Received: 29 July 2021 | Revised: 24 November 2022 | Accepted: 23 December 2022

DOI: 10.1002/ca.24001

EDUCATION

CLINICAL ANATOMY WILEY

A proposed anatomy syllabus for entry-level physiotherapists in the United Kingdom: A modified Delphi methodology by physiotherapists who teach anatomy

Hope Gangata[1] | Stuart Porter[2] | Neil Artz[3] | Kim Major[4]

[1]Faculty of Health and Life Sciences, University of Exeter, Exeter, UK

[2]School of Health and Society, University of Salford, Manchester, UK

[3]School of Health and Social Care, University of Gloucestershire, Gloucester, UK

[4]School of Allied Health Professions, Keele University, Keele, UK

Correspondence
Hope Gangata, Department of Clinical and Biomedical Sciences, University of Exeter Medical School, Faculty of Health and Life Sciences, St Luke's Campus, Heavitree Road, Exeter EX1 2LU, UK.
Email: hopegata@yahoo.co.uk

Abstract

The ever-increasing scope of physiotherapy practice is raising questions on what anatomical knowledge and skills ought to be taught within qualifying physiotherapy degree programmes in the United Kingdom (UK). The aim of the study was to create core anatomical knowledge and skills learning objectives to inform knowledge and skills for entry-level physiotherapists in the UK. A two phased modified Delphi methodology created a consensual anatomy curriculum. A Research-Team-Expert-Panel of four physiotherapists who teach anatomy proposed Anatomy Learning Objectives (Anat-LOs) and accompanying clinical rationales relevant for newly qualified entry-level physiotherapists. A Teacher-Expert-Panel of nine physiotherapists who taught anatomy to physiotherapy students in the UK reviewed Anat-LOs in two consecutive Delphi Rounds, and rated and commented on each Anat-LO. After each Delphi Round, the Research-Team-Expert-Panel reviewed the ratings and comments from the Teacher-Expert-Panel and banked Anat-LOs that passed the 85% acceptance threshold. There were 182 banked Anat-LOs that spanned all eight areas: Introductory Concepts, Principles and Basic Histology; Head and Neck; Thorax; Abdomen, Pelvis and Perineum; Upper Limb; Lower Limb; Spine; and Neuroanatomy regions/systems. The Anat-LOs develop both anatomical knowledge and key anatomical skills, such as palpation and conducting manual tests on model patients. A first ever core anatomy curriculum for entry-level physiotherapists has been created for entry-level physiotherapists, typically Band-5 NHS physiotherapists, and takes an integrated learning approach. The anatomy curriculum brings clarity to students, teachers, clinical supervisors and future employers on the expected anatomical standards for entry-level physiotherapists.

KEYWORDS
anatomy syllabus, entry-level physiotherapists, UK

1 | INTRODUCTION

Anatomy is a key discipline for various health professionals (McHanwell et al., 2007). Anatomical knowledge informs clinical reasoning and diagnosis, both of which can be considered as threshold concepts correlating with mastery of physiotherapy practice (Kneebone, 2009; Ma et al., 2017). Over the last three decades, anatomical teaching has suffered from ever reducing curricular time (Bergman et al., 2011; Heylings, 2002; McCrorie, 2000; Paalman, 2000), and has prompted educational anatomists to regroup and formulate minimum anatomical standards for health professional students (Leonard, 1996; McHanwell et al., 2007; Smith, Finn, Stewart, Atkinson, et al., 2016). The International Federation of Associations of Anatomists (IFAA) has initiated developments to assure the worldwide public of minimally acceptable international standards of anatomical education among medical students (Moxham et al., 2020). The IFAA hoped to prevent the development of anatomical curricular blind spots, for example, embryology (Drake et al., 2014). The IFAA has created internationally recognized core standards for medical students by creating a core list of topics (rather than Anatomy Learning Objectives [Anat-LOs]) for the thoracic region (Moxham et al., 2020), head and neck (Tubbs et al., 2014), embryology (Fakoya et al., 2017), the musculoskeletal system (Webb et al., 2019) and neuroanatomy (Moxham et al., 2015). The IFAA hopes to reconcile their core list of topics with Anat-LOs in future (Moxham et al., 2020).

Where international standards are proposed for all countries, the IFAA has taken the approach to review and potentially adopt these, but this may not fully consider local constraints and national regulatory frameworks. Consequently, Berman (2014) recommended starting with local or intranational syllabuses based on local and national contexts to build international agreements among national syllabuses later.

Health care training and provision is regulated by national regulatory bodies, which reflect important differences between countries. In the UK, there are now numerous routes into physiotherapy, including traditional and apprenticeship pathways for BSc undergraduate and MSc accelerated programmes and, more recently, professional doctorates, which have replaced the approved Postgraduate Diploma route. In contrast, USA physiotherapists enter with a minimum of a BSc Science degree followed by a Doctorate in Physiotherapy (Ambler, 2020). Given these exemplar differences, any request to create a "common standard" of universal Anat-LOs to work across countries to satisfy different national regulatory bodies (Carroll, Tracy-Bee, & McKenzie, 2021) is unlikely in the short-term, owing to differing educational frameworks, and the reluctance of national regulatory bodies to adopt similar standards. This is further compounded as neither USA (Carroll, Tracy-Bee, & McKenzie, 2021; Woodley et al., 2022) or UK regulatory bodies have agreed their own syllabuses of Anat-LOs to guide physiotherapy education (Woodley et al., 2022).

Anatomical knowledge provides part of the scaffolding that underpins clinical reasoning to inform developing clinical assessment and diagnosis (Chernikova, 2020). In addition, this knowledge informs rehabilitation prescription and progression, and contributes to the limitation of disability and disease using exercise-based methods, which characterize physiotherapists' professional scope of practice. The Anatomical Society of Great Britain and Ireland, propelled by a lack of statutory and regulatory guidance (Smith, Finn, Stewart, & McHanwell, 2016) has led the way in designing appropriate national anatomy syllabuses for the United Kingdom, and mapped the core anatomy syllabus for entry-level medical doctors (McHanwell et al., 2007; Smith, Finn, Stewart, Atkinson, et al., 2016), nurses (Connolly et al., 2018), pharmacists (Finn et al., 2018) and dentists (Matthan et al., 2020). The anatomy syllabus void still persists for physiotherapy curricula in the UK (Gangata & Vigurs, 2017), USA (APTA, 2020; Carroll, McKenzie, & Tracy-Bee, 2022; Carroll, Tracy-Bee, & McKenzie, 2021; Worthingham, 1968) and South Africa (Shead et al., 2018). The IFAA initiated compilation of musculoskeletal anatomy learning concepts for physiotherapy for a global physiotherapy audience (Carroll, Tracy-Bee, & McKenzie, 2021; IFAA, 2019; Woodley et al., 2022). These have been presented as a series of lists and phrases, rather than learning objectives, and generally does not include non-musculoskeletal anatomy (Woodley et al., 2022). Additionally, threshold pedagogical concepts for entry-level physiotherapists were suggested in the USA (Carroll, McKenzie, & Tracy-Bee, 2022).

