Both clinical and academic pathology are becoming increasingly interdisciplinary in nature. Discuss.

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# Introduction

In any field of medicine, there is no hiding the trend to specialise. In hospitals, general internal medicine is in decline1, and there is an increasing number of subspecialties in all branches of medicine. Even for ophthalmologists, who are already dealing with just two 7.5 grams of tissue, subspecialisation is the norm. Of course, when you’re working with delicate cataract surgery, the reason for subspecialisation is laudable. We all want what is best for our patients; with subspecialisation comes practice, and even 5-year-old Johnny knows that practice makes perfect.

Gone now are the generalist days where one pathologist will carry out everything in a hospital, at least in well-resourced settings such as the NHS2 (well-resourced in the grand scheme of things). Even President of the Royal College of Pathologists, Dr Suzy Lishman, said in the recent Pathology Summer School for Medical Students held in Oxford that she was eager to find out what her other colleagues do, as the consultant cellular pathologist does not handle clinical biochemistry, haematology, or microbiology cases.

For this reason, one can be forgiven for believing that pathology is headed towards the same death that general internal medicine faces – sliced into a multitude of subspecialties. However, it is clear that this is not the case. With increasing subspecialism in pathology comes a greater need for interdisciplinary education, training, and practice. The all-too-cliché phrase says that we must stand on the shoulders of giants, but if we are to provide comprehensive, evidence-based practice, we must not only stand on the shoulders of giants, but stand with them, and this, I believe, is the essence of interdisciplinary pathology.

Professor Phil Quirke once said that pathology is in the business of providing information3. It can only thrive in the future if it remains the best way of doing just that. Thus, with every advance in the mathematical, computational, physical, engineering, and life sciences, pathology must be able to cross these academic boundaries. It must become innovative and use an increasingly large toolbox that spans across several domains.

# The Academic’s Role in Expanding the Pathology Toolbox

Academic pathology expands this toolbox in three ways. First, due to subspecialism, research needs to be interdisciplinary and to take into account other fields. For example, a histopathologist can no longer ignore infectious diseases when understanding the causes of cancer. Even ignoring the wackiest of newspaper headlines4, certain viruses5, bacteria6, and parasites7 are implicated in cancer pathogenesis.

An interdisciplinary approach to pathology research, however, does not just entail a subspecialty crossover. Pathologists at Drexel University in Philadelphia worked with engineers to show that computational methods on histology images can be used to develop classifications of tumours, by accurately measuring the density of cell nuclei with open chromatin and other variables8. While density can be eyeballed for diagnostic purposes, a quantitative approach allows research to progress by enabling statistical analysis, and to contribute to bioinformatics, which may later be used to show associations between the tumour classification and clinically important considerations, such as prognosis. Thus, it is important for research laboratories to become interdisciplinary, to engage nonclinical scientists with clinical questions. For example, the Department of Oncology at the University of Oxford is keen to recruit graduates from a wide range of scientific backgrounds, including mathematics, the physical sciences, and engineering9.

Conversely, it is a truth universally acknowledged, that a basic scientist in possession of a grant application form, must be in want of a clinical question to answer. Israeli physicists at Ben Gurion University showed that Fourier-transform infrared microspectroscopy (FTIR) could be used to differentiate between adenomatous polyp and malignant cells10. Academics will need to gain an understanding of such techniques in order to compare the FTIR method with ‘the pathological method’.

Both of the above examples exemplify the need for multidisciplinary journal clubs and interdisciplinary conferences such as the NCRI Cancer Conference11, which brings together researchers from technology, epidemiology, health services, and biomedical backgrounds. Indeed, the NCRI Cancer Conference brings in the critical patient perspective in deciding research priorities. If that’s not a good example of interdisciplinary research, nothing else is.

Academic pathologists also spend time in teaching and managerial positions12. Pathology teaching is increasingly becoming interdisciplinary due to the rise of educational technologies13-14, such as massive open online courses (MOOCs), video broadcasting, digital slides, and electronic student response systems. The teaching academic can no longer masquerade as a lecturer nor as a glorified demonstrator. Education research has also helped to revamp the medical school curriculum, with some medical schools having a problem-based learning or integrated curriculum approach to pathology teaching.

