The Royal College of Pathologists
Pathology: the science behind the cure

The neuropathology workforce: challenges and solutions

A Meeting Pathology Demand briefing

Introduction

As part of the Royal College of Pathologists' (RCPath) Meeting Pathology Demand series, we collaborated with the British Neuropathological Society (BNS) to carry out a survey of the neuropathology workforce. The intention of the survey was to help determine whether there is the right number of staff with the right skills in the right places to ensure safe and effective high-quality patient care and support. Like many pathologists, neuropathologists have a role in the direct management and treatment of patients as well interpreting data derived from diagnostic tests and establishing neuropathological diagnoses.

This report contains the findings of the survey, open between May and December 2021, which was designed to be completed by one individual for each neuropathological centre in the UK by the service lead for neuropathology. The results of the survey highlight the challenges facing neuropathology. We have made recommendations for solutions to those challenges and set out the commitments the College is making to help alleviate the problems facing neuropathologists.

What is diagnostic neuropathology?

The specialty of diagnostic neuropathology (DN) covers the study of diseases in the central (brain and spinal cord) and peripheral nervous systems, and skeletal muscle. In some centres, it also covers ophthalmic specimens. These tissues are sampled through surgical resections or biopsies to remove a space-occupying lesion, or solely establish tissue diagnoses that will guide the management of patients with disorders of these organ systems. DN also covers the cytological examination of cerebrospinal fluid.

The number of patients wishing to donate their brains for research after death (or donating their brain tissue specimens following surgery) is steadily increasing. Alongside the diagnostic work, some neuropathologists may play a vital role in diagnosing, collecting and storing these samples in ‘tissue banks’ or ‘tissue resources’ (or interchangeably, tissue collections). The samples may be studied by neuropathologists to support research into diseases of the nervous or musculoskeletal systems.

Who are neuropathologists?

Neuropathologists are medically qualified doctors responsible for the diagnosis and assessment of disorders of the nervous system, diseases of tissues adjacent to the brain and spinal cord, and neuromuscular diseases using histopathological methods to analyse tissue. Additionally, and depending on local arrangements, in some centres, neuropathologists are also responsible for the diagnosis of disorders of other organs. This is reflected in Tissue pathways for non-neoplastic neuropathology specimens, published by the College.

The central nervous system and its diseases are still a long way from being completely understood. Neuropathologists provide tissue-based diagnoses for diseases of the brain, spinal cord, nerve, muscle and pituitary gland, from in-life biopsies or surgical resections. They also investigate causes of death via post mortems. They contribute to undergraduate and postgraduate medical education and to neuroscience research.

DN is a highly specialised discipline and some of the conditions dealt with are rare. Most diagnostic neuropathologists are based in regional neuroscience centres where they work closely with clinical colleagues including, but not limited to, neurology, neurosurgery,

neuroradiology, oncology, radiotherapy, and other specialty areas such as rheumatology, ophthalmology, endocrinology and haematology.

The range of clinical practice varies between centres depending on the local needs and specialist services. In some centres, for example, neuropathologists may be involved in diagnosing ophthalmic (eye) diseases, in forensic neuropathology and in paediatric neuropathology. Owing to the highly specialised nature of the work and the rarity of some diseases, case referral is important, including to national centres.

The impact on patients

Neuropathological diagnosis, which often incorporates findings from molecular testing, is essential to the planning of treatment for a range of neurological diseases. Much of the work is time-sensitive because of the impact these diseases have on individuals and, in the case of brain tumours, the poor prognosis for many patients. This is also an important issue for other disorders, such as inflammatory diseases, where prompt treatment may be required to prevent clinical deterioration. Increasingly detailed tissue analysis, utilising newer methods as they become validated, allows for more precise, pathobiologically meaningful diagnoses and better prognostication and patient stratification so that the treatment can be tailored to the individual patient.

The speed at which patients receive their first treatment can have a positive effect on their clinical outcome. Oncologists, for example, rely on neuropathologists to diagnose tumours so they can prepare treatment plans for patients. It is important that patients with oncological diseases are treated promptly. Other disorders may have a genetic basis and there are implications for counselling as well as management.

Working methods

Neuropathological investigation uses histopathological methods common to other cellular pathology disciplines. This may, on occasion, include the gross anatomic assessment of pathology, and almost always microscopical analysis using light microscopy and sometimes electron microscopy. Microscopical analysis uses conventional stained sections (typically H&E) and can include extensive immunohistochemical investigation. Microscopy is nowadays often supplemented by molecular investigation, which is increasingly important for diagnosis, prognosis and the prediction required for

personalised medicine. In recent years, neuropathologists have therefore developed a knowledge of molecular pathology in addition to morphology and the understanding to be able to integrate molecular with morphological and clinical information to reach an integrated diagnosis.

Neuropathologists are core members of formal multidisciplinary teams (MDTs). They provide key diagnoses and prognostic oncological information that are central to treatment planning and to the timeliness of treatment. They also attend informal meetings for non-oncological disorders such as neuromuscular disease. Some neuropathologists provide networked services, and digital pathology can facilitate such networks and could also be used for discussion of rare and difficult cases between different centres of expertise.

Autopsy services for neuropathological diseases are provided for both hospital-consented cases and for coronial cases. Currently, there is only a small pool of individuals who have time allocated to perform this complex type of work. Coronial autopsies are not part of the NHS job plans, and usually are not part of most individuals' contract, therefore it may be difficult to get time allocated to perform such types of autopsies. Neuropathologists may carry out full or central nervous system-only autopsies, or analysis based on referred post-mortem brains or tissue samples.

Brain tumours

Brain tumours are a significant cause of mortality and morbidity in the UK. Their prevalence increases with age; however, they are a disproportionate cause of death in younger individuals. After suicide, brain tumours are the major cause of death in men aged under 40 years and they are a leading cause of cancer death in children.

Diagnosis of brain tumours is time-sensitive and can be complex. The 'two-week wait' supports early diagnosis, which is important for improving survival. It is important that patients with potential cancer symptoms are referred promptly by their GP. Any delays in establishing a diagnosis causes patients to wait, increasing clinical deterioration and patient (and, for children, parental) anxiety. The time taken to achieve complex neuropathological diagnosis will be an important consideration in achieving potential new NHS targets for turnaround times for treatment of brain cancers.

Brain tumour classification can be complex, as there are many different types of tumours. While the introduction of increasingly detailed and technically advanced molecular

investigations has become a major component in brain tumour diagnostics, this has increased the number and complexity of tests required for some tumour types to achieve a full, integrated diagnosis. Consequently, this increases the time taken to reach a diagnosis.