The UK physiotherapy profession was formally launched in 1920 after the awarding of the Royal Charter to the Chartered Society of Physiotherapy (CSP) (Wicksteed, 1948) and 2020 marked its 100th anniversary (Barclay, 1994). By 1994, UK physiotherapy had upgraded to an all-graduate entry profession (Barclay, 1994). Typically, physiotherapists tend to work for the NHS upon graduation, where their first post offers broad experience across different core physiotherapy specialties. However, as the scope and knowledge of physiotherapy practice expands, it is becoming more challenging to establish what may be regarded as core anatomical knowledge and skills that physiotherapy students should learn as an undergraduate. Both anatomists and physiotherapists have been recommended to form Delphi panels of reviewers (Carroll, Tracy-Bee, & McKenzie, 2021), and those experienced in both physiotherapy focused anatomical teaching and physiotherapy clinical practice may be considered as optimally placed to develop and propose a syllabus of core Anat-LOs. A Delphi panel/s of UK physiotherapists who teach anatomy are optimally placed to best understand the relevance of anatomy, the physiotherapy undergraduate syllabuses, NHS placement learning, clinical physiotherapy practice experienced by entry-level physiotherapists and to create an informed core anatomy syllabus for UK physiotherapy students.

The aim of this Delphi method study is to use two panels of physiotherapists who teach anatomy to create a syllabus of the entire breadth of core Anat-LOs covering both knowledge and skills for entry-level physiotherapists in the UK. A "syllabus" is a student facing document, while a "curriculum" is the totality of what is taught and is teacher facing (Berman, 2014). First, the created document is intended for use by physiotherapy students to know what is expected as they start work as entry-level physiotherapists to enable ownership of their learning destination. Second, it aids the teaching destination for anatomy teachers for physiotherapy and clinical supervisors for students during physiotherapy placements. Third, it informs employers of the expected anatomical caliber of newly qualified entry-level UK physiotherapists.

2 | MATERIALS AND METHODS

A two-phased modified Delphi methodology was used to create a consensual anatomy syllabus using two panels of physiotherapists who teach anatomy: a Research-Team-Expert-Panel (RTEP) made up of the four authors and a Teacher-Expert-Panel (TEP) of nine additional participants. It is important for Anat-LOs for physiotherapy to be peer-reviewed and vetted (Carroll, Tracy-Bee, & McKenzie, 2021). The study utilized a modified Delphi methodology where participants reviewed an initial set of Anat-LOs, in place of a pure Delphi type where participants start with blank statements (Moxham et al., 2014; Smith, Finn, Stewart, & McHanwell, 2016). The modified Delphi was used rather than the pure Delphi because it would have taken many more rounds and consumed more of the participants' time to create the final list of Anat-LOs. The modified Delphi methodology has been used by several studies (McHanwell et al., 2007; Smith, Finn, Stewart, & McHanwell, 2016). Ethical approval (Reference number ERN_17-1013) was granted by the Science, Technology, Engineering and Mathematics Ethical Review Committee of the University of Birmingham.

Brief profiles of the Research-Team-Expert-Panel are usually provided in modified Delphi methods, for example, Finn et al. (2018) and Matthan et al. (2020). The RTEP was made up of the four authors who are UK registered physiotherapists and have between nine and 30 years' experience in teaching anatomy, whose anatomy and physiotherapy credentials are described later in the "Notes on Contributors".

The RTEP compiled Anat-LOs for physiotherapy drawing from their own anatomy teaching experience. The RTEP also added the accompanying clinical rationales to the Anat-LOs to justify their inclusion, which typically included clinical situations/scenarios/cases that a newly qualified entry-level physiotherapist would encounter, and facilitate the sought after transfer of anatomy knowledge for basic physiotherapy training for all clinical specialties (Carroll, Tracy-Bee, & McKenzie, 2021). The Anat-LOs covered "Introductory Anatomical Concepts, Principles and Basic Histology" and seven anatomical regions/systems: Head & Neck, Thorax, Abdomen-Pelvis-Perineum, Upper Limb, Lower Limb, Spine and Neuroanatomy.

There was a discussion among the RTEP regarding the level of detail of Anat-LOs and it was decided that the Anat-LOs should not be too prescriptive, but should be informative enough for the students and faculty. The intention is to provide institutions with sufficient flexibility to utilize local strengths and offer the teacher the opportunity to use their teaching expertise (Berman, 2014). For example, a highly prescriptive Anat-LO would have listed all the bony features found on the scapula one by one and a less prescriptive strategy was used, that is, "Name & identify the bones & bony points of the shoulder complex". A less prescriptive strategy will give anatomy teachers discretion to decide which bony features the students best integrate with clinical need.

The TEP was drawn from physiotherapists who teach anatomy from 37 universities teaching the BSc Physiotherapy degree. The members of the TEP were physiotherapists registered with the Health and Care Professions Council (HCPC), experienced in teaching anatomy to undergraduate physiotherapy students and currently undertaking that role. The website of the HCPC lists all 37 approved universities running approved physiotherapy training programmes in the UK (HCPC-Register, 2021), from which the names, email addresses and telephone numbers of anatomy teachers for physiotherapy were retrieved. Contact details of other key individuals, such as the course leaders and administrators of BSc and MSc Physiotherapy degree programmes were obtained to request email contact details of known anatomy teachers for physiotherapy within their departments. A second, follow-up, reminder email was sent 2 weeks later and, lastly, telephone contact was attempted after a further week or two as a last resort. Other anatomy teachers for physiotherapy known by the authors of this study were approached and added to the list. Sixty-four potential anatomy teachers for physiotherapy were identified and nine signed the consent form and completed the demographic sheet. The process of searching for potential participants and identifying the nine participants was carried out over a period of 6 months.