Management and leadership feature frequently in the life of an academic pathologist, with laboratories and departments often managed by consultants, rather than professional managers. The reasons for this are manifold, but can be distilled to the interdisciplinary nature of the mind of the managing academic. Not only do today’s leaders need to understand the subtleties of business administration, they also need to understand clinical need of individual patients and the population as a whole, as well as the all-too-necessary portioning and rationing of funding15. Funding directly impacts research, teaching activities, and the delivery and distribution of pathology services. To be able to thrive in such a field truly requires an interdisciplinary understanding of pathology and healthcare as a whole.

Academic pathologists as managers or leaders also act as representatives of the medical community, and thus push forward public engagement schemes, such as those led by Lishman, making pathology a household term all over the world for more reasons than just CSI and dead bodies. Of course, this isn’t just for pride and recognition; the ability for pathology to gain funding through charities, patient groups, and policymakers is vital for its own progress.

Figure 1 summarises the interactions and mechanisms discussed above and shows the relationship between academic and clinical pathology.



**Figure 1** The interactions and mechanisms that contribute to the interdisciplinary nature of academic and clinical pathology

# The Clinician’s Use of the Pathology Toolbox

Meanwhile, in clinical pathology, there is a latency period, during which research and theory mature, incubating in laboratories, before their eventual release as policy and practice. Thus, the development of an interdisciplinary practice in clinical pathology is somewhat rate-limited by the advances in and funding of academic pathology.

For example, a non-academic forensic pathologist interested in a non-invasive form of autopsy needs to acquire an understanding in scanning and imaging techniques to apply it in clinical practice. Only until the academic pathologists, radiologists, and technologists have developed the technique of the virtual autopsy or ‘virtopsy’16-21 can the clinical pathologist be able to learn and apply such techniques.

Similarly, the practice of pathology has since evolved from a field viewing stained tissues and cells to exploring the genetic, epigenetic, and molecular mechanisms of disease. Thus, it is not just the academic pathologist who needs an interdisciplinary understanding of the basic sciences. Clinicians will need to have been taught from the onset – from medical school and perhaps even before – the importance of physics, engineering, chemistry, and allied sciences to pathology.

This understanding does not just benefit pathology practice; it also ensures value-oriented delivery of pathology services through intelligent commissioning and requesting22 of diagnostic and screening services. Furthermore, an alliance between pathologists can information technology experts can ensure that test results, workforce and performance data, and local and national epidemiological information are delivered to appropriate individuals in a secure and timely manner. Such an alliance will increase value-oriented delivery by increasing inefficiency within the system.

Finally, I believe that the clinical pathologist’s job is made interdisciplinary by public engagement. Two guidelines from the General Medical Council’s ‘Good medical practice’23 succinctly summarises the importance of public engagement:

“When advertising your services, you must make sure the information you publish is factual and can be checked, and does not exploit patients’ vulnerability or lack of medical knowledge.”

and

“You must work in partnership with patients, sharing with them the information they will need to make decisions about their care, including:

1. their condition, its likely progression and the options for treatment, including associated risks and uncertainties
2. the progress of their care, and your role and responsibilities in the team
3. who is responsible for each aspect of patient care, and how information is shared within teams and among those who will be providing their care
4. any other information patients need if they are asked to agree to be involved in teaching or research.”

The pathology toolbox has several other tools that clinical pathologists use, aside from the light microscope, FNA needle, gram stain, electron microscope, and microtome24. Clinical pathologists need to have excellent clinical practice, and this is affected by research, teaching, government policy and guidelines, ethics, and public engagement. Public engagement is itself found in this toolbox, and it is a means to produce more funding and increase the recognition of pathology among the ranks of the surgeons and physicians. Finally, a pathologist must always have cost-effective and value-oriented delivery of care in mind, to cope with increasing demands on pathology service and decreasing healthcare spending and funding.

