do a debrief clinic, a clinical debrief, and it's sort of outside of the remit of my course content. But I think that it's really important that students learn to talk about their

patients and learn to talk about their cases and work together; you know, because debrief, obviously, is a team environment, so to reflect on a team environment to improve, but also to recognise where people are out after there so you know, I do think there are other things that we can bring in that actually have to improve clinical practise and so like I guess models of learning around...Learning how to take other people's ideas and to process them and to give commentary.

4.6 Pathology is a unique and challenging subject

Participants agreed that pathology is a challenging subject, but a basic understanding of underlying pathologic changes is essential for achieving a better understanding of common pathologies, which will dramatically benefit students' future practice and development; as Participant C indicated,

basic understanding of underlying pathologic changes helps students to have better understanding of clinical signs and how this pathophysiology will affect the human being...understanding of how these pathological features will enable students later on to interpret this mechanism to appreciate clinical signs with other differential diagnoses.

In the meantime, because pathology is a content-intensive course, lecturers believed that although they wanted to teach basic disease mechanisms, they should focus on the most useful information to students' clinical practice, even for common pathologies, as Participant C pointed out,

we would like to give them a few details, so we need to focus into what's major and what's common, rather than to go into details with each for two reasons, first reason for time consuming; second, from the clinical perspectives, what are important from their clinical practice, because there are a lot of pathologies to focus on.

Lecturers also believed that pathology was a challenging course for MI students, especially at the cellular level. Participants C and E believed that pathology knowledge was closely related to professionals involved in clinical management; a better understanding of pathology could be achieved usually by people with good clinical knowledge, such as medical specialists. Therefore, it is important to be careful about what is taught and the level at which it is taught; as expressed by Participant C,

pathology is a hard subject, it is a hard topic especially if you're going at the cellular level...(deep understanding) is not (particularly) for medical imaging students, but for medical and also for the expertise like radiologist or medical staff or physician...Gross morphology pathology is (relatively) easy because it depend visual understanding rather than to go on the deep of that issue.

Also, as Participant C notes, details of disease mechanisms could be challenging to MI students; therefore, it would be better to concentrate on helping students better understand imaging features instead of asking them to appreciate rationales for clinical management (Participant E) or differentiate pathologies on histologic slides (microscopic changes) (Participant C).

Sometimes in the pathology the details of a mechanism could be hard. For example, sometimes we go into the deeps of that to understand how the cirrhosis develops. It's sometimes too difficult for students...(In) medical image, you need to understand the underlying pathology of what's happening here rather than to understand to compare is it acute inflammation or chronic inflammation between two lung section. (Participant C)

My understanding if we give them the basic academic standard in relation to the topic, this will be the good idea rather than to go on the deeps. We can't expect that the

students become a very expertise in pathology. We need to give them just only the what's important for your practise. (Participant C)

In the meantime, lecturers believed that a certain academic level of pathology education should be maintained, especially underlying pathologic changes for imaging features.

we need to keep certain academic standards as a highly proficient programme like medical imaging, as the bachelor degree of Health Science with focus into medical images with the health, especially for students to contribute to commenting on images (even not reporting yet), better preparing students if they work overseas. (Participant C)

Some pathologic concepts would be better explained through individual conditions instead of general concepts, such as inflammation,

pathology teaching should be more related to the individual clinical like entities instead of just general pathology concepts; for example, (inflammation is better taught through diseases, such as trauma or pneumonia). (Participant A)

while others might be better taught under general pathology; for example, some tumours might be better taught together under neoplasia instead of in individual systems (Participant B).

4.7. Summary

There are two key findings of this research. The first is that MI lecturers strongly believe that pathology teaching should focus on the most common conditions to MI clinical practice, particularly those aligned with the general domain or pathologies attached to specific X-ray projections. The second is that lecturers experience strong tensions when trying to choose pathology content for students.

Although pathology learning is challenging for MI students, participants highlight the importance of teaching basic underlying pathologic changes for clinical manifestations and imaging features. For those common conditions, MI lecturers want students to reach a basic but sound understanding of pathologic changes, even though students struggle with this. The MI lecturers also provided explanations about how a basic appreciation of underlying pathologic changes of common diseases can greatly benefit students' future practice in many ways, reflecting their desire to help students meet the needs of the profession.

A powerful tension exists for lecturers when choosing pathology content for MI students. Participants believe pathology teaching should cover the most common pathologies only; however, they realise that pathology content is usually still heavy because pathology study covers all the body systems. MI lecturers also agree that an overall understanding of pathology is important, which likely involves covering some topics that are not directly relevant to general radiography. Lecturers in this study wanted students to have a basic and appropriate pathology understanding, but tended to limit the disease mechanisms teaching to MI students in consideration of their heavy workload. However, when considering better patient care and the development of the MI profession, more pathology teaching becomes warranted. The participants agreed that a fine balance is required while deciding pathology teaching content, and that establishing that balance is not easy.

Chapter 5: Discussion

5.1 Introduction

This chapter discusses factors affecting MI lecturers' selection of pathology teaching content identified from the literature review and research findings. First, it examines the impacts of the under-developed MI profession associated with a lack of advanced practice, including a discussion of potential causes for the profession being less developed. Second, it looks at the influence of lecturers' beliefs about the aims of education as an essential consideration of curriculum development. Then, it discusses tension in lecturers' pathology content selection considering multiple interactive factors, such as features of pathology discipline and its knowledge and student workload, in addition to MI clinical practice and aims of education.

5.2 Current issues in MI clinical practice

5.2.1 A less-developed profession

MITs or radiographers use various modalities (imaging equipment) to generate diagnostic images. In New Zealand, MITs mainly focus on the quality of those images, such as the contrast, sharpness, density, region of interest, and positioning of images. They do not substantially contribute to patient diagnosis and management; in other words, MITs do not take any formal responsibilities in the radiological diagnosis based on the images they have generated. Usually, clinicians request specific radiological examinations and body parts on referrals, such as X-ray chest or CT head, and radiographers perform the prescribed examinations based on the department protocols established by radiologists or other medical specialists. After the examinations, MITs send the images to radiologists for reporting, who will interpret the images and send reports back to the clinicians. As discussed previously, this blind adherence to protocol practice among MITs is considered 'mindless practice' (Yielder & Davis, 2009). It is still common and affects pathology teaching to MI students. This is

because students cannot see the relevance of having a higher level of understanding of pathologic changes of common conditions if a formal contribution to radiological diagnosis is not required in radiographers' clinical practice.

According to andragogy, a theoretical model for teaching adults, adults are self-directed and anticipate being responsible for decisions in their learning (Chan, 2010, p.28). Adult learners are more interested in learning topics that have immediate relevance to their jobs (Imel, 1989; Lieb, 1991). Since MITs currently do not have any official roles in patient diagnosis, there is a lack of drive for students to learn more about or for MITs to improve their understanding of underlying pathologic changes. MITs often feel a lack of support, knowledge, and training for commenting on images (Yielder et al., 2014).