Regarding the profiles of the TEP, six of the nine participants were employed as lecturers and three were senior lecturers at nine different universities within the UK. All were registered chartered physiotherapists, having been qualified for between 5 and 20 years, with most holding a bachelor's degree in physiotherapy, while two had qualified with a pre-registration master's degree in physiotherapy. Five members had Fellow of the Higher Education Academy (FHEA) status, one was a Senior Fellow, one Associate Fellow and one was working towards Fellowship, while one did not answer this question. The majority of the TEP typically spent between 3 and 20 h per week teaching anatomy. Most had taught anatomy to physiotherapy students for between 4 and 6 years. Four members had taught anatomy formally in the clinical setting and all nine had assessed the anatomical knowledge of physiotherapy students in clinical settings. Much of the TEP had specific interest in musculoskeletal physiotherapy with five holding postgraduate qualifications in the subject.

Other studies have asked Delphi participants to categorize anatomy content using "essential", "important", "acceptable" or "not required" categories (Fakoya et al., 2017; Smith, Finn, Stewart, Atkinson, et al., 2016; Woodley et al., 2022). Berman has questioned whether participants can be sure of the difference between "important" and "acceptable" (Berman, 2014) and called for more discrete categories. Similar concerns have been raised where anatomical structures were rated as important, but not core (Webb et al., 2019). Later papers adopted clearer categories, for nursing students (Connolly et al., 2018) and medical students (Smith, Finn, Stewart, & McHanwell, 2016) who used "accept", "reject" or "modify". Consequently, the current study asked the TEP to rate the Anat-LO created by the RTEP using "accept", "modify" and "decline" options, and added the fourth option of "unclear", to ensure clarity was achieved in all cases. The TEP was asked to rate the Anat-LOs proposed by the RTEP by rating and commenting on a Microsoft Word document and email reminders were sent after 2 and 4 weeks. Finally, a follow-up telephone call was made if no response was received.

To begin, the RTEP created the initial Anat-LO statements that were rated by the TEP during each of two Delphi Rounds. The responses from the TEP were subsequently reviewed by the RTEP who revised most of the Anat-LOs that did not achieve 85% consensus by the TEP. The typical minimum consensual standard for Delphi methodologies is 70% (Ab Latif et al., 2016; Finn et al., 2018), while

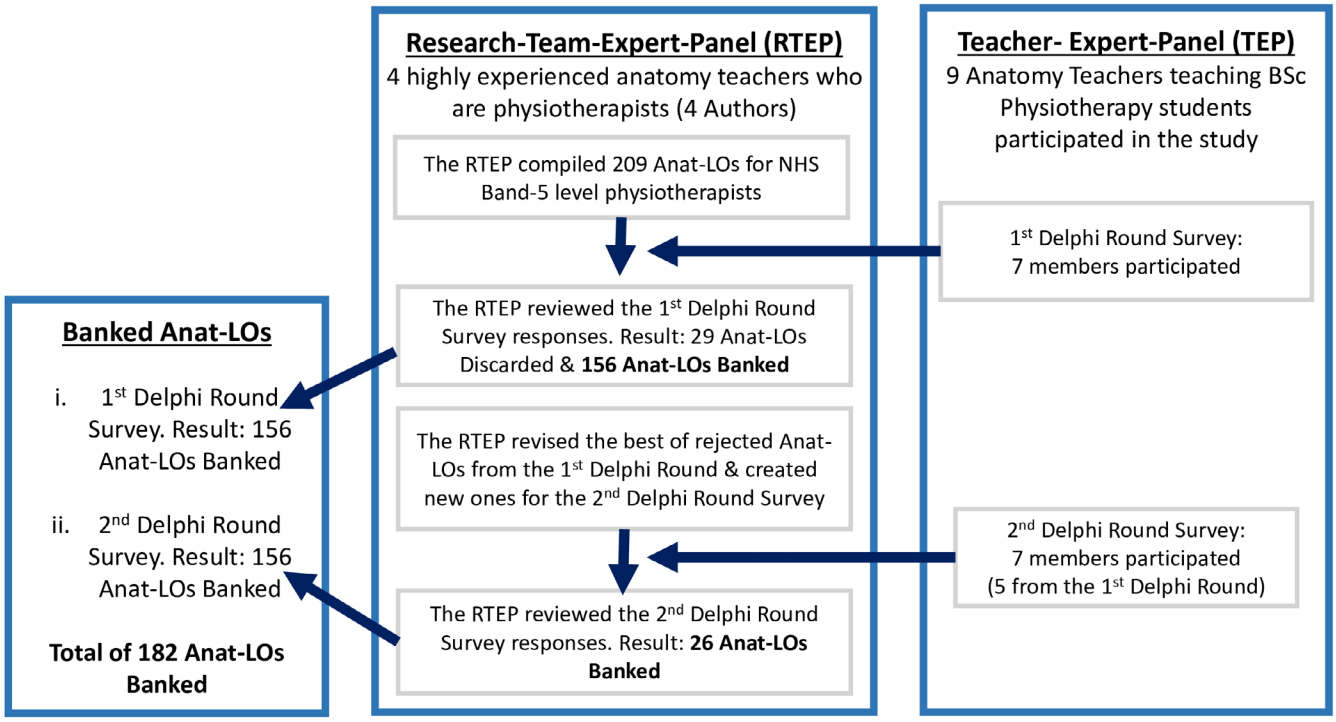

FIGURE 1 1st and 2nd Delphi reviewing stages

75% is considered a good standard to use (Keeney et al., 2011). The most common Delphi consensual rate for creating core anatomy syllabuses is typically 80% (Connolly et al., 2018; Matthan et al., 2020; McHanwell et al., 2007; Moxham et al., 2014; Smith, Finn, Stewart, Atkinson, et al., 2016). Figure 1 shows how the RTEP and TEP used two Delphi Round reviews to create 182 Anatomy Learning Objectives (Anat-LOs) for entry-level physiotherapists.