Since the 2016 update of the WHO brain tumour classification, and increasingly so in the 2021 central nervous system WHO classification (5th edition; accessed March 2023), molecular tests have been incorporated into the definition of many brain tumour types and are now central to diagnosis. Neuropathologists may therefore produce an initial diagnostic opinion and then a final report that integrates the often-complex molecular findings. Such molecular data may be obtained from various modalities of molecular testing, including different sequencing techniques (increasingly), cytogenetic analysis (e.g. fluorescence in situ hybridisation; decreasingly) and DNA methylation analysis (increasingly). This may also mean that cases are discussed not only once, but often twice or more at the MDT.

This represents a trend towards an increasing complexity of diagnostic procedures to establish a final, integrated diagnosis. It is expected that this trend will continue in the future. Thus, neuropathologists have an increasing responsibility to communicate these results and discuss the clinical implications to the MDT. A higher proportion of paediatric tumours require a full molecular workup than is necessary for adult tumours. Many neuropathologists need access to opinion and investigation in super-specialist national or supra-regional centres.

Most of the investigations are referred to and performed by the various NHS Genomic Laboratory Hubs (GLHs), which may be offsite. Good communication and well-established specimen transport pathways are essential. Standardisation across GLHs and their turnaround times for performing the molecular tests requested by neuropathologists is also an important facet. Importantly, the final integration of the diverse molecular test results into a final diagnosis remains the domain of diagnostic neuropathologists.

Skull base and pituitary pathology

Pathological processes involving tissues around the nervous system, including meninges and skull, impinge on the brain and fall within neurosurgical and therefore DN practice. Meningiomas form a large part of the tumour workload. Since the publication of algorithms

to predict the recurrence risk of meningiomas, there is an increasing demand for methylation profiling and copy number assays of meningiomas. This further increases the molecular pathology workload. In addition, although an endocrine organ, pathology of the pituitary gland is dealt with by neurosurgeons in neuroscience centres and forms part of DN practice. Therefore, neuropathologists may also be members of skull base and pituitary MDTs, depending on local needs.

Non-neoplastic biopsy pathology

In addition to tumours, a variety of non-neoplastic disorders may require neuropathological assessment. The diagnosis of disorders such as cerebral vasculitis is also time-sensitive because of the clinical urgency of these cases.

Neuromuscular pathology

This highly specialised area requires non-standard technical methods (i.e. the specimen preparation and processing does not always seamlessly integrate into a routine histopathology operation). These methods include enzyme histochemistry (nowadays increasingly replaced by highly specific immunohistochemical stains), resin preparations, teased fibre work and electron microscopy. This necessitates biomedical scientists with the ability to perform these specialist methods. Analysis of muscle pathology for the genetic muscular dystrophies is often not time-sensitive; however, the workup can be complex and the findings are important for patient counselling in both adults and children. Because of the rarity of these disorders, following an initial diagnostic evaluation and report, reserved tissue may need to be referred to a national reference centre. Some forms of neuromuscular pathology, particularly inflammatory processes, may be clinically urgent and diagnostic delay may result in poorer functional outcome.

Autopsy neuropathology

Neuropathologists provide a national autopsy service to coroners as formal neuropathology may be required to establish a cause of death or determine circumstances around a death. The range of possible pathologies is broad and there may be various issues including medicolegal and health and safety issues. Neuropathology may be required for road traffic accident cases and for head injuries and, in some cases, neuropathologists may be working with forensic pathologists. Cases such as sudden death in epilepsy require neuropathology to exclude another cause of death.

Creutzfeldt-Jakob disease (CJD) and meningitis are public health issues that require input from neuropathologists. Examination of patients with suspected CJD requires dedicated post-mortem facilities with specifically trained mortuary staff. In cases of death after medical intervention, neuropathology may be required to clarify the effects of treatment. In some neurodegenerative cases, such as dementia, a definitive pathological diagnosis with detailed assessment of the pathological features within the central nervous system is currently only possible after death. In hospital cases, an autopsy may provide additional information for relatives as well as for clinicians.

Research

Neuropathology is a heavily research-oriented field, and many neuropathologists are in joint academic and NHS contracts (see workforce analysis). Neuropathology has made major contributions to the classification of diseases of the brain, to mechanistic understanding and in translational research to develop new diagnostic tools. Such research can lead to new developments and improve the lives of patients. Advances, such as the identification and description of variant CJD, have had major epidemiological and public health impacts.

Some neuropathologists are active researchers, obtaining competitive research grants and leading research groups. Neuropathologists also make a much broader contribution to research by providing collaborative expertise and tissue to basic research. Therefore, neuropathologists are integral to the brain tissue banks in the UK, which include disorders such as neurodegenerative diseases and multiple sclerosis. Biopsy tissue is also available to researchers through neuropathologist-led initiatives such as Brain UK.

Neuropathologists can be involved in clinical trials as part of central review panels, and often contribute to the design of the pathology aspects of such trials. This has been important in trials for new treatments in brain tumours and in identifying better tumour markers.

Results of the RCPath workforce survey and annual workload survey of the BNS

The RCPath workforce survey was open between 20 May and 31 December 2021 and was designed to be completed by one individual for each neuropathological centre in the UK. The results of the survey highlight the challenges facing the specialty. Of the original 29 organisations who were sent a copy of the survey, 24 responded (83%) and 5 did not (17%).

College staff initiated a new approach to the survey; as well as offering a Word document for individuals to complete and return, they could speak to a member of staff and talk through the questions via Zoom or MS Teams, which took less than 10 minutes. The latter approach proved popular.

The survey (see Appendix A) had 25 questions. College staff and the chair of the Neuropathology Specialty Advisory Committee (SAC) analysed the results and prepared the findings for this report.

In addition to this RCPath survey, the annual workload survey of the BNS was considered for inclusion in this report. However, recent data had not been released when this report was finalised and is not included.

Findings

Workforce

There are 64 diagnostic consultants working in 24 centres in the UK. However, this equates to only 50.2 whole-time equivalent diagnostic consultants owing to a proportion of respondents having joint appointments with academic sessions (appendix B, **Figure 1**).

Neuropathology is a research active specialty. The findings indicate that the majority of consultants (54 [84%]) are involved in collaborative research. The number of consultants involved as principal investigators in research is 22 (34%). Half the consultants (32) are currently named on grants and the number of consultants involved in clinical trials is 31 (48%).

Many consultants have a higher research degree or doctorate. There is a high teaching commitment for the neuropathology workforce, with extra academic duties that include developing and delivering lectures and courses. 18 consultants are in fully or partly university-funded posts and both academic and NHS neuropathologists have research commitments.

There has been a decline in academic neuropathology posts in recent years with some university posts being lost in Glasgow, Nottingham, Kings College London and Cambridge. Sheffield established an academic neuropathology department in 2000/2001. Bristol retired an academic post in October 2021, however, there has been a personal chair there since April 2021. The decline in academic neuropathology posts may reduce the attractiveness of the specialty, its ability to research and apply new technologies, and the contribution of neuropathology and tissue availability to the UK research community.