There was an agreement among the participants in the current research that pathology teaching should focus more on common conditions found in MI clinical practice. Those common pathologies should be taught to ensure that students have a basic but adequate understanding of the underlying pathologic changes of those diseases. However, considering the current MI practice and student workload, lecturers were cautious about the level of pathology teaching to MI students, and they did not want the level of pathology teaching to be too high, for example, at the level of a training doctor. They focused more on improving student's appreciation of the pathologic changes for patients' presentations or imaging features to help them work effectively and collaboratively and contribute to better patient care. However, lecturers tend to consider achieving a better pathology understanding within the current MITs' clinical practice, in which commenting on images is not required, instead of assisting students in contributing to patient diagnosis and management by providing their opinions on images because this is not in MITs' current job descriptions.

The ability to understand underlying pathologic changes and to comment on images is critical for the development of advanced practice; it is also essential for MITs to improve patient care

because it is widely involved in clinical reasoning and making decisions in their clinical practice. For any individual pathology topic, less pathology information is expected to be covered for MI students than for medical students because some information is not required for MI practice, such as pathology knowledge for clinical treatment or procedures and laboratory tests. However, for any specific information necessary for MI students, the knowledge is usually the same as that in medical education. A more comprehensive understanding of pathology is required if MITs want to move to provide relatively formal opinions on images. Therefore, no requirements for commenting on images in MIT's practice likely induce significant resistance in pathology learning among MI students due to the short and crowded programme curriculum and unfamiliar and challenging knowledge for students. As a common goal of health professionals, better patient care is a strong argument to support improved pathology understanding. However, a better understanding of underlying pathologic changes is unlikely to be achieved without having more clearly defined requirements for pathology topics to be covered, such as providing opinions on images, which, in return, will fail to achieve better patient care due to a lack of knowledge of pathologic changes.

It is common for MITs to perform radiological procedures based on referrals only; apart from trauma patients, they often do not ask people further clinical questions. Patients usually do not expect instant opinions after the imaging procedures because it is commonly believed that MITs are not entitled to provide comments on the images to patients. This 'mindless practice' likely damages the reputation of the MI profession, as some patients comment, 'radiographers only pushing the button.' Although many MITs would likely be unhappy about this comment, it reflects the nature of MITs' current practice in New Zealand and the fact that most MITs are not ready to provide formal opinions about the images (Yielder et al., 2014). How has radiography, the MI profession, developed into a profession of mindless practice?

5.2.1.1 Who's fault for the mindless practice?

Medical dominance

Medical dominance is widespread in the healthcare sector, even with the movement towards collaborative clinical practice in recent years (Belrhiti et al., 2021; Bolderston, 2005). The resistance to the development of advanced practice in non-medical professionals is often from their associated medical specialties (Bolderston, 2005). Traditionally, radiographers spent a lot of time examining X-rays in addition to generating the images; they were familiar with the important radiographic features of common conditions. However, this advantage was lost when a medical specialist branch in radiology was fully developed, and radiologists became the experts in radiographic features. In New Zealand, radiologists are unwilling to support MITs in performing reporting (Yielder et al., 2014). Without the involvement of radiologists, radiographer reporting is unlikely to happen due to the difficulties in gaining recognition of the practice and providing the required support and training for those MITs who are willing to take on the challenge.

Blind adherence to protocols practice

Plain radiographs were the main radiological examinations for many decades before the advent and clinical use of CT scans (British Institute of Radiology, n.d.). Due to the limitations of imaging equipment in the early days of radiography, lesion detection and making a lesion visible on radiographs were much more important and challenging. How well the lesion was shown and whether certain important radiographic features were visible on X-rays depended heavily on radiographers' skills, including their understanding of anatomy and radiographic features of pathologies. Radiographers contributed significantly to the radiological examinations then and were also involved in reporting X-rays in the early 20th century (Price & Obe, 2020). Image acquisition has become much easier with the

introduction of CT scans in clinical use in the 1970s and subsequent ongoing technology development. MITs have gradually become passive technicians, simply following the protocols. Radiologists continue to dominate reporting, and they also set up the department protocols for X-rays, CT scans, and MRI scans. Senior radiographers have no role in establishing imaging protocols, and radiographers are sometimes even unsure why a specific view or sequence is required or how a particular radiographic view is taken. Partly due to medical dominance, radiographers' work is commonly understood as being technical and associated with new technology and equipment. However, MI training has always focused on applying technology or equipment and has never been designed to develop new technologies or equipment. Without adequate consideration of patient anatomy and pathology, radiographers' routine work will continue to be a mindless practice due to a deficiency in knowledge unique to the MI profession and a lack of autonomy in clinical practice.

Low self-adherence culture

Radiologists continue to dominate the radiology service in New Zealand. Low self-esteem and feeling subservient to radiologists are common among radiographers (Lewis et al., 2008). MITs are kept away from providing opinions on diagnostic images; they do not attend radiology meetings with clinical departments, in which clinical cases are discussed between radiologists and medical specialists from various areas of medicine. Radiographers do not feel comfortable discussing imaging features or their diagnoses among clinical cases with radiologists; they reach out to radiologists often because they need guidance about a procedure or images required, sometimes even just about whether images are acceptable. Due to the low self-esteem culture, MITs get used to just producing images and telling people they are not entitled to comment on images. Trained in this kind of work culture, students are not only successfully trained to follow the protocols blindly, but they also resist learning pathology adequately because they cannot see its relevance to their clinical practice.

As identified by the participants, possibly due to medical dominance, the interaction between MITs and radiologists is sometimes unfriendly or even ugly. MIT's practice has been more directed and confined to applying imaging technology and manipulating equipment. As a result, radiography training is focused on teaching technical aspects of imaging instead of helping students better understand how images can contribute to patient diagnosis and management. Participants want to improve students' pathology understanding and help the MI profession grow out of a 'semi-profession.' However, a deep understanding of a significant number of pathology topics is required for those goals to be achieved. This is likely less appreciated by participants due to the tension in content selection, possibly influenced by other considerations, such as high student workload or the relatively low academic background of MI students. The 'mindless practice' damages the reputation of the MI profession; it also likely impacts patient care and increases radiation to the public.

5.2.1.2 Patient care potentially compromised

In current practice, MITs pay more attention to the quality of images according to radiographic criteria instead of focusing on whether the images have sufficiently answered the clinical concerns, which could affect patient care. For example, if the MIT is not sure about what the orthopaedic surgeon is looking for in the follow-up x-rays of a fracture clinic patient, images could be radiographically acceptable but have not answer the clinical questions; subsequently, the patient is likely to be sent back for more images, which could cause some patient discomfort and affect the workflow in the busy fracture clinic.