Prior to the first Delphi Round, the RTEP compiled a list of Anat-LOs and accompanying clinical rationales. During the first Delphi Round, a TEP of seven physiotherapists who taught anatomy to physiotherapy students in the UK reviewed 209 Anat-LOs created by the RTEP, and scored them as "accept", "modify", "decline" or "unclear". As soon as any email response from participants was received from each Delphi Round, the data was anonymised and prepared for review by the RTEP, and thus each participant was blinded to the responses of other participants. After the 1st Delphi Round, a column was created in the analysis sheet that contained all the summarized and anonymised comments from the seven participants of the TEP to enable the RTEP to have an overview of the responses for each Anat-LO. The summarized comments were then categorized as either relevant for the Anat-LO or the clinical rationales. The RTEP reviewed the comments from the TEP, tallied Anat-LOs and rationale scores separately and adjusted those Anat-LOs and/or rationales requiring improvement. Anat-LOs with seven or six "accepts" were banked (i.e., at least 85% consensual acceptance of the seven participants), while Anat-LOs with five to three "accepts" were either revised to be returned back to the TEP or rejected if they had a small chance of being accepted based on the depth and breadth of negative comments provided by the TEP participants. All the Anat-LOs with two or less "accepts" were rejected.

Revisions of the supporting rationales did not require the 85% threshold. A significant number of comments requesting adjustment of the rationales wished for more clinical examples, however, it was important to keep the syllabus as concise as possible. The RTEP completed other amendments as follows: the position of some Anat-LOs was adjusted within the same anatomical subsection or moved to a different subsection to enhance the logical flow of the document; some Anat-LOs were revised to improve their grammar or spelling; a few Anat-LOs were amalgamated and wording standardized for consistency of Anat-LOs across the whole syllabus. Revised Anat-LOs from the 1st Delphi Round were then returned to the TEP for rating during the 2nd Delphi Round. The 2nd Delphi Survey responses from seven participants (five from the 1st Delphi Round) were similarly reviewed by the RTEP and 26 Anat-LOs with at least 6-accepts were also banked. In both the 1st and 2nd Delphi Rounds, participants were sent an email reminder after 1 month, if there was no response.

3 | RESULTS

The Results will be described in two parts: quantitative description and then qualitative description.

3.1 | Quantitative description of the results

Figure 2 portrays the number of "accepts" in the 1st Delphi Round given by the seven participants for the 209 Anat-LOs across the

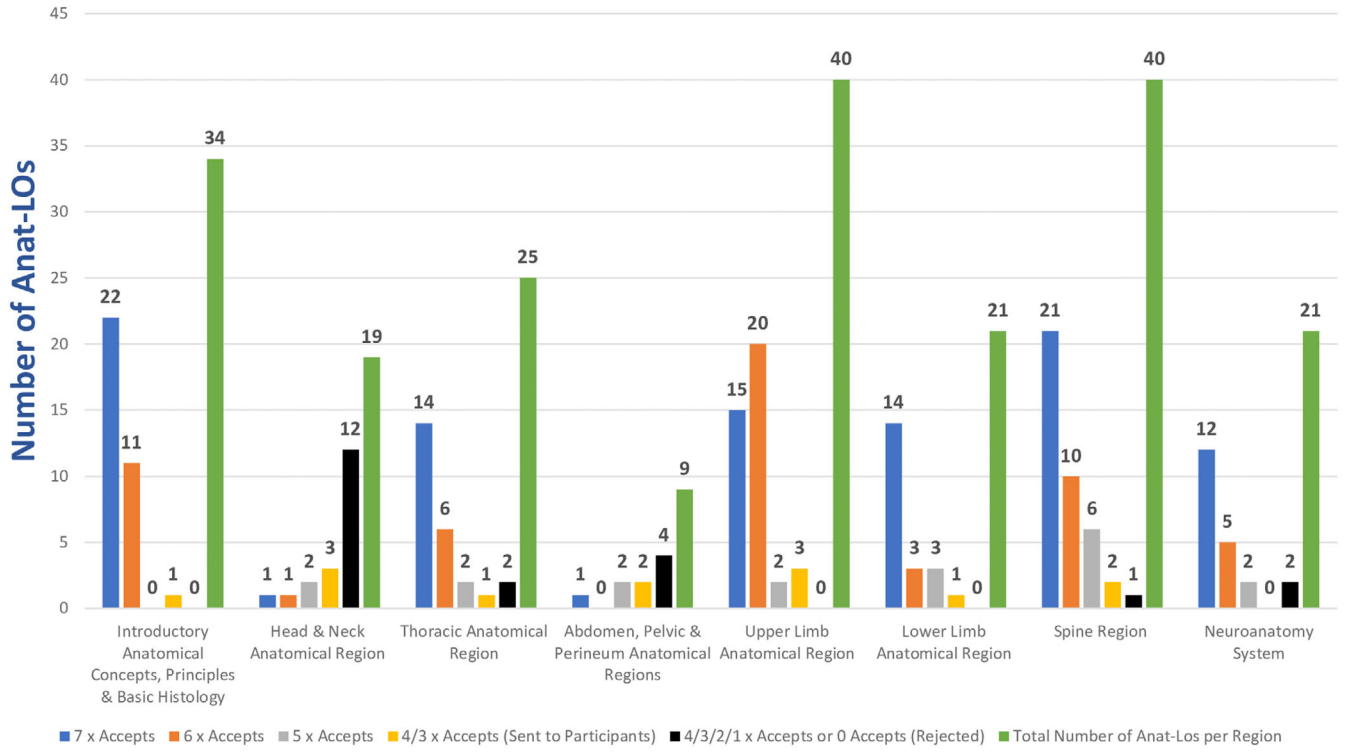

FIGURE 2 1st Delphi Round acceptance scores of Anat-LOs

"Introductory Anatomical Concepts, Principles & Basic Histology" and seven anatomical regions/systems.

The threshold for banking Anat-LOs was six and above "accepts" out of seven "accepts". The "Introductory Anatomical Concepts, Principles & Basic Histology", "Upper Limb" Region and the "Spine" Region had the highest number of bankable Anat-LOs with 33, 35, and 31 Anat-LOs respectively, in part because they had the highest Anat-LOs submitted into the 1st Delphi Round with 34, 40, and 40 Anat-LOs, achieving 97%, 88%, and 78% of each region, respectively. The "Thorax" Region, "Lower Limb" Region and the "Neuroanatomy" System had moderate numbers of bankable Anat-LOs with 20 (80%), 17 (77%), and 17 (81%) Anat-LOs respectively. The "Head and Neck" Region and "Abdomen", "Pelvis and Perineum" Regions had much lower Anat-LOs banked, with two and one Anat-LOs banked respectively (each representing 11% of their total regional Anat-LOs). The "Head and Neck" Region had the highest number of rejected Anat-LOs across all regions.