The loss of joint NHS–academic posts leads to the establishment of fewer full-time NHS posts (i.e. maintaining the total number of NHS PA to cover diagnostic services). As a result, the appointment of a smaller number of consultants can make individual departments or services more vulnerable to retirement, relocation or absence through illness. There have been examples of closing and outsourcing of entire services owing to difficulties in recruiting or financial considerations. The benefits of joint appointments (either NHS–academic appointments or across different hospitals) include more effective management of a higher workload and greater risk mitigation, making the service more resilient to retirements, relocation and illness.

The findings indicate that 13 departments out of 24 have at least 0.5–1 academic, university-employed neuropathologist (i.e. 54%). Only 3 departments have more than 1 academic neuropathologist (range: 2–4) (Appendix B, **Figure 1**).

The age profile of the consultant workforce in neuropathology indicates a need for succession planning for existing posts. Data related to the retirement plans of 44 consultants in 20 centres were returned. The survey showed that 12 (27%) consultant neuropathologists indicated that they are due to retire within the next 1–5 years (group A in **Figure 2**), 9 (20%) due in 6–10 years' time (group B in **Figure 2**) and 23 (group C in **Figure 2**; i.e. approximately half [53%] of the workforce) were planning to retire in 11 or more years.

Trainees enter the specialty at ST3, after completing 2 years in general histopathology training and passing their FRCPath Part 1. The average time spent in neuropathology training is 3 years. There are 17 trainees currently in post. The specialty needs an extra 3–4 trainees in post annually for the next 5 years to increase the pool of consultants required to meet the workload requirements. It has been quite difficult to attract candidates to apply for trainee vacancies in this specialty. **Figure 3** illustrates the establishment of training posts in the 24 centres and highlights the difficulties in recruiting (in 2021).

Workload

The neuropathologist generally issues an initial report based on microscopical findings and immunohistochemistry, which can include mutation-specific molecular markers. Based on this, an appropriate battery of molecular tests is requested. An initial report and MDT discussion are required as patient management needs to be initiated and preliminary information needs to be given to the patient. Current turnaround times for molecular tests are not quick enough to wait for a single report.

The molecular test itself is performed by teams of clinical or biomedical scientists in a molecular laboratory and information on the range of mutations, chromosome changes, methylation profile, etc. are reported to the pathologist. Not all genetic changes are specific of a diagnosis. The neuropathologist must then consider the molecular profile, integrating this with information from the microscopy and potentially clinical information to reach a final integrated diagnosis. The final diagnosis then needs to go back to the MDT for definitive management planning. This is reflected in the much longer reports that neuropathologists now produce for tumours and the time it takes to carry out these 2 stages in the diagnosis.

To avoid lapses in discussion, a reflex relisting 3 or 4 weeks after an MDT initial discussion can be useful, to ensure an integrated diagnosis is captured. The neuropathologist is best placed to advise on the timeframe for relisting and will be responsible for presenting an integrated, complete diagnosis.

Workforce vacancies and recruitment

Survey respondents reported 9 consultant posts are currently vacant (appendix B, **Figure 3**). Over the period of the survey, 2 centres had managed to fill a consultant post. 3 other

centres were unsuccessful in appointing to consultant vacancies owing to a lack of applicants.

There are 13 vacant trainee posts – 10 centres tried to recruit to these posts; 8 had no applicants and 2 are ‘about to recruit’. Only 1 centre filled a trainee post. There could be several explanations for this. A 2021 survey of all the current neuropathology trainees conducted for the College’s SAC suggested that potential barriers to entering neuropathology may include:

- lack of exposure to neuropathology at medical school, in foundation years and early histopathology training years
- lack of understanding of the full role of neuropathologists
- timing of neuropathology placements
- time to wait for a national training number
- not wishing to relocate for training and then likely again for a consultant post in a small specialty
- having to do post mortems as a compulsory component of training.

Current trainees indicated that factors in their choice of neuropathology as a career included prior exposure to neuropathology and an existing interest in neurosciences. This survey provides useful information, however, it is limited to those who have already successfully entered training.

Networks

Some centres have merged, while other neuropathology services have been dissolved and transferred to adjacent, larger centres and are now delivering a networked service. Networking provides flexibility, resilience and better continuity of cover with usually noticeable economies of scale. For example, workload in a small centre may only justify a single neuropathologist but such single-handed departments are not sustainable, for example, during periods of leave or ill health. Furthermore, consultants benefit from being with colleagues for case discussion and maintenance of standards.

Of the 24 centres, 8 (33%) are in a network, while 16 (67%) are not. When asked if they would be interested in forming a network, 11 (69%) of the 16 were interested and 5 (31%) were not. A graphical illustration is provided in appendix B, **Figure 4**.

We have analysed the willingness of joining a network against the seniority of the consultants, to establish if those who are closer to retirement have a different attitude to network formation than those who have more years of service ahead in their career. When analysing the different age groups (A = 1–5 years, B = 6–10 years, C =11+ years to retirement) of those who are not in a network and their preparedness/willingness to form or join a network, 7 consultants were not in a network and were not interested in forming a network. Of these, 2 were in group A (28%) and 5 in group C (71%), i.e. those in group C (longest time to retirement) appear to be overrepresented. For those who are not in a network but are interested in a network (N = 22), the data does not indicate a bias towards a specific age group (A = 8 [36%; closest to retirement], B = 3 [14%] and C = 11 [50%; most distant to retirement]).

Digital pathology

Digital pathology viewed through an image management system has the potential to improve patient care and support the pathology workforce as the technology is established, developed and embedded. (Note that digital pathology is used in this document to describe the use of digital slides also referred to as whole slide images.)

Digital pathology has a role and is useful for sharing cases, referrals, etc. and may be efficient for this. At present, the technology is not widespread (30% of centres are using it for reporting; appendix B, **Figure 5**). It should be noted that digital pathology's role in primary diagnosis is still to be established. In addition, developments in technology-enhanced learning provide unique opportunities to support future training models, which will attract high-calibre trainees. For example, the Pathology Portal has been launched. The adoption of these beneficial modern technologies requires initial funding and ongoing financial support to maintain up-to-date systems.

As part of the RCPath workforce survey, the respondents were asked whether digital pathology was used in their department. Of the 24 responding centres, 15 (62.5%) centres used it, while 9 (37.5%) did not. Of these 15 centres, 7 (47% [30% of all centres]) used it for reporting, while 8 (53%) did not. In addition, 11 (73%) of the centres used it for MDTs

and/or presentations, with 1 centre using it for training. 1 centre was in transition to using it for reporting, MDTs and presentations. **Figure 5** illustrates the relationship between the availability of digital pathology and its use in a simplified illustration.