There is clinical demand for MITs to be involved in patient diagnosis, and some patients ask radiographers' opinions after their examinations. But MITs often feel uncomfortable commenting on images, especially those they are not familiar with, such as chest X-rays. MITs usually ask for an urgent report, but this often still takes time, depending on the availability of radiologists. Also, radiologists frequently ask MITs to put extra comments on

the referral to help radiologists do reporting, either by having another pair of eyes and saving time for identifying abnormalities in the images or by providing additional patient clinical information. The accurate and useful additional information is of great importance in diagnosing cases where the radiological signs are subtle in the images, or there are multiple critical differential diagnoses to consider. However, without proper education, MITs' comments may be unhelpful or even misleading to radiologists' reporting.

5.2.1.3 Unnecessary patient radiation

MITs aim to provide radiographically perfect images, but often, they can only achieve images adequate for a radiologic diagnosis, commonly due to the variations in patients' anatomy or the limitations of how much patients can do. Therefore, there is usually an allowance for imperfect images to be accepted. The decision to repeat images (with additional radiation dose) is often subjective and relies mainly on the radiographic quality of the images. If images are sufficient to address the clinical concerns, repeating any of those images is probably unnecessary, even if the images are not perfect radiographically. In fact, MITs do many unnecessary repeats because they do not pay enough attention to whether the images have adequately answered the referral requests (Kjelle & Chilanga, 2022). In the meantime, some images may be completely acceptable radiographically, but additional X-rays may be necessary if the original images have not answered the clinical concerns.

5.2.2 A lack of advanced practice in the MI profession

Participants identified that the MI profession is less developed in advanced practice than other health professions in New Zealand, such as nursing. Although ways have been explored to implement advanced practice, such as employing a pre-defined framework of a possible structure for career progression (Yielder et al., 2014), there is still no reporting on general X-ray images by radiographers in New Zealand. Due to the belief that a profession should have

a body of specialist knowledge and skills (Yielder & Davis, 2009), much research regarding various aspects of MI practice has been performed within the MI profession in recent years to help the MI profession grow out of its understanding of itself as a 'semi-profession.' Domains of the MI profession have also been established by the registration body Medical Radiation Technologists Board (MRTB) to uphold specialist knowledge by controlling who can enter certain areas of MI practice (Yielder & Davis, 2009). MITs use technology and equipment to generate images of normal anatomy and pathologic changes in patients. The technical part of their work, such as the application of technology, equipment manipulation, and following imaging protocols and safety procedures, is primarily based on information derived from other professionals, including scientists, engineers, radiologists, and medical physicists. An essential part of their practice is closely associated with understanding underlying pathologic changes for clinical manifestations, imaging features, and their management. Therefore, a sufficient body of specialist knowledge is unlikely to be constructed without adequate knowledge of underlying pathologic changes.

The availability of advanced practice of radiographers in different countries is predominantly dependent on the government policies and the way the healthcare systems are organised and governed in those countries, although cultural and economic factors may also play a role (Catania et al., 2024). Many probable factors preventing radiographers from developing advanced practice have been determined in contexts outside of New Zealand (Catania et al., 2024). Similarly, those obstacles, such as the New Zealand culture, practice and organisation in the New Zealand healthcare system, and medical dominance, are likely affect the development of advanced practice of radiographers in New Zealand. In addition, a shortage of radiologists being less of an issue than in some other countries likely incurs more resistance to its development (Smith & Yielder, 2008). The principal resistance to radiographer reporting is possibly from the belief that pathology education in MI training is

insufficient; radiographers do not have the knowledge and experience to associate pathologic changes in patients with their clinical presentations, imaging features, and principles of management (The Royal College of Australia and New Zealand Radiologists, 2018).

Although the belief that radiographers do not have flexible knowledge "to associate the relevant radiological findings to clinical conditions" (Hardy et al., 2010, p.31) is probably related to a lack of pathology education (The Royal College of Australia and New Zealand Radiologists, 2018), there is strong evidence that radiographers can provide accurate general X-ray reports, with appropriate training (Brealey, 2005). Establishment of advanced practice will help radiographers develop professional pride and contribute to job satisfaction and better patient care (Catania et al., 2024).

Lecturers identified that mindless practice is prevalent in the MITs' clinical work, the MI profession is much behind in advanced practice, and the MI practice is capped, significantly limiting the professional development of many talented radiographers. However, when they decided on pathology teaching content for MI students, participants tended to consider the issue under the presumption that advanced practice of MITs is unlikely to be seen in New Zealand. As a result, they focused more on improving student pathology understanding instead of helping them comment on images. The importance of advanced practice is possibly not fully appreciated. Without the advanced practice of radiographers, students do not see the benefits of studying more pathology topics. Due to the busy programme curriculum and a lack of background knowledge from students, engaging students in pathology teaching is often challenging, and the effort to encourage pathology learning by highlighting the importance of patient care is usually less effective. In return, the low academic standards in the MI profession, especially for pathology education, have negatively affected the development of advanced practice (The Royal Australia and New Zealand College of Radiologists, 2018).

5.3 A balanced curriculum is beneficial, focusing on multiple educational aims

5.3.1 Pathology education needs to satisfy multiple educational aims

A range of aims of pathology education have been identified

MI lecturers identified a range of aims of pathology education, that are mostly practical with direct relevance to MI practice. They include satisfying academic course standards from NZQA and professional registration requirements from MRTB, considering those requirements from overseas registration bodies. Participants also believe pathology teaching should enable students to provide better patient care by helping them understand how disease manifests itself clinically and radiographically, knowing positioning and the protocols well, communicating effectively using pathology and radiology terminologies, and developing genuine empathy with patients. In addition, they believe that pathology education should also contribute to developing skills among students, such as critical thinking, lifelong learning, effective citizenship, creativity, curiosity, teamwork, and decision-making. Collectively, according to the participants, pathology teaching should aim to foster the development of the MI profession and help students achieve a successful and meaningful life.

Content selection is challenging, considering multiple educational aims

According to Biesta (2015), education can be seen to have three main aims, qualification, socialization, and subjectification. What to teach should also be an essential consideration in education, especially in curriculum development (Biesta, 2015; Null, 2017). Education is considered hollow and empty if it is focused on learners and the learning process only (Biesta, 2015; Null, 2017), and learning is more meaningful when there is clarity about what subject knowledge to learn. Thinking about the aims of education is powerful when deciding on teaching content; it enables educators have a more comprehensive understanding of issues. It may also help them be open-minded and accept different views more easily. Considering

the aims of education is highlighted as an important part of curriculum development (Kelly, 2009; Null, 2017); however, with multiple educational aims to be achieved, content selection can become more challenging because some aims of education are inconsistent with others.

5.3.2 A balanced pathology curriculum is beneficial

Aims of education contributing to each other

Achieving some educational aims can contribute to developing others and vice versa.