Of the 209 Anat-LOs that entered the 1st Delphi Round, the 156 Anat-LOs that attained six or seven accepts were banked and were not taken into the 2nd Delphi Round. The most promising of the 53 rejected Anat-LOs, that is, with five, four or three "accepts" were revised by the RTEP. New alternative Anat-LOs were suggested in the comments of Anat-LOs written by the TEP that were strongly declined (with fewer than three "accepts"), and the RTEP created new alternative Anat-LOs that accommodated the comments of the strongly declined Anat-LOs. The revised and newly created Anat-LOs following the 1st Round were then entered into the 2nd Delphi Round. In total, 26 Anat-LOs were banked from the 2nd Delphi Round. The "Lower Limb" and "Spine" Regions had the highest number of seven banked Anat-LOs each, which had attained seven and six "accepts", as indicated in Figure 3. Overall, only four Anat-LOs were rejected at this stage.

Figure 4 highlights all the banked Anat-LOs. "Introductory Anatomical Concepts", the "Upper Limb" and "Spine" Regions had the highest number of Anat-LOs banked with 35, 38, and 38 Anat-LOs respectively while the "Head and Neck" Region had the least, with two Anat-LOs banked. In total, 182 Anat-LOs and their accompanying clinical rationales were banked from all the eight anatomical regions/systems and are presented in Table 1.

3.2 | Qualitative description of the results

Overall, the Anat-LOs selected as most pertinent to a newly qualified entry-level physiotherapist belong to five of the 12 systems of the body: the skeletal, muscular, nervous, respiratory and cardiovascular systems. The selected Anat-LOs reflect the specialist professional knowledge that underpins entry-level clinical practice and competence, illustrated by the accompanying clinical examples. Organisationally, this knowledge is preceded by Anat-LOs to promote understanding of relevant principles and terminology to facilitate interpretation and application of anatomical knowledge. There are Anat-LOs that guide the understanding of micro-anatomy, where cellular and molecular level anatomy contributes to understanding of physiological and pathological processes. Subsequently, the Anat-LOs that focus on gross or macro-anatomy are organized and presented