Biomedical scientists

Biomedical scientists are a vital part of the neuropathology service. Several procedures required for neuropathology, particularly for neuromuscular pathology, are highly specialised and require staff well-trained and experienced in these methods. Some of the technical work is also highly specialised, especially muscle histochemistry, nerve embedding in resin blocks and preparation of teased fibres, and the preparation of intraoperative smears. There are 101 biomedical scientists working in neuropathology across the 24 centres (appendix B, **Figure 6**). In 16 (67%) centres, these individuals were part of a histopathology department and may also be doing general histopathology work. There are no plans for consultant biomedical scientist staff in neuropathology.

What is needed?

Increased investment

More investment is required:

- to ensure there are sufficient neuropathologists in the UK, to manage the increased complexity of cases
- to provide laboratory support. This should focus primarily on local neuropathology and histopathology laboratories and ensuring that the GLHs are adequately resourced to provide the ever-expanding panels of tests that are now required in a clinically relevant timeframe. This refers to infrastructure support rather than the neuropathology workforce per se, as neuropathologists will not be able to meet expected standards if these factors are not in place.
- to increase the molecular genetics services and staffing levels. This will involve lobbying governments, workforce agencies and the National School of Healthcare sciences.
- to improve laboratory equipment and infrastructure. Liaison with accreditation bodies (UKAS in particular) is needed to scrutinise whether IT systems are fit for purpose, and to exert sufficient pressure on NHS trusts to release investment and implement changes.
- to update hospital information technology (hardware and software).

Adequately resourced molecular testing

Molecular laboratories and the clinical scientists that run them need to be adequately resourced to cope with ever-expanding test repertoires and to meet pressure on turnaround times. The latter is made up of time required for neuropathology laboratory workup, time for molecular testing where appropriate (usually referred to GLHs, which may be in a different centre or sometimes in a different city) and neuropathologist reporting time. Neuropathologists interpret the molecular findings and integrate them into the diagnosis process. It is not usual practice to finalise a diagnosis until data from molecular tests are available as the test results could radically change the diagnosis and prognosis.

Improved recruitment into training and early exposure to pathology

There is already a government initiative to increase medical student numbers and the College supports further necessary expansion. We are also seeking to influence medical students through increased exposure to (neuro-) pathology in the undergraduate curriculum. Our pathology undergraduate curriculum, promoted through the Medical Schools Council, supports a range of activities to promote neuropathology and, more broadly, pathology as a career among undergraduates as they become foundation trainees. We need to find new ways to attract trainees into the specialty, and a small increase in the number of neuropathology training posts over the next 5 years could help provide more opportunities to attract trainees.

The College will support and advocate for the expansion of medical trainee and consultant numbers in neuropathology through our work with Health Education England, the UK government and within the devolved nations. We also support specialist biomedical scientist training in neuropathology. We will engage our current neuropathology fellows and trainees and use virtual and face-to-face resources to facilitate early exposure to neuropathology for medical students, foundations doctors and histopathology trainees.

Support for the consultant workforce

Not only do the posts left vacant owing to retirement need to be filled, there also needs to be an increase in the number of consultant posts.

Work is required with universities to ensure that academic posts are preserved and increased. Academic training pathways should be available for those with a research interest, with mentoring and support to ensure that such individuals can be competitive for the fellowship schemes needed to achieve an academic career. Given the central role of brain banking nationally in neuroscience research, this is particularly important for neuropathology.

Loss of academic posts has been widespread and partly contributed to by government policy. The Lords Science and Technology Committee pointed out that the UK faces a severe shortage of doctors who work both in the NHS and at universities, threatening medical research and teaching. They stated that, in the coming years, there will be a precipitous decline of clinical academics through retirement, who cannot be replaced by a

much smaller number of younger clinical academics. The enquiry also concluded that problems with pay and pension inequality must be tackled to ensure that clinical academics are not disadvantaged if they pursue research rather than working full time as clinicians (BMJ; https://www.ft.com/content/, accessed March 2023).

DN uses highly specialised neuropathological techniques, requiring biomedical scientist staff with this specialist expertise to support the service. The College supports the recruitment and development of additional specialist biomedical scientists to assist the neuropathology services.

The College will continue to press for the implementation of a long-term UK-wide solution to the NHS pension tax issue for the benefit of patients together with the Academy of Medical Royal Colleges. We also support calls for a solution to the university pension issues that are affecting academics who are not employed by the NHS and which is impacting academic recruitment.

IT systems that are fit for purpose

Pathologists need better IT hardware and software for day-to-day work. This includes sufficiently dimensioned desktop computers and monitors, robust hospital hardware and network infrastructure with sufficient speed capability (e.g. switches and servers), modern, functional laboratory information management systems (LIMS), voice recognition support and remote working software for MDTs.

It is particularly important to facilitate communication between centres (e.g. for transferring molecular results), which is vital for patient safety as well as efficiency and turnarounds. The College appreciates the announcement of a significant investment of £120 million in LIMS/digital pathology in the 2022 financial year. This fits with the 10 NHS priorities for 2022/2023 announced in February 2022 (achieving ‘a core level of digitisation in every service across systems’). These modern systems are vital in pathology services to effectively manage requests for diagnostic tests, samples and reports. These underpin the provision of safe and accurate diagnostic results on which to base guidance for treatment and plan further investigations.

The major challenge in achieving a noticeable improvement in the foreseeable future, despite planned investments, is a highly fragmented landscape of LIMS, patient

information systems, potentially digital pathology reporting systems, laboratory workflow management systems and their often expensive and convoluted integration via interfaces. Sometimes integration is not possible at all. This fragmented landscape is often the result of a neglected or failed trust IT strategy, aggravated by a lack of investment over decades, and laborious decision-making and approval processes.

Appendix A

RCPath survey of the neuropathology workforce 2021

Introduction

The Royal College of Pathologists and the British Neuropathological Society are working together to gather accurate data on the current state of the workforce in neuropathology. With the impact of the SARS-CoV-2 pandemic, it is particularly critical at this time to have such data to hand to plan provision for the future and to lobby for appropriate increases in numbers of training posts.

This short questionnaire should take less than 15 minutes to complete.

No personal data will be included in any reports. We draw your attention to the RCPath Privacy Policy, to which we adhere.

Survey

Contact details of person completing the survey (to ensure we do not double count or unintentionally misunderstand the data we receive. This information will be kept confidential.)