Critical thinking, lifelong learning, and citizenship are commonly recognized educational aims. Good citizenship is essential to achieving harmony and prosperity in modern society; it also requires people to be informed in the community, including local and global challenges, government policies, and technology development, which likely help people develop critical thinking and lifelong learning skills through activities. In the fast-changing world and globalization, critical thinking and lifelong learning skills can help students follow technology development and learn and digest newly emerging information, which, as a result, further helps them become more efficient citizens. Critical thinking ability and lifelong learning skills can also help students update their knowledge and skills to maintain their jobs and make reasonable decisions, which likely benefits their communities. More people with sound views will likely work towards a common good locally or internationally (Elder, 2022).

A balanced pathology curriculum is beneficial

A physical and mental balance is widely believed to be healthy for the human body; likewise, a balanced pathology curriculum is likely beneficial to MI students. Flourishing (living well and developing successfully) is a widely accepted ideal of the desired human life (Kristjansson, 2016). Being unable to experience emotional and moral urges will prevent students from achieving flourishing, and it is suggested that in tertiary education, educators

help students gain experience of those urges (Kristjansson, 2016). Some educational aims are more fundamental, such as creative understanding and autonomy, which are believed to help students achieve a healthy and comprehensive view of challenging issues (Gutmann, 2015) or qualities of minds, such as open-mindedness, academic honesty, and soundness of argument (Weithman, 2015). Creative understanding and autonomy also contribute greatly to developing other highly recommended educational aims, such as lifelong learning, critical thinking, and citizenship. According to some education philosophers, these fundamental aims are better achieved by reaching a deep understanding of topics of subject knowledge (Weithman, 2015), such as pathology. In accordance with government policies, health professionals are obligated to develop skills, such as time management, resilience, teamwork, communication, and collaboration because these skills or qualities that are essential to work in current busy and challenging health environments. Therefore, being too idealistic, focusing only on students thriving or academic success, and not satisfying government requirements, education does not go far enough.

Participants identified the importance of helping students develop the best of themselves, be cautious about student workload, and improving the pathology learning experiences of their students. These are closely associated with student well-being from different discourses, such as physical and psychological well-being and flourishing (Spratt, 2016). Student well-being is important in education (Thorburn, 2015) because it has considerable implications for the curriculum and teaching practice (Norwich et al., 2020). It is important to note that academic study usually involves some degree of mental discomfort; it is unrealistic to expect stress-free study. Overly emphasizing personal well-being (satisfying individual needs and preferences) potentially impairs the importance of subject knowledge learning (Thorburn, 2015). On the contrary, successfully acquiring relevant subject knowledge can promote social-emotional well-being by arriving at intellectual and emotional satisfaction together. It is suggested to

have balanced well-being between subjective worthiness and being engaged in subject knowledge learning (Thorburn, 2015). Those who have developed academic strengths and personal qualities through education may achieve - healthy and balanced well-being, which helps protect mental health (Biesta, 2015).

A balanced pathology curriculum will likely benefit our society as well. With multiple educational aims to be accomplished, fostering students to experience emotional and moral urges is challenging. Awe is a strong emotional feeling, often leading to happiness and experiences of moral virtues, mingled with a sense of fear (Kristjansson, 2019). We commonly focus on how awe can elicit intellectual, moral, and aesthetic elevation and achieve human flourishing; people almost put less importance on awe's effects on our daily life and being good citizens. The ability to experience awe with a sense of fear can help young people to think about others, feel humble, help strangers, and protect environment (Shiota, 2021). When education becomes a commodity, and students become education customers, lecturers are obligated to appease students' demands because they are threatened by getting negative student feedback. Due to challenges in pathology learning, lecturers often struggle to maintain academic standards of pathology teaching. As a result, lecturers are unable to focus on developing qualities of mind among students, which likely affects the further development of other educational aims, such as critical thinking and effective citizenship.

5.4 The tension in pathology content selection

5.4.1 Pathology is a challenging discipline

A unique discipline

Pathology is a difficult discipline mainly due to the features of its knowledge. As identified by the participants, pathology is the foundation of all clinical practice aspects, including

clinical manifestations, laboratory and imaging tests, and clinical management. It closely relates to numerous medical science subjects and links them to clinical practice. Pathology is associated with significant content because it covers diseases of all the body systems.

Pathology understanding is primarily based on cellular and subcellular changes because the disease is derived from the cells (Kumar et al., 2012). It focuses more on disease mechanisms and provides a scientific guide to clinical practice. Building up enough pathology knowledge requires real effort but is essential to clinical practice.

A content-heavy discipline

Pathology courses commonly involve learning a great deal of information. The human body has ten organ systems: the respiratory, cardiovascular, digestive, urinary, musculoskeletal, nervous, endocrine, immune, reproductive, and integumentary (skin) systems. Each body system has a range of diseases according to their causes, such as traumatic, infectious, inflammatory, autoimmune, degenerative, metabolic, vascular, neoplastic, genetic, developmental, and environmental diseases. Because pathology provides a foundation for clinical practice, for each condition, pathology study covers a wide range of information, including aetiology (causes), pathogenesis (disease mechanism), morphology (gross and microscopic), clinical signs and symptoms, laboratory and imaging tests, and other related information, such as epidemiological and statistical data (Kumar et al., 2012). Because pathology study covers all the body systems and the amount of pathology information has expanded dramatically from research in the past several decades (Domizio, 2006; Marshall et al., 2004), pathology is characteristically a content-heavy course, even if only the most common and essential pathologies are discussed, as agreed by the participants. Although most of our students can comprehend individual pieces of pathology information, many students struggle to keep up with pathology learning when dealing with a large amount of content based on the MI lecturers' pathology teaching experience and student feedback.

A discipline with many separate pieces of descriptive information

The importance of factual knowledge teaching may vary among various disciplines (Maurice-Takerei & Anderson, 2016). For example, specific individual pieces of pathology knowledge are most useful in clinical practice. Since this is how we use pathological information, we focus on disparate pieces of pathology knowledge in both pathology teaching and assessment. Pieces of knowledge are the building blocks, and individual understanding of knowledge constructs a structure in the brain based on the information blocks and connections between them. Building a meaningful understanding of factual knowledge is essential to developing higher-order thinking skills (Furst, 2021).

Pathology learning involves recalling many individual pieces of information about various pathologies. We want to help students apply the knowledge, analyse the data, and make judgements; however, students cannot achieve those higher levels of knowledge if they have not understood and recalled enough pathological information. Clinical reasoning and critical thinking are essential personal qualities, but these skills can only be successfully developed when students have achieved enough and a good understanding of disciplinary knowledge (Weithman, 2015), including that of pathology. Focusing on developing abilities to work with knowledge without retaining adequate information, as suggested in Bolstad et al.'s report (2012), is not helpful in pathology study and clinical practice.