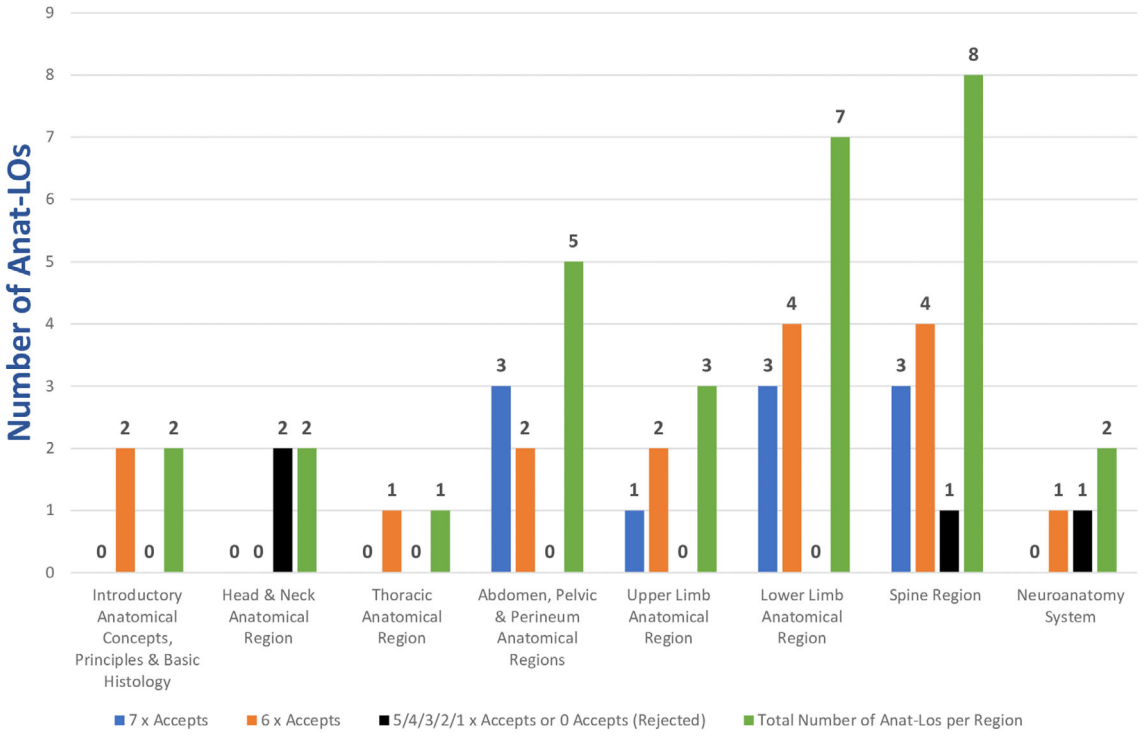

FIGURE 3 2nd Delphi Round acceptance scores of Anat-LOs

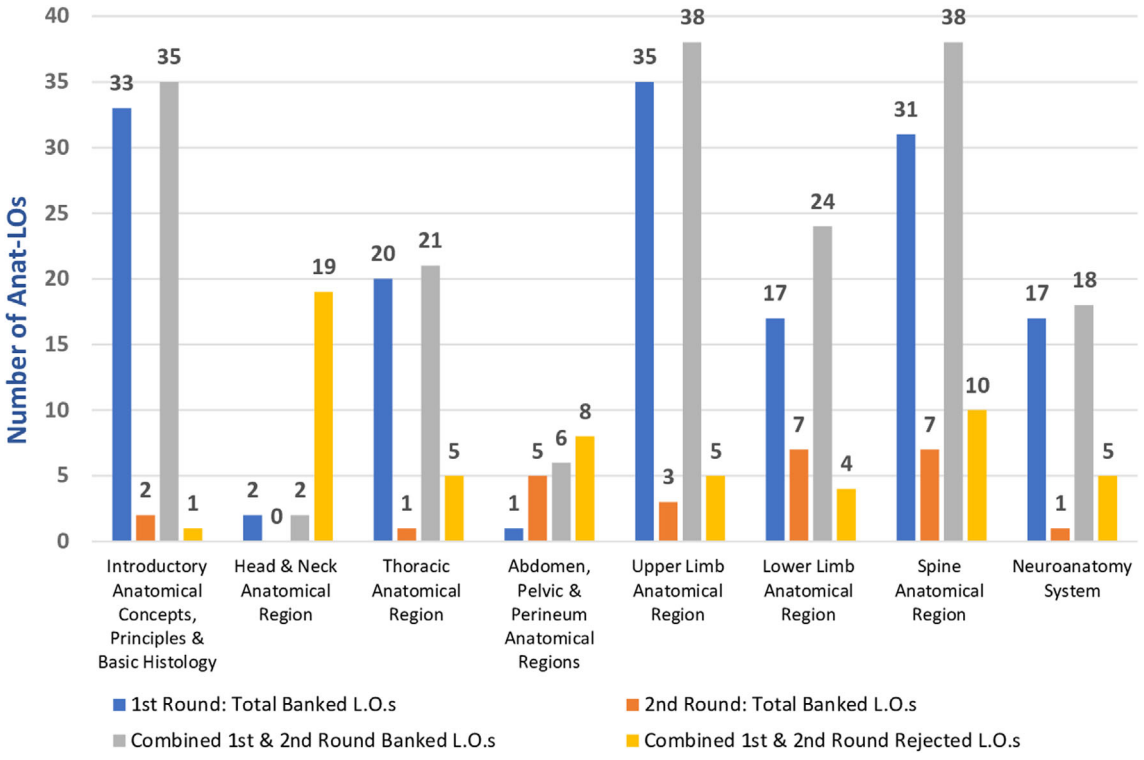

FIGURE 4 Banked Anat-LOs per anatomical region/system from both the 1st & 2nd Delphi Survey rounds

regionally, reflecting the way physiotherapists assess patients and make use of anatomical knowledge, to inform their understanding of relational anatomy and the potential for interaction between adjacent structures when impacted by pathology. Regional Anat-LOs are ordered as follows: from superiorly to inferiorly and anteriorly to posteriorly - with reference first to axial structures and then the

TABLE 1 The final list of 182 banked Anat-LOs and their clinical rationales

Anatomical region	Learning objective: A newly qualified level Band 5 physiotherapist should be able to	Clinical Situations/Scenarios/Cases/Assessment/ Analysis[a] that a newly qualified level Band 5 physiotherapist will encounter & would require the objective
Introductory anatomical concepts, principles and basic histology		
Introductory anatomical concepts		
	1. Describe why a physiotherapist needs to learn anatomy.	To understand clinical conditions in patients where anatomical knowledge & skills inform assessment & treatment.
	2. Describe the major subdivisions of anatomy, according to study methods, such as gross anatomy, surface anatomy, regional anatomy, systematic anatomy, anatomical imaging, histology, embryology & neuroanatomy.	To know which sources have most appropriate anatomical information (e.g., gross anatomy vs. histology books/journals).
	3. Use common anatomical terminology appropriately for describing anatomical regions & recognize limits of anatomical regions & parts.	To read & write using appropriate anatomical terminology to reduce errors of miscommunication.
	4. Use common anatomical terminology for describing the location of injury or pathology on a patient & correctly use terms, for example, superior/lateral.	Same as Point 3 above.
	5. Use common anatomical terminology for describing anatomical movement, for example, flexion.	Same as Point 3 above.
	6. Use common anatomical terminology for describing anatomical laterality, such as unilateral/bilateral /ipsilateral/contralateral.	Same as Point 3 above.
	7. Describe the main basic anatomical planes & axes: axial/transverse/horizontal/sagittal/coronal.	To understand & accurately communicate human movements, cross-sections or imaging.
	8. Understand the naming principles & derivations for anatomical structures, for example, Latin/Greek meanings for: fossa/deltoid & eponyms (Achilles' tendon/Broca's area/Lister's tubercle).	To promote deeper knowledge & understanding of naming rationales to facilitate knowledge retention.
Application of broad systems-based anatomical principles		
	9. Use basic palpation principles to distinguish between the major types of anatomical structures (e.g., subcutaneous fascia, muscle, tendon, bone, artery, vein & nerve) on a patient.	To develop basic tactile palpation skills to locate & demarcate structures to aid differential diagnosis.
	10. Describe how the body has various fluid spaces with visceral/parietal serous linings, for example, pleura.	To understand clinical conditions involving pleura (pleural effusion/rub) or pericardium.
Key principles: musculoskeletal systems	11. Describe the significance of the origin & insertion of a muscle & the role they play in open & closed kinetic chain exercises.	To know the impact of starting positions & actions when prescribing open & closed kinetic chain exercises for patients.
	12. Describe gross anatomical muscle classification of the types of pennation patterns of muscles & how they influence muscle function.	To explain how pennation patterns affects the muscle force produced & velocity.
	13. Describe the principle of manually testing superficial & some deep muscles on a patient.	To apply standardized muscle testing principles during assessment of muscle function.
	14. Describe the characteristics of muscles stabilizers or mobilisers.	To inform diagnosis & management strategies aimed at optimizing muscle function, for example, when mobiliser muscles compensate for stabilizer muscles.
	15. Describe the characteristics of single & two joint muscles.	To recognize & demonstrate active/passive insufficiency & predisposition to injury.
	16. Describe how gravity affects the activity of muscles of the whole body with reference to the line of gravity, center of gravity & base of support.	To use the MRC/Oxford Muscle Strength Grading Scale & know the best starting joint position for patients.
	17. Describe the roles & regional adaptations of fascia (e.g., superficial fascia/fascial septa/aponeuroses & sheaths) & mobile/fixed fascial planes	To explain how fascia limits the spread of infection & could contain pressure, for example, compartment syndrome.

(Continues)

TABLE 1 (Continued)