1. Name
2. Position
3. Hospital/organisation.
4. Are you in a network with another centre? Yes/No
   If no, are you interested in forming a network with another centre? Yes/No
5. Do you provide neuropathology for another major centre? Yes/No

Consultant staff:

6. Number of consultants in department
7. Funding:
   Number funded by NHS.
   Number funded by university.
   Number funded by Other. Please specify:
8. Number of full-time consultants
   Number of part-time consultants

9. Number of consultants involved in collaborative research

10. Number of consultants involved as principal investigators in research.

11. Number of consultants named currently on any grants.

12. Number of consultants involved in clinical trials

13. Number retiring in the next 1−5 years, 6−10 years, 11+

Predicted requirements:

14. What are your predicted requirements for additional consultants for the next 2 years?

Working practices:

15. Do you use digital pathology? Yes/No
If yes, do you use it for reporting? Yes/No
Do you use it for MDT preparation and presenting? Yes/No

Trainees:

16. Number of trainees in department

17. Do any of the trainees want to pursue an academic career? Yes/No

18. Do any of the trainees have or are doing an academic degree? Yes/No

19. Are any of them seeking training in an additional subspecialty interest, e.g., forensic neuropathology, ocular neuropathology, etc.? Yes/No
If yes, how many?

Vacant posts:

20. Number of vacant consultant posts

21. If applicable, have you tried to recruit to the consultant posts? Yes/No
If yes, what was the result of trying to recruit?

22. Number of vacant trainee posts

23. If applicable, have you tried to recruit to the trainee posts? Yes/No
If yes, what was the result of trying to recruit?

Biomedical scientist staff:

24. Number of neuropathology technicians within the department

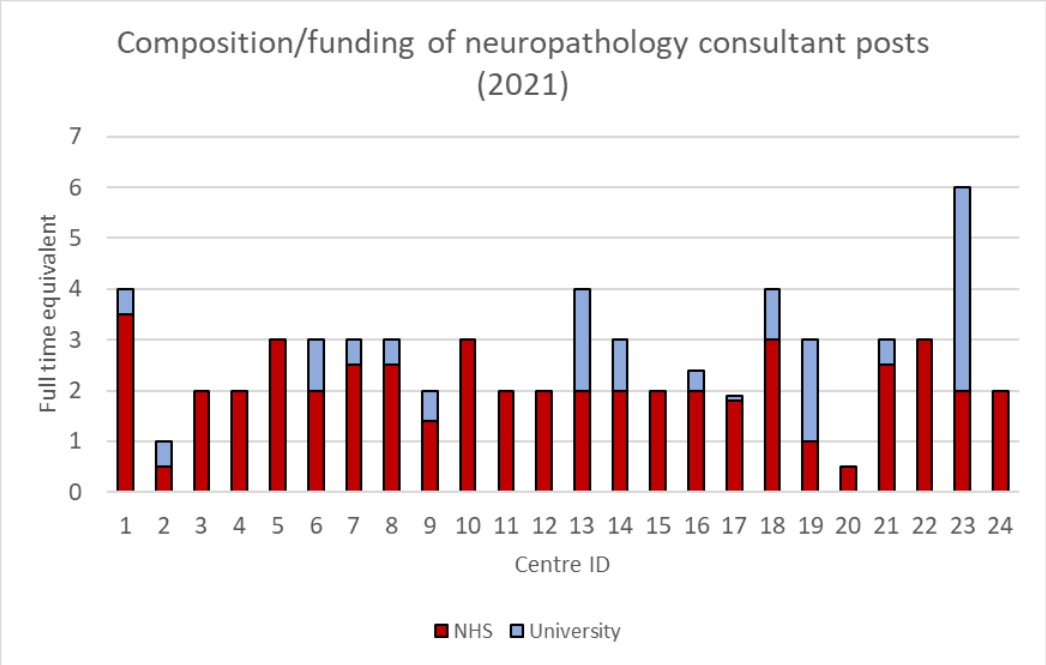
25. Do the neuropathology technicians also do general histopathology? Yes/No

Additional comments: (if wished)

Many thanks for completing this important survey.

Appendix B

Analysis of the workforce survey



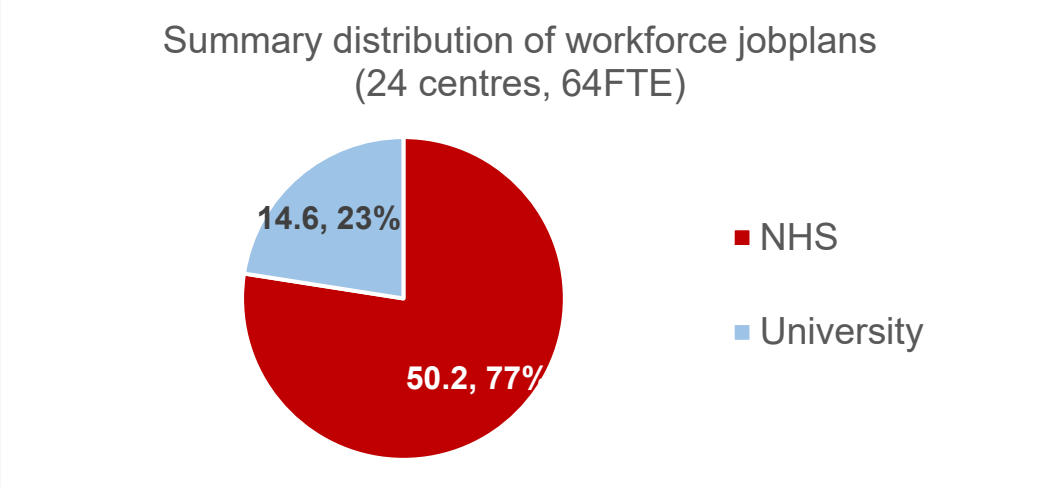


Figure 1: Funding of consultant neuropathologist posts in 24 centres.

Upper panel: funding for FTE posts displayed by individual centres, showing the proportion of NHS funding and university funding. 14 of 24 centres have consultant posts partly funded by university contribution. 10 centres have their consultant posts exclusively funded by the NHS. 4 of the centres have consultants who are funded 50% or more by university contributions (centres 2, 13, 19 and 23). Lower panel: overall distribution of

funding of the neuropathology consultant workforce (total 64 FTE). On average, approximately a quarter is university funded and three quarters are NHS funded.
FTE: Full-time equivalent.