Learning about underlying pathological changes

Studying how a disease is formed and developed (disease mechanism) is usually more challenging than learning its causes or clinical presentations alone, but it provides students with a deeper understanding of the disease that could greatly improve their clinical practice. For example, tissue swelling and redness are the clinical features of acute inflammation; when we teach acute inflammation, there is an agreement among participants that we should

teach basic underlying pathologic changes for those clinical presentations. Suppose we teach how tissue swelling and redness are produced. In that case, we will inevitably include basic microscopic cellular changes, such as the structure and changes of small vessels, fluid in the tissue, various inflammatory cells, and basic tissue structures of affected organs.

Consequently, the pathology content will be increased, and it will also involve teaching basic microscopic cellular changes that most students are not familiar with, which will likely worsen the content volume.

Learning underlying pathologic changes for imaging features is a unique aspect of pathology studies for the MI profession. For example, hyperinflated lungs, blood vessel thinning, and coarse lung markings with bronchial wall thickening are the main radiographic features of chronic obstructive pulmonary disease (COPD). Studying the underlying pathologic changes specific for imaging features is challenging for most students, but this is the most effective way for students to understand the imaging features better. MI lecturers also agree that we should teach the basic underlying pathologic changes for important imaging features, which will also increase the volume of teaching content.

5.4.2 Student workload considerations

Importance of subject knowledge learning

It is commonly believed that curriculum coverage plays an important role in the progression of students' learning (Bertram et al., 2021). Also, as indicated in the current study, adequately covering subject knowledge is essential for students' future practice. Partly due to the large amount of information, students tend to forget specific pathologic information gradually, but it should not stop them from learning pathology knowledge they feel more comfortable about what to do and what to say in front of patients if they are familiar with the specific relevant information, either from previous study or recent review. In addition, students' skills are

better developed through subject knowledge learning, such as critical thinking and lifelong learning skills. Furthermore, in higher education, educators should focus more on explaining complex knowledge pieces and delivering teaching by involving their own deep understanding of the teaching content (Weithman, 2015).

Adverse impacts of a heavy student workload

However, overambitious curricula can have adverse outcomes due to the limited cognitive load capacity of the human brain (Pritchett & Beatty, 2015). Based on a literature review of student workload, D'Eon and Yasinian (2021) identified a range of adverse impacts of a heavy student workload on their learning, such as negative learning experiences, impaired academic success, and unhealthy attitudes toward learning. Similarly, in this study, MI lectures reported that heavy content was the primary concern of students in pathology teaching, and it damaged their learning experience. A heavy workload is also closely associated with students' psychological well-being because it often causes learners stress, anxiety, and burnout (Tempski et al., 2012).

A new way of looking at student work

It is difficult to measure student workload reliably. Although various methods have been tried, there are flaws in all measures, both objective and subjective ones (D'Eon & Yasinian, 2021). D'Eon & Yasinian (2021) proposed a new approach to thinking about student workload. Instead of workload, they suggested using student work, defined as the product of student effort and achievement. Based on the literature review, they classified student effort into four domains: cognitive, physical, psychological, and social, and possible resources for interventions or student support are also suggested (D'Eon & Yasinian, 2021). More importantly, they developed a more positive way of looking at the issue, providing

individualised student support and adding additional assets to the resources students brought into the course to help them attain their goals (D'Eon & Yasinian, 2021).

5.4.3 What pathology content should we teach to MI students?

From the current study, all participants agreed that we should adequately teach pathologies that are common and important to the MI practice, including studying underlying pathologic changes for essential clinical presentations and imaging features and covering topics, understanding of which is critical for a better overall understanding of pathology. Participants emphasized the importance of focusing only on those common conditions because it is commonly known that pathology is a content-heavy course. It is widely assumed that student pathology learning experiences will improve if we only cover the essential pathologies. Unfortunately, the issue is far more complex.

Participants have noticed that, as part of the nature of the pathology discipline, the pathology course involves a great deal of information, even though only common conditions are discussed. If there was a decision to include underlying pathologic changes for clinical manifestations and imaging features, as suggested by the MI lecturers, the volume and difficulty of pathology content would be further increased. Although there are many considerations regarding student workload (D'Eon & Yasinian, 2021), still, MI lecturers tend to focus more on limiting teaching content whenever there is a student concern, largely due to the tension in pathology content selection. Their main arguments are that too much content does not help students' learning and that tertiary education should focus more on developing skills instead of transferring knowledge.

In current tertiary education, student course feedback plays a major role in the course design, delivery, review, and planning. Student feedback is more meaningful if it includes how students feel about the course and provides constructive feedback. The main student concern

about the pathology course at Unitec was the content volume, which was also the key driver to undertake this research. Although too much content damages student learning in many ways, student workload is a complicated issue. Students' perceptions about the volume of course content are difficult to measure reliably (D'Eon & Yasinian, 2021). Student workload in the pathology course varies greatly among MI students due to factors such as previous academic learning, background knowledge, and student motivation, (D'Eon & Yasinian, 2021). Some of the Unitec students enjoyed the pathology course despite all the challenges associated with the course. In addition, student workload considerations should not just be targeted at passing the course, as agreed by all the participants.

Although this study focuses on pathology teaching content selection for MI students, it is closely related to pathology curriculum development. Content selection should be based on a wide range of considerations, including why those topics are chosen, instead of focusing exclusively on the actual topics or syllabus (Kelly, 2009). These considerations could include thoughts about the MI programme and profession and their development, aims and concepts of education, a healthcare organization in NZ, and pathology discipline. The importance of subject knowledge in the curriculum design and development has been recognized by many educators (Rata, 2021).

To satisfy multiple educational aims, including providing better patient care, lecturers would ideally want MI students to study more pathology topics. In the feedback from the College of Radiologists regarding radiographer reporting in Australia and New Zealand (2018), the main concern was an unsatisfactory understanding of anatomy and pathology among radiographers. Therefore, more topics need to be covered to prepare radiographers better. In the meantime, covering more topics is often required and potentially beneficial to MI students because they are unable to reach the desired level of understanding themselves due to a lack of medical experience in many conditions. Lecturers could help students better understand

pathologies by sharing their insights and experiences of those conditions, which is meant to be the teaching focus (Weithman, 2015). Many educators believe education should focus on subject knowledge teaching, and skills are better formed through subject knowledge learning (Weithman, 2015), with which lectures also agreed through interviewing.

There is potentially another related issue that makes the MI lecturers believe that heavy content is likely to be the problem, and reducing 'unnecessary' content is expected to be the solution whenever there is a concern about pathology content from students. The issue is the lack of standards of pathology teaching to MI students. Pathology knowledge is briefly and vaguely mentioned in the revised MRTB Competence Standards for MRTs (2023, p. 26) as "including the pathophysiology underpinning disease and injuries affecting the human body." This description does not tell us what pathology knowledge we should teach MI students, potentially leaving room for people to cut the content. The most important content-related issue in pathology teaching to MI students is whether we teach causes and clinical presentations of diseases only (superficial pathology knowledge) or also teach basic underlying pathologic changes and how those clinical presentations are formed. If a lack of formal pathology teaching is the main obstacle to developing the MI profession, particularly the advanced practice, then this suggests that maintaining the pathology teaching standards for MI students is important.