Anatomical region	Learning objective: A newly qualified level Band 5 physiotherapist should be able to	Clinical Situations/Scenarios/Cases/Assessment/ Analysis[a] that a newly qualified level Band 5 physiotherapist will encounter & would require the objective
Key principles: neurological systems	18. Describe how sensory & motor innervations are broadly organized.	To conduct & accurately interpret neurological examinations, for example, discuss the clinical significance of the neural pathway of a knee reflex.
	19. Describe the principle of how spinal nerves mix through nerve plexuses to form peripheral nerves & distinguish between dermatomes & cutaneous nerves; myotomes & peripheral motor nerves.	To recognize, during patient assessment, the clinical significance of neural lesion location with respect to patient expectation & management.
	20. Describe the principles of referred pain & radiating pain.	To inform differential diagnosis of referred pain, for example, angina pain/diaphragmatic pain/stomach pain, from somatic pain.
Key principles: cardiovascular and respiratory	21. Name & identify the major vessels of the body & briefly outline their roles.	To inform clinical diagnosis, prevention & treatment of deep vein thrombosis/severe atherosclerosis/oedema.
Basic histology		
Introductory histology	22. Describe the biological levels of organization of the human body in terms of key biochemicals, organelles, cells, tissues, organs, body systems.	To recognize & understand the organizational level of specific conditions, diseases & pathologies.
	23. Describe the major classifications of connective tissue subtypes, their constituents & properties, for example, dense regular & irregular, loose & adipose connective tissues.	To inform assessment & treatment of various structures such as membranous fascia, iliotibial band, tendons, ligaments.
	24. Describe the main types of epithelia, such as simple & stratified squamous, cuboidal, columnar epithelia.	To inform the assessment & treatment of the skin (in burns & open/healing wounds) & respiratory epithelium (suctioning).
Histology: musculoskeletal	25. Describe the major histological concepts of skeletal muscles, for example, sarcomere, myofibril, (intra- & extra-fusal) muscle fibers, motor unit & motor point.	To explain normal & impaired muscle contraction & tone.
	26. Describe the main classifications of muscles (e.g., cardiac, smooth & skeletal muscle types) based on microscopic histochemistry classification (e.g., key subtypes of type 1 & 2) & how they influence muscle contraction.	To explain muscle physiology (e.g., force generation/ fatigue), muscle fiber changes (atrophy/hypertrophy/ sarcopenia) & muscle disorders (e.g., muscular dystrophy).
	27. Describe the basic histology of cartilage & bone tissues.	To explain the histology of bone & cartilage through development to maturity, & apply this to pathology, for example, osteoarthritis & fracture healing.
	28. Describe the concepts of primary & secondary ossification centers, growth plates & endochondral ossification.	To recognize active growth plates in pediatric radiographs & as contra-indications to specific treatment modalities.
	29. Describe the classification & typical features of joints (fibrous, cartilaginous & synovial) & describe the features of a typical synovial joint.	To inform joint specific assessment & the performance of joint mobilisations.
Histology: neurology	30. Describe the appearance & roles of organelles of a typical neurone, for example, axon, dendrite & synaptic vesicle.	To explain medical conditions, such as epilepsy, multiple sclerosis, neurofibromatosis & neurone trauma.
	31. Describe the difference in structure between myelinated & unmyelinated axons, for example, axon, Schwann cell & node of Ranvier.	To explain how the histology of myelinated versus unmyelinated axons accounts for their different electrical stimulation responses
	32. Describe the histological arrangement of connective tissue around axons of peripheral nerves (e.g., endoneurium, perineurium, epineurium) & regeneration of injured axons.	To explain neurapraxia (class i), axonotmesis (class ii) & neurotmesis (class iii) lesions.

TABLE 1 (Continued)

Anatomical region	Learning objective: A newly qualified level Band 5 physiotherapist should be able to	Clinical Situations/Scenarios/Cases/Assessment/ Analysis[a] that a newly qualified level Band 5 physiotherapist will encounter & would require the objective
	33. Describe the histology of organelles & the main biochemical constituents of a typical neuromuscular junction involved in transmitting an impulse from an axon to the contraction of myosin & Actin myofilaments.	To explain normal & impaired impulse conduction across the neuromuscular junction, for example, myasthenia gravis & botulism.
Histology: cardiovascular and respiratory	34. Describe the roles & histological differences between arteries, veins, capillaries & lymph vessels.	To inform the assessment & management of conditions, such as atherosclerosis, aneurysms & deep vein thrombosis.
	35. Describe the histology of the mucosae in the nasal cavity, trachea, bronchi & lungs	To explain the mucociliary escalator mechanism & inform understanding of nasal congestion & nasal/tracheal suctioning.
Head & neck anatomical region		
	1. Describe the major features that change on pediatric skulls from neonates to teenagers, including the four major fontanelles.	To enable safe basic handling skills of heads of neonates with fontanelles.
	2. Palpate the superficial borders of the anterior & posterior triangles of the neck, their subdivisions & contents, including surface anatomical locations of key organs for example, hyoid bone, trachea.	To understand congenital torticollis, the location of a tracheostomy tube, & inform manual stimulation the trachea to trigger cough.
Thoracic anatomical region		
Thoracic Wall	1. Describe the features of a typical vertebra.	To facilitate basic understanding of spinal imaging.
	2. Describe the relationships at the intervertebral foramen of the spinal nerve, spinal cord, meninges, with pedicles, disc & any changes, for example, impact of osteophyte formation.	To understand when to ask specific neural screening questions & perform neural tests, for example, spinal nerve impingement & straight leg raise tests.
	3. Describe the shape, features, articulations & surface anatomy of a typical rib & articulations of atypical, floating, true & false ribs.	To inform assessment of rib fractures, thoracic wall deformities (e.g., pectus excavatum/carinatum).
	4. Describe the features of the sternum, including those that can be palpated.	To use anatomical landmarks to facilitate body mapping, for example, using the suprasternal notch to palpate the anterior surface of the trachea
	5. Palpate & describe the surface anatomical significance of the manubriosternal joint.	Accurately palpating any given rib 2-12/location of thorax viscera.
	6. Briefly describe the ossification of ribs & costal cartilages in children, adults & the elderly.	To be able to distinguish growth plates from fractures & recognize implications for rib cage flexibility & chest compressions.
	7. Palpate the "bucket handle" & "pump handle" movement of the sternum & ribs during breathing.	To inform chest examination & thoracic expansion exercises.
Musculature	8. Describe the diaphragm: its attachments, shape & orientation, actions, innervations, structures passing through, its status in babies & changes during pregnancy.	To understand the mechanism of breathing & inform breathing exercises, including in neonates & during pregnancy.
	9. Describe how the musculature of the thorax & upper limb participate in quiet & forced inspiration & expiration & how to test them manually.	To understand muscle recruitment strategies in quiet breathing, strenuous exercises & changes in, for example, a severe asthmatic attack.
	10. Describe how varying levels of spinal cord damage would affect breathing muscles, for example, L4, T12, T4, T2, C4 & C1 transections of the spinal cord.	To understand the impact of injury on breathing abilities of patients with varying levels of paraplegia or quadriplegia.
Mediastinum	11. Describe the concept of the mediastinum & its subdivisions, demarcations & major contents.	To explain surface anatomy for detecting lung atelectasis & tracheal shifts.
Lungs	12. Describe the trachea, primary bronchi up to tertiary bronchi: courses, innervation, surface anatomy, palpation & basic histology.	To understand & explain basic histopathology of asthma, tracheostomy insertion sites, tracheal suctioning & thoracic surgical interventions.