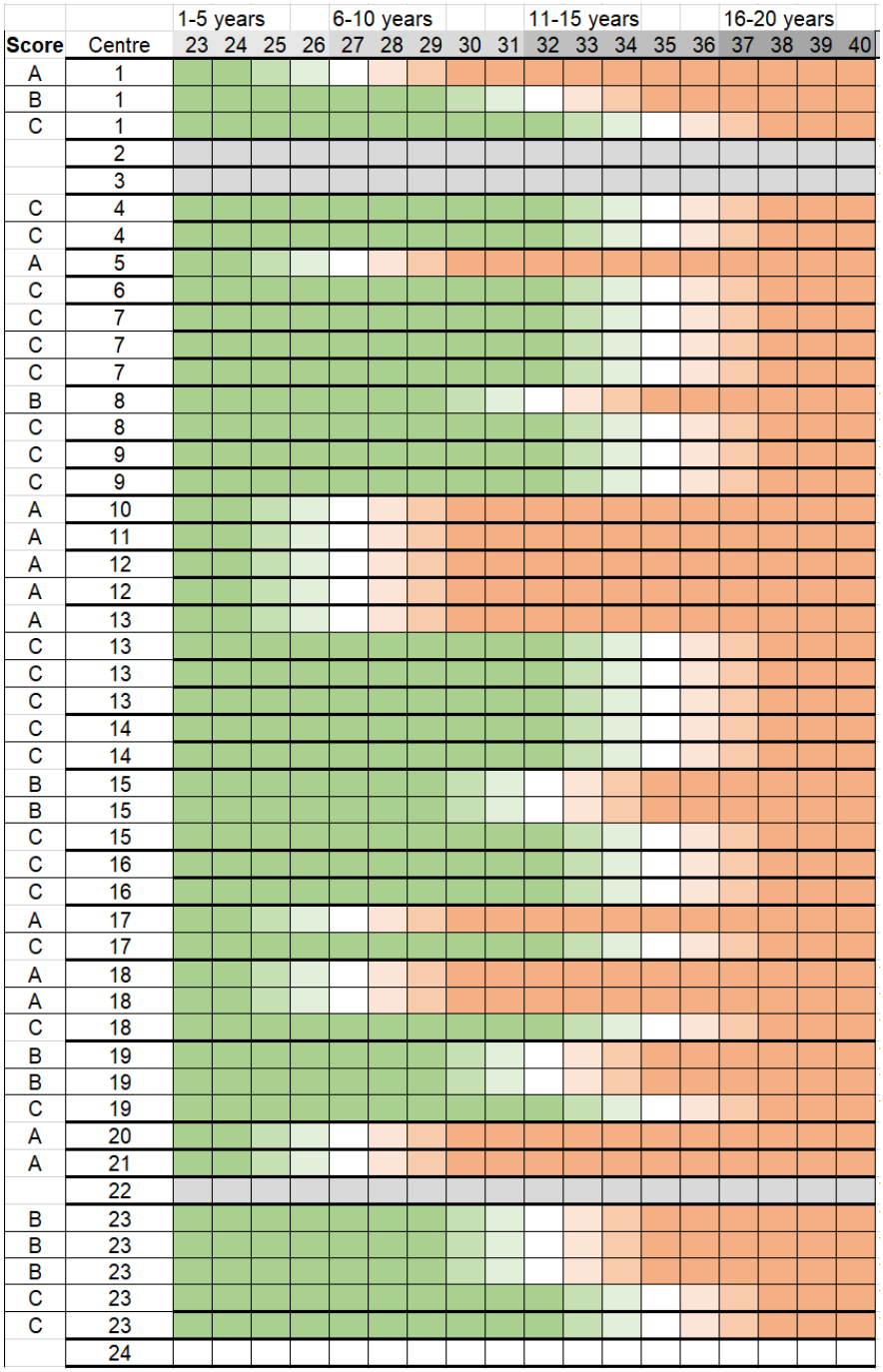


Figure 2: Workforce planning and retirement.

The retirement ranges in the survey were given as 1–5 years (score A), 6–10 years (score B) and 11+ years (score C). The schematic table shows the number of retirements per

centre and the expected time in employment until retirement in green, with shadings towards orange indicating the transition to retirement. The data obtained did not indicate how many additional staff members retire at a later stage. Data were obtained in 2021 and adjusted accordingly for the current year (2023).

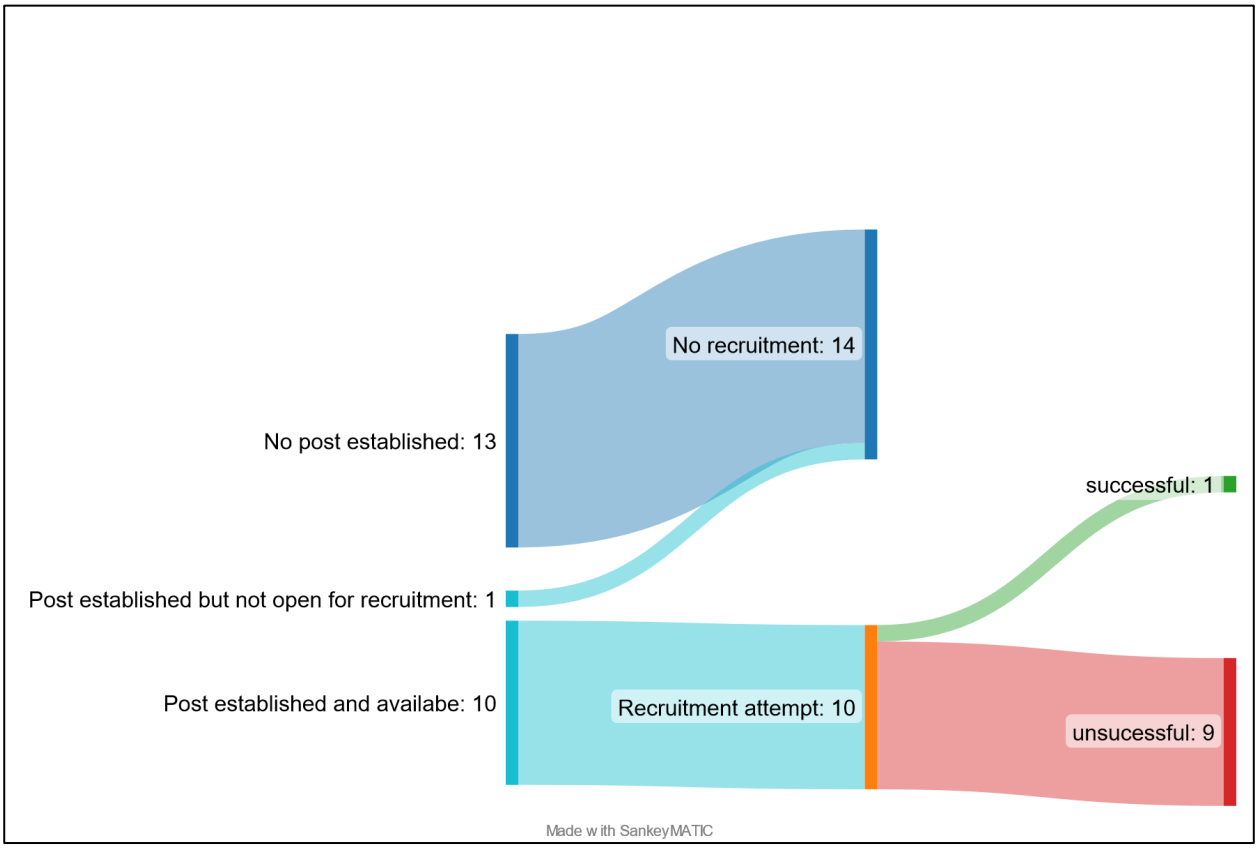


Figure 3: Recruitment and training.