Due to a lack of background knowledge from students, a busy programme curriculum, heavy content, and unfamiliar information from the pathology discipline, pathology teaching to MI students is challenging. Without pathology teaching standards, some students might not reach the expected level of understanding because the course requirements are too high for those students (D'Eon & Yasinian, 2021). If pathology standards were established, lecturers could explore other resources to improve students' pathology learning experiences instead of focusing on reducing teaching content. For example, previous related knowledge is the major

resource in the mental (cognitive) effort domain, and biology study as an entry requirement might be appropriate for some students who lack the basic knowledge to build up pathology information. As indicated in medical literature, the integration of pathology teaching is the new trend in medical education (Marshall et al., 2004); pathology teaching can be integrated with other academic papers and into clinical training, and an even more extended programme curriculum (4 years) may be considered.

MI lecturers have different views about their profession and pathology teaching to MI students because they are from various backgrounds and have different experiences and this affects their view of the pathology curriculum. The findings of this study suggest that a broader view of the pathology curriculum among educators would be useful. *In the meantime, the first step to developing a pathology curriculum would be to establish a broader view of the purpose of the pathology curriculum.* For example, if better patient care is the aim of MI education, better pathology teaching and adequate content coverage becomes vital to pathology education for MI students. Focusing on satisfying requirements of current clinical practice is not enough for achieving better patient care. Educators in Polytech institutions in NZ may need to become more comfortable with expecting some student discomfort in academic study.

5.5 Summary

MI lecturers have noticed that it is a challenging task to choose pathology teaching content because there are many considerations involved. The discussion in this chapter has highlighted some of the reasons for the tension in content selection. Pathology is a challenging discipline due to the nature of pathology knowledge, and pathology learning demands more effort from MI students as a result of a busy and short programme curriculum and a lack of biological background knowledge from students. MI practice significantly impacts pathology education for MI students because it determines how much pathology

knowledge is required in clinical practice. There is an increased demand for advanced practice for radiographers, which will potentially help MI students better understand pathology. However, an improved pathology understanding in MI education is essential to establishing advanced practice in the beginning. Pathology content decisions are complex; it is critical to consider the aims of education in curriculum development. A balanced pathology curriculum is likely beneficial, targeting multiple educational aims. When considering student workload, it is healthier to support students to develop the abilities they lack to meet the requirements and attain their goals, rather than focus on limiting teaching content.

Chapter 6: Conclusion

The current research aimed to explore lecturers' beliefs on what pathology knowledge and skills we should teach MI students and the reasons for their decisions. All the participants highlighted the importance of aligning pathology teaching with the MI clinical practice, primarily the general radiography domain. For those essential conditions, participants believe that they should teach adequately to help students achieve a basic understanding of underlying pathologic changes and better appreciate clinical manifestations and imaging features. These agreements are predominantly because an adequate knowledge of essential conditions has a wide range of benefits to students' future practice. Participants also realized that a tremendous amount of tension is associated with pathology content selection, and managing the volume of pathology learning content and improving student learning experience was far more complex than expected. This is because decisions about pathology content is influenced by multiple competing aims of education, the educational foundation of the MI profession, and the characteristics of pathology discipline and its knowledge.

Facts: an issue in pathology education

Pathology is a challenging discipline mainly due to the features of its knowledge. It investigates how conditions are developed by studying disease causes and linking them to clinical presentations and management. Pathology knowledge is predominantly descriptive, describing the pathologic changes of the affected tissue or organ, including macroscopic and microscopic features. Recalling adequate pathology knowledge is essential because discrete pieces of pathology information are most valuable in clinical practice. Building up pathology knowledge, especially that descriptive information, is an arduous and tedious task, demanding real effort. However, without retaining the foundational information, students cannot apply and enjoy the beauty of pathology knowledge. In the meantime, it is critical to

understand the basic microscopic changes of conditions because diseases are primarily derived at cellular and subcellular levels (Kumar et al., 2012).

The difficulty of studying pathology is associated chiefly with its heavy content because pathology learning covers various conditions in all the body systems (instead of focusing on one group of diseases or a single body system), and its knowledge has increased remarkably in the last decades from research (Domizio, 2006; Marshall et al., 2004). Affected by the shift in medical education and challenges in pathology teaching, there has been a demand for a change in traditional pathology education since the late last century. A hallmark of this new trend is the integration of pathology teaching, either with other disciplines horizontally or with clinical rotations longitudinally (Marshall et al., 2004). Pathology teaching to MI students is more challenging because of a lack of foundational knowledge from students and a busy and short programme curriculum. Although a comprehensive pathology syllabus is traditionally only seen in medical education, individual pieces of pathology knowledge are the same for medical and MI students, and most MI students can understand them. A substantial improvement in pathology education is essential to help MITs develop advanced practice and better contribute to patient care. Teaching strategies alone are unlikely to significantly improve the student learning experience of pathology due to its heavy content and extra challenges to MI students. What pathology content to teach becomes the leading question to be answered first.

Satisfying multiple educational aims: a challenging task

It is believed that higher education should have numerous aims to help students succeed in a modern democratic society, many of which contribute to each other, while some educational aims, such as autonomy, foster the development of others from a more foundational level.

Participants also identified multiple educational aims that are more aligned with radiographers' clinical practice. Caring for patients is considered an essential clinical role of

radiographers. Although there are many meanings or aspects of caring (Kammies & Archer, 2022), consistent quality images, as low as achievable patient radiation exposure, and contributing to correct and prompt diagnosis are thought essential for being classified as better patient care (Nocum et al., 2021). If better patient care is a goal of pathology teaching, MI lecturers often intend to teach more to make students better informed and prepared. Primarily due to the features of pathology knowledge, pathology teaching will likely become challenging to most MI students if lecturers want to teach pathology adequately, even at a basic level. On the other hand, lecturers are cautious about the volume of teaching content in consideration of student learning experiences and well-being. Unfortunately, pathology teaching content is typically heavy, even if it only covers common conditions. The tension among participants was evident during the interviews while talking about their views.

Strengths and limitations of this research

MI lecturers are a valuable source for providing insights into pathology content selection because they know the MI profession and the pathology education of MI students the best. Based on what was found in the literature, a wide range of factors potentially affecting pathology content selection were considered in this project, from the registration body requirements to personal development. In addition, broader issues were considered, including the development of the MI profession and the aims of higher education. Although a small number of interviews were undertaken, ideas about pathology content selection were explored in depth. This is one of the strengths of employing an interpretivist paradigm.

One limitation of the study is that due to time constraints, this project did not examine the views of students and qualified MITs. Involving other stakeholders could contribute to a more comprehensive understanding of the challenges of what pathology content should be included in MIT courses. Lecturers' views are predominantly developed from considering issues of MI practice, aims of education, and features of pathology knowledge, which can be potentially

applied to other MI programmes. However, due to differences in pathology curriculum between MI programmes, those views may not be fully applicable to other MI programmes.