# An Interdisciplinary Future for Pathology

It is clear that the future of the academia and clinical practice of pathology lies in the medical students’ ability to comprehend vast amounts of information from a myriad of sources. In order to future-proof pathology, we need to create opportunities for budding pathologists to improve on the six essential features of an interdisciplinary career in pathology: research, teaching, management, value-oriented delivery, accepted dogma and clinical practice, and public engagement.

We need to foster an environment where students actively want to do research, either as part of medical school education, or as part of an intercalated BSc or PhD. For example, disadvantages of undertaking a formal research degree25 include the inordinate amounts of organisation and pre-planning and loss of skills through lack of clinical pathology exposure. Increased funding and places for academic pathology training pathways26 would alleviate these disadvantages. At the same time, we need to showcase role models in academic pathology and promote research activities in medical school to encourage students to follow an academic career and to find their own clinical interests within pathology.

Pathology teaching needs to be interdisciplinary27 and integrative28. Medical schools should introduce pathology early in medical school curriculum to engage students with clinical issues. Ultimately, the future of pathology teaching lies in teachers using innovative ways of teaching that is informed by education research, such as the use of educational technologies like MOOCs and digital slides as well as apprenticeship activities like grand rounds and interdisciplinary journal clubs.

Courses in the management of health services or pathology laboratories should be offered as part of intercalated degrees or student selected components, and will contribute to better recruitment of academic pathologists. These courses should include future concerns within the NHS such as those laid out in the Five Year Forward View, like workforce planning and operational efficiency. Such courses will improve the value provided by pathologists. However, as Dave Branford, chair of the English Pharmacy Board at the Royal Pharmaceutical Society said, “Whatever the financial cost of mistakes we must never forget the real and lasting impact that a serious patient safety incident has on all of those involved.” For this reason, we must also focus on bolstering medical students and trainees’ ethically informed and evidence-based clinical practice.

Finally, as the icing on top, plenty of public engagement activities where medical students and trainees can become involved with informing the public, future medical students, the government, and policymakers will ensure that pathology remains in the spotlight as an important and integral branch of medicine.

With the above six features firmly future-proofed, I envisage a future in pathology where patients drive decision-making, where there is little variation in the delivery of pathology services, and clinical practice is personalised to each patient. The next century is an exciting one for pathology and I certainly look forward to entering medicine with these future prospects for pathology.

# Conclusion

Except perhaps for general practitioners, who still have to maintain their understanding of all aspects of health and wellbeing, all doctors are compelled to subspecialise. But subspecialisation and interdisciplinarity are not mutually exclusive. In fact, both are mutually dependent on each other.

Head and neck surgeon Dr. Quyen Nguyen said about science in a TEDMED talk, “Our society loves to romanticise the idea of the single, solo inventor who, working late in the lab one night, makes an earth-shaking discovery, and voila, overnight everything's changed. That’s a very appealing picture; however, it’s just not true. Medicine today is a team sport. Successful innovation is not a single breakthrough. It is not a sprint. It is not an event for the solo runner. Successful innovation is a team sport, it’s a relay race.”

In no other specialty does this statement ring more true than in pathology.

At least, speaking from a privileged, Eurocentric view, gone now are the days of the lone pathologist in the hospital running from autopsy, to sputum sample, to cancer biopsy, to vials of blood. As demand for pathology services and increasingly specialised doctors rise, are we ushering ourselves into an era that will see the formation of the Royal College of Paediatric Dermatooncopathologists? No, even 5-year-old Johnny knows that FRCPDOPath is too many letters after your name.

Of course, as it lies on the frontiers of human knowledge, academic pathology will certainly become more quickly interdisciplinary than clinical pathology will. However, what is heartening is that clinical pathology underpins medicine, as the ‘lead provider of information’ to medical services3. Due to pathologists’ interdisciplinary training, the NHS simply cannot do away with pathology; we provide value for money. With all the expertise offered by technicians, biomedical scientists, and even ‘professional managers’, medics are irreplaceable – for the simple reason that we do not only stand on the shoulders of giants, but we stand with them.

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