24 centres returned a response. In approximately half of the centres (11), training posts are available. Of these, 10 attempted to recruit, and only 1 recruitment was successful. The remaining 13 centres had no established training post and did not attempt recruitment.

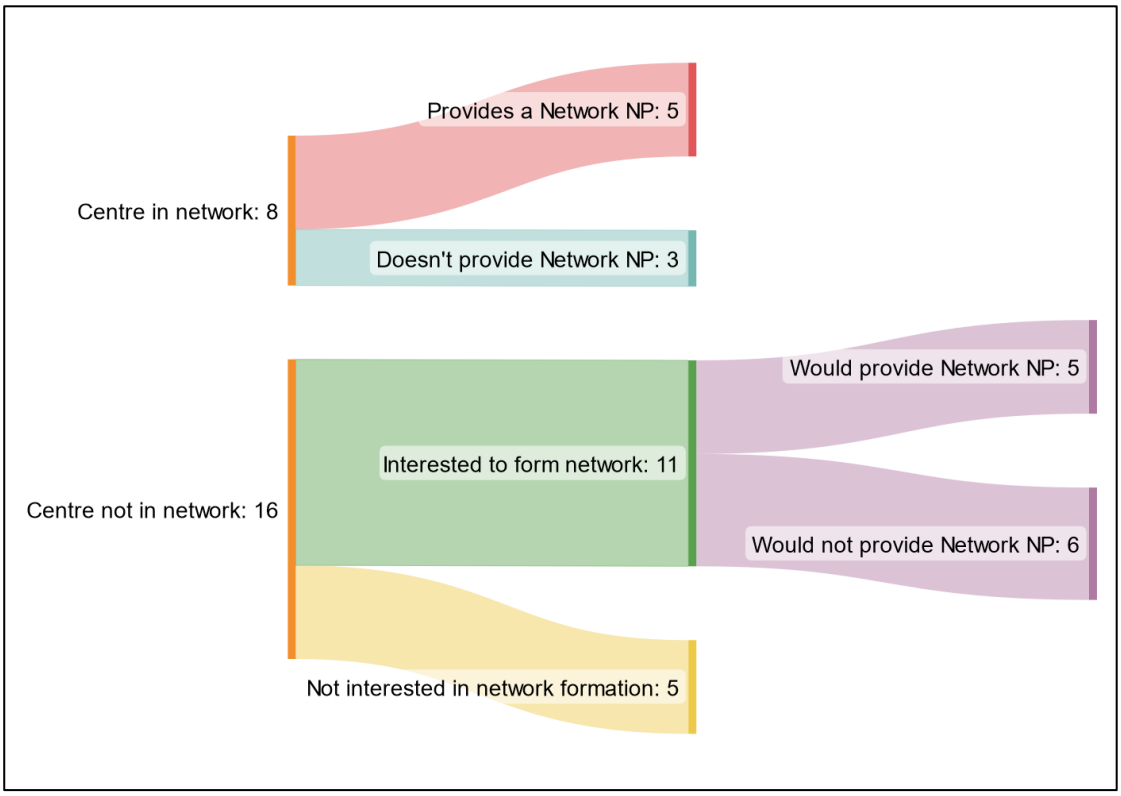


Figure 4: Analysis of the integration and provision of regional or supra-regional networking.

Only one third (8) of the 24 centres are part of a network. Of these 8, 5 provide a neuropathologist within the network, while 3 do not. The majority (two thirds [16]) are not in a network but 11 would be interested in forming a network. Approximately half of these interested centres would provide a neuropathologist and the remaining interest centres would not provide a neuropathologist. A small minority of the centres who are not in a network would not be interested in joining a network.

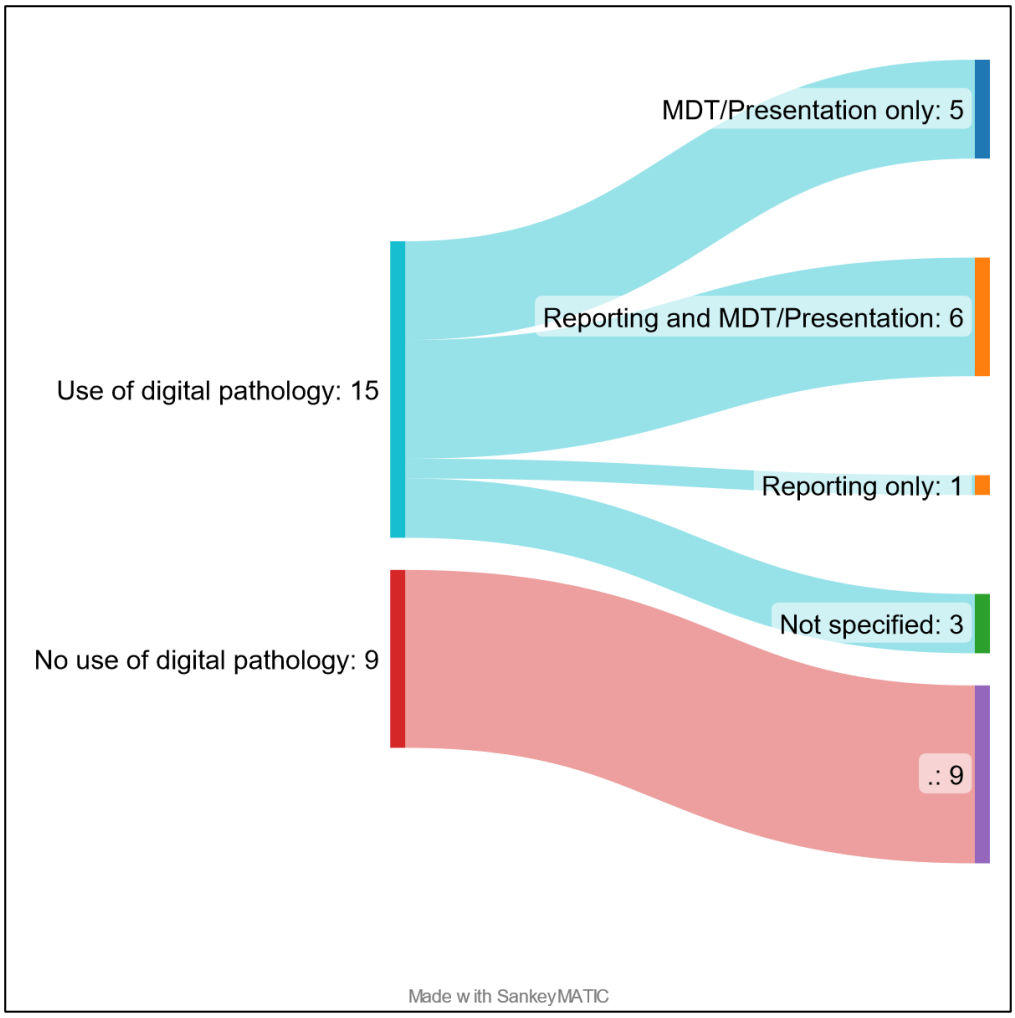
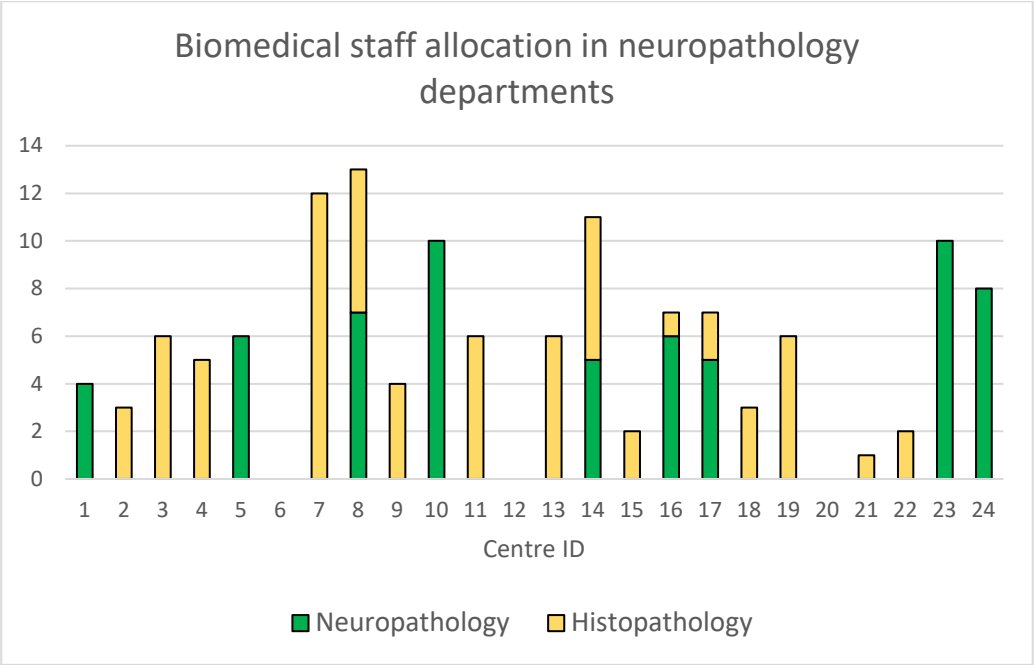