Recommendations

Although it is essential to consider multiple aims of education in the development of a pathology curriculum, the current MI practice has a higher impact on pathology learning from a student perspective. Due to a lack of pathology standards in MI education, there is often strong resistance to learning this challenging discipline because students cannot see the direct importance of a deep understanding of underlying pathologic changes. It has contributed significantly to and continues to sustain a 'mindless practice' and negatively affects the development of the advanced practice of radiographers. Pathology standards for MI students, including required pathology topics, would greatly help engage students and improve their learning experience by signalling that those topics were necessary for professional registration. They would also help develop the MI profession by enhancing the understanding of pathologic changes of MITs, one of the two essential medical science subjects, and potentially lead to establishing an advanced practice of radiographers in New Zealand.

Student well-being is not only an educational aim; it also significantly impacts students' academic achievement. Although student workload is an important consideration of student well-being, it isn't easy to measure it accurately and reliably, and the feelings about the workload vary considerably among students. It is more beneficial to think about student workload by helping students make up the knowledge and skills needed and lacking from students while entering the course and for completing it. Pathology is a challenging discipline due to the features of its knowledge. Based on a significant amount of pathology teaching experience in medicine, an extended and intergraded pathology curriculum is generally recommended. Consequently, a longer pathology curriculum for MI students, such as a pre-entry requirement in biology and anatomy, an extended programme curriculum, or integrated

into clinical training, would likely ease the tension in pathology content selection and improve the student learning experience.

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Appendix A: Ethics Approval



28 March 2024

Megan Lourie
Faculty of Culture and Society

Dear Megan

Re Ethics Application: **24/17 Medical Imaging lecturer's selection of pathology knowledge and skills to teach**

Thank you for your responses to AUTEK's conditions.

Your ethics application has been approved for three years until 28 March 2027.

Standard Conditions of Approval

1. The research is to be undertaken in accordance with the [Auckland University of Technology Code of Conduct for Research](#) and as approved by AUTEK.
2. All public facing documents must have the AUTEK approval number and be of a high standard of spelling and grammar. Dates on the Information Sheet(s) and Consent Form(s) must be consistent.
3. Any amendments to the project must be approved by AUTEK prior to being implemented.
4. A progress report is due annually on the anniversary of the approval date.
5. A final report is due at the expiration of the approval period, or, upon completion of project.
6. Any serious or adverse events must be reported to AUTEK, this includes unforeseen issues that might affect continued ethical acceptability of the project.
7. AUTEK grants ethical approval only. You are responsible for obtaining management permission for access from any institution or organisation at which your research is being conducted and you need to meet all ethical, legal, public health, and locality obligations or requirements for the jurisdictions in which the research is being undertaken.

The application number and title need to be referenced on all correspondence related to this project.

All forms are available online <http://www.aut.ac.nz/research/researchethics>

For any enquiries, please contact ethics@aut.ac.nz

(This is a computer-generated letter for which no signature is required)

The AUTEK Secretariat

Auckland University of Technology Ethics Committee

Cc: czy1237@autuni.ac.nz

Appendix B: Organisation approval for interviews



Marcus Williams
Director-Research and Enterprise
Tuapapa Rangahau – Research and Postgraduate Office
Unitec Institute of Technology – Te Pūkenga Te Whare Wananga o Wairaka

Thursday 4 April 2024

Researcher: Lixin Yang

Supervisor: Megan Lourie,

Faculty of Culture and Society
AUT University

Re: Organizational Consent for researchers to undertaking the research study: 24/17 Medical Imaging lecturer's selection of pathology knowledge and skills to teach (Ref: AUTEK 24/17)

I, Marcus Williams, Director – Research & Enterprise at Unitec – Te Pūkenga give consent for Megan Lourie to undertake research in this organization as discussed with the researcher.

This consent is granted based on prior approval of the researcher's research ethics application by the AUT University Ethics Committee and a copy of the application approval letter has already been received by the Research Office.

Signature:

A handwritten signature in black ink, appearing to be 'M Williams', written over a faint horizontal line.

Note:

This study has been approved by the AUT University Ethics Committee (AUTEK on 28 March 2024 (Ref AUTEK 24/17). Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor, Megan Lourie, megan.lourie@aut.ac.nz, 09 921 9999 ext. 8517 Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEK, ethics@aut.ac.nz, (+649) 921 9999 ext. 6038.

Participant Information Sheet

Date Information Sheet Produced:

26 March 2024

Project Title

Medical Imaging lecturer's selection of pathology knowledge and skills to teach.

An Invitation

My name is Lee Yang; I studied medicine and had training in diagnostic radiology overseas. Currently, I teach pathology courses in the medical imaging (MI) programme at Unitec and work as a general radiographer at a large rural GP practice.

I invite you to participate in research for my Master of Education (Higher Education) thesis, which looks at pathology teaching to MI students at Unitec. Pathology learning is challenging but essential to medical imaging practice, but it contains curriculum challenges including how much content to include, the best way to teach that content, and reducing student stress levels around content acquisition.

Before you decide whether to participate in this research, you need to understand why the research is being done, what it would involve for you, and how privacy and conflicts of interest will be managed. Please take time to read the following information carefully, and feel free to ask questions if anything you read needs clarification or if you want more information.

What is the purpose of this research?

Due to a lack of background knowledge from MI students and a busy and short programme curriculum, pathology teaching to MI students is very challenging. Many students need help with achieving a deep understanding of certain pathology concepts, mechanisms, or pathologic changes. Combined with large content, students often struggle with retaining enough pathology information or applying the knowledge. As a result, emotional changes are common among students associated with anxiety, which could affect their well-being and confidence in lifelong learning. In the meantime, better pathology knowledge is required for an increased demand for better patient care and the development of advanced practice in medical imaging. Because content volume is students' primary concern, what to teach becomes the most critical question to be addressed first.

This research aims to discover the ideal content volume of the MI pathology course to improve students' understanding of pathology and their learning experience. With clearly outlined learning content, active learning strategies can be considered and developed more effectively, including exploring the possibilities of integrating pathology teaching with other academic courses or clinical modules. In addition, explicit teaching content will help to build pathology teaching standards for MI students, which is recommended in medical education. It is hoped that the process of working through the issues related to pathology teaching in the Unitec MI programme will provide an opportunity to improve how we approach this important curriculum area.

The findings of this research will be the basis for my thesis and may be used for academic publications and conference and other presentations.

How was I identified and why am I being invited to participate in this research?

You have been identified by me as a colleague associated with pathology teaching on the Unitec MI programme, because pathology is widely involved in all aspects of MI education. Because this study focuses

Appendix C: Participant Information Sheet

on how Unitec faces the challenges of teaching pathology and the stressors on our students, all academic staff in the programme are being invited to participate. I'm interested in your opinions about what pathology knowledge and skills we should teach MI students.

How do I agree to participate in this research?

Please respond to the invitation email after you have decided. If you want to participate, you need to sign a Consent Form before the interview. Your participation in this research is voluntary (it is your choice), and whether or not you choose to participate will neither advantage nor disadvantage you. You are able to withdraw from the study at any time. If you choose to withdraw from the study, you will be offered the choice between having any data identifiable as belonging to you removed or allowing it to continue to be used. However, once the findings have been produced, removal of your data may not be possible.

What will happen in this research?

As topics and content volume are the major concerns in pathology teaching, this study aims to find how lecturers decide on pathology teaching content for MI students. Because your perspectives are the most valuable data and an interview is the most effective method to discover your opinions, you are invited to participate in an interview with me. The interview will take about an hour and will be scheduled at your convenience in a meeting room at the Waitakere campus. You will be asked to provide opinions about topics (subject knowledge) to be covered in the pathology course, along with your justifications for your views. I would also like to ask you to comment on different views and provide your explanations. After the interview, a summary of your comments will be provided for you to verify and clarify further. The interview will be recorded and transcribed, and you will receive a transcript of your interview for checking.

What are the discomforts and risks?

You may feel uncomfortable discussing work issues associated with pathology education with a colleague or participating in a research project that investigates pathology teaching in our programme. You may be concerned that your views on how pathology is taught differ from the researcher or your other colleagues.

If you disagree with the problem the researcher has identified, you are welcome to either not participate in the research, with no explanation as to why, or to participate and explain your position on the topic.

How will these discomforts and risks be alleviated?

This research is designed to encourage thinking about how to improve the way pathology is taught to MI students at Unitec. It is not intended to be a critique of the institution, the teaching programme, or individual staff. The aim is for a constructive collegial process that investigates ideas to improve curriculum design and delivery.

Participants will be deidentified during the research, that is, comments will not be attributed to an individual participant.

Participation is strictly voluntary; the research will proceed even if there are only a small number of participants.

What are the benefits?

Irrespective of your decision to participate or not, this research project has the potential to feed into curriculum revisions. It may open up a conversation as to how we can improve our teaching and reduce our students' stress. You may have ideas you would like to share on how we currently approach this challenge and what can be done to tackle the current tensions between the competing forces of time and content.

Better pathology achievement by our students will significantly contribute to the development of the medical imaging profession with the introduction of advanced practice, which will help achieve better patient care.

As the researcher, the findings will inform my pathology teaching practice and help me further my pathology education research. The writing of this thesis will assist with my gaining a Master of Education (Higher Education) degree.

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How will my privacy be protected?

Your name will not be used in the thesis or any other research outputs. Comments will either be aggregated, or not attributed to a specific person. However, the organisation this research centres on (Unitec) will be named, and people who know where you work may guess that you were a participant in this study. Given the size of the potential pool of participants, the research can only offer you limited confidentiality.

You can withdraw from the research project or amend your interview transcripts and ask that comments be edited, deleted, or added to, until close to the thesis submission date.

What are the costs of participating in this research?

The interview will take about an hour at your convenience, and more time may be required to verify the summary of your comments.

What opportunity do I have to consider this invitation?

Please consider this information sheet and contact me with any questions. I would appreciate it if you could let me know your decision in two weeks, but more time is possible if you require it.

Will I receive feedback on the results of this research?

I will provide you with a one- or two-page summary of the findings when the research is completed. I will also inform the whole teaching team of the findings.

What do I do if I have concerns about this research?

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor, Megan Lourie, megan.lourie@aut.ac.nz, 09 921 9999 ext. 8517

Concerns regarding the conduct of the research should be notified to the Executive Secretary of ATEC, ethics@aut.ac.nz, (+649) 921 9999 ext. 6038.

Whom do I contact for further information about this research?

Please keep this Information Sheet and a copy of the Consent Form for your future reference. You are also able to contact the research team as follows:

Researcher Contact Details:

Lixin Yang, czy1237@autuni.ac.nz

Project Supervisor Contact Details:

Megan Lourie, megan.lourie@aut.ac.nz

Approved by the Auckland University of Technology Ethics Committee on 28 March 2024, ATEC Reference number 24/



TE WĀNANGA ARONUI
O TĀMAKI MAKĀU RAU

Consent Form

Project title: Medical Imaging Lecturer’s Selection of Pathology Knowledge and Skills to Teach

Project Supervisor: Megan Lourie

Researcher: Lixin Yang

- I have read and understood the information provided about this research project in the Information Sheet dated 28 January 2024.
- I have had an opportunity to ask questions and to have them answered.
- I understand that notes will be taken during the interviews and that they will also be audio-taped and transcribed.
- I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time without being disadvantaged in any way.
- I understand I can potentially be identified due to the small number of participants. My comments will be written using pseudonyms in the findings of this research. No private or sensitive information is involved in the research, and I can ask for some comments to be removed. However, limited confidentiality may only be offered, given the size and nature of the pool of potential participants.
- I understand that if I withdraw from the study, then I will be offered the choice between having any data that is identifiable as belonging to me removed or allowing it to continue to be used. However, once the findings have been produced, removal of my data may not be possible.
- I agree to take part in this research.
- I wish to receive a summary of the research findings (please tick one): Yes No

Participant’s signature:

Participant’s name:

Participant’s Contact Details (if appropriate):
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Date:

Approved by the Auckland University of Technology Ethics Committee on 28 March 2024, AUTEK Reference number 24/17.

Note: The Participant should retain a copy of this form.

Appendix E: Interview Questions

Research interview questions:

Q1. Can you tell me about your previous professional and teaching experience?

Q2. Tissue swelling and redness are the clinical features of acute inflammation. When we teach acute inflammation, do you think we should only focus on those clinical features, or should we also briefly cover how tissue swelling and redness are formed?

If we teach how tissue swelling and redness are produced, we will inevitably include basic microscopic/cellular changes, such as the structure and changes of small vessels, fluid in the tissue, various inflammatory cells, basic tissue structures of affected organs, etc. What are your opinions about this?

Q3. Hyperinflated lungs, blood vessel thinning, and coarse lung markings with bronchial wall thickening are the main radiographic features of COPD. Should we include teaching basic underlying pathologic changes for those imaging features, or should we only focus on those features?

Q4. What do you think is the purpose(s) of teaching pathology to MI students?

What do you think are the aims of tertiary education?

Q5. For a given body system that you are familiar with, how do you decide on pathology teaching content?

Q6. Some students are struggling with studying basic underlying pathologic changes for clinical presentations or imaging features. What do you think we should do about this?

Q7. Glomerulonephritis is not closely related to Medical Imaging, but understanding basic pathologic changes in glomerulonephritis is essential for a better overall understanding of kidney conditions. Should it be included in the pathology teaching to MI students?