Figure 5: Use of digital pathology.

24 centres returned a response. Not all centres who responded 'yes' to the question about whether they used digital pathology specified how these systems are used (2 options were available: MDT/case presentation and diagnostic reporting). The majority of centres use digital pathology (approximately two thirds). A small minority use this infrastructure for reporting only, 3 centres did not specify how digital pathology is used, 6 use it for reporting and MDT/presentation and 5 use it for MDT presentation only (i.e. not for diagnostic reporting).



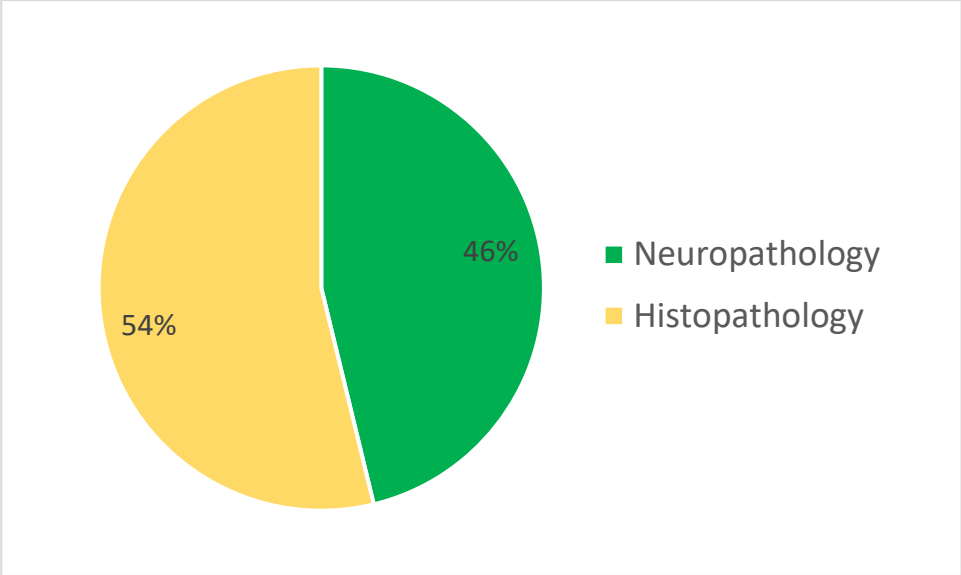


Figure 6: Biomedical staff allocation in neuropathology departments.

Upper panel: distribution of biomedical staff working within dedicated neuropathology departments (green) or neuropathology-allocated staff working within histopathology departments (yellow). There are 3 scenarios: (i) departments with exclusive allocation of neuropathology biomedical staff (centres 1, 5, 10, 23, 24); (ii) departments with a mixed model (centres 8, 14, 16 and 17); and (iii) departments where all neuropathology-allocated staff work within the histopathology department structure (centres 2, 3, 4, 7, 9, 11, 13, 15, 18, 19, 21, 22).

Lower panel: Across all departments (24 returns), there is an approximately equal distribution of biomedical staff working in dedicated neuropathology facilities (green, 46%), and biomedical staff working within a histopathology department, allocated to perform neuropathology work (54%).

Pathology: vital to patient care

Pathology is the study of disease.

Pathologists work with frontline hospital clinicians, primary care practitioners and patients to prevent, identify, treat, and monitor diseases.

Pathologists are involved in the diagnosis of disorders affecting every organ of the body, from before birth to after death.

The work of pathologists and clinical scientists is vital for effective healthcare. Most tests requested by doctors will be performed and interpreted by a clinical scientist or medically qualified pathologist.

Pathologists carry out millions of tests every day and are involved in almost all patient care pathways within the NHS.

About the Royal College of Pathologists

The College works with pathologists at every stage of their career. We set curricula, organise training and run exams, publish clinical guidelines, and provide best practice recommendations, as well provide continuing professional development.

We engage with a wide range of stakeholders to improve awareness and understanding of pathology and the vital role it plays in everybody's healthcare. Working with members, we run programmes to inspire the next generation to study science and join the profession.

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