(Continues)

TABLE 1 (Continued)

Anatomical region	Learning objective: A newly qualified level Band 5 physiotherapist should be able to	Clinical Situations/Scenarios/Cases/Assessment/ Analysis[a] that a newly qualified level Band 5 physiotherapist will encounter & would require the objective
	13. Describe the drainage, location & surface anatomy projections of bronchopulmonary segments.	To explain & apply the rationale of patient positioning for postural drainage of bronchopulmonary segments.
	14. Describe the pleura & lung fissures in the thoracic cavity & their surface anatomical projections.	To explain pleural effusion, pneumothorax, pleural rub, empyema.
	15. Describe the innervations of visceral & parietal pleura.	To understand the clinical significance of painful versus painless coughing.
	16. Describe how the thoracic surface anatomy of the lungs & heart changes from supine to standing (gravity) & during inspiration/expiration.	To conduct physical examination & treatment of the lungs & heart more accurately
Heart	17. Describe the four chambers of the heart: locations within the heart, valves connecting them & their surface anatomical projections.	To be able to explain anatomical relationships in common pathologies, for example, cor pulmonale & pulmonary embolism association with deep vein thrombosis in the leg.
	18. Describe the arteries, veins & conduction system of the heart.	To explain ischemic heart disease, angina pectoralis, & undertake cardiac rehabilitation.
	19. Describe the changes to blood circulation that occur when a baby is born.	To understand congenital heart conditions, for example, atrial septum defects & patent ductus arteriosus.
	20. Describe the course of the aorta & its major branches.	To understand & explain changes associated with coarctation of the aorta & aortic aneurysm.
	21. Describe the course of the superior & inferior vena cava: its course & major tributaries.	To explain the significance of raised or low jugular venous pressure in patients.
Abdomen, pelvic & perineum anatomical regions		
Abdomen Region	1. Describe the basic surface anatomical projections of major abdominal organs on the abdominal wall.	To relate surgical incisions on the abdominal wall to locations of underlying abdominal organs.
	2. Describe the key muscles of the abdominal walls & how to test them manually, for example, rectus abdominus, external & internal oblique muscles.	To undertake re-education, proprioceptive neuromuscular facilitation of abdominal muscles. To understand the impact of different surgical incisions on trunk activity.
	3. Describe the basic anatomy of major abdominal organs: roles, shape, size, innervation & basic relations.	To be aware of the concept of visceral referral patterns to inform musculoskeletal assessment & inform post-surgical management.
Pelvis and Perineum	4. Describe the features on the pelvic bones & palpate superficial features.	To inform Interpretation of imaging under supervision, managing fractures, physical examinations of the pelvis.
	5. Describe the basic anatomy of major pelvic organs: roles, shapes, innervation & basic relations.	To be aware of the concept of visceral referral patterns in pelvic musculoskeletal assessment & inform post-surgical management.
	6. Describe the basic anatomy of the pelvic floor muscles.	To inform pelvic floor training, Kegels exercises, management of uterine or vaginal prolapse.
Upper limb anatomical region		
Shoulder complex		
Osteology	1. Name & identify the bones & bony points of the shoulder complex.	To complete an accurate musculoskeletal assessment & treatment using appropriate underpinning structural knowledge.
Joints of the shoulder complex and scapula-thoracic interface	2. Describe the types of joints at the shoulder complex & scapula-thoracic interface; including joint classification, articular surfaces & shapes, available movements (refer to planes/axes/degrees of freedom/open & close packed positions) & scapulohumeral rhythm.	To be able to differentiate normal & abnormal scapulohumeral rhythm during assessment & classify scapula dyskinesis.
	3. Describe the soft tissue structures (including bursae, capsule, ligaments & intra & extra-articular features), rotator cuff muscles & discuss their function.	To inform clinical reasoning of signs & symptoms during an assessment, for example, of adhesive capsulitis & labral pathology.

TABLE 1 (Continued)

Anatomical region	Learning objective: A newly qualified level Band 5 physiotherapist should be able to	Clinical Situations/Scenarios/Cases/Assessment/ Analysis[a] that a newly qualified level Band 5 physiotherapist will encounter & would require the objective
	4. Palpate important bony points, joint surface anatomical marking & attachments of joint soft tissue structures of the shoulder complex, for example, acromion.	To palpate surface landmarks to guide the assessment of static/dynamic posture & active/passive joint range.
	5. Conduct passive movement testing of the shoulder complex utilizing anatomical knowledge to inform appropriate patient positioning for optimal ergonomic handling.	To apply optimal ergonomic principles to ensure health & safety during a musculoskeletal assessment.
Muscles acting on the shoulder complex	6. For the muscles in following muscle groupings of the shoulder joint complex: a. Muscles from trunk to scapula b. Muscles from trunk to humerus c. Muscles from clavicle & scapula to humerus The Learning Objectives are: i. Describe origin, insertion, action, functional (applied) anatomy & innervation of each named muscle. ii. Accurately palpate accessible muscle bellies & tendons. iii. Instruct a model patient to perform manual muscle testing using appropriate lay terms & application of resistance if necessary.	To use knowledge of muscle structure, function & assessment strategies to inform functional analysis & specific muscle testing during assessment. To identify & palpate named muscle & tendon structures during musculoskeletal assessment & clinical grading of muscle. To perform & interpret muscle strength testing using MRC/Oxford scale, and/or 1RM & 10RM protocols.
Nerve supply	7. Describe the roots, basic course & supply of major terminal branches of the brachial plexus: radial, median, ulnar, musculocutaneous, axillary & long thoracic nerves in the shoulder girdle.	To be able to conduct a basic musculoskeletal assessment & recognize common peripheral nerve lesions/ postures, for example, axillary nerve wrapping round a fractured surgical neck of humerus or Erb's palsy.
Other factors	8. Describe the relational anatomy of important structures around the shoulder complex.	To explain signs & symptoms of thoracic outlet syndrome or sub-acromial pain syndrome.
	9. Discuss & demonstrate the factors limiting movements of the joints of the shoulder complex, including active & passive insufficiency.	To systematically test any abnormal movement limitations (end feel) & interpret to identify relevant structures.
Functional anatomy of the shoulder complex	10. Perform a basic functional analysis of the main components & sequencing of the scapula-humeral complex.	To inform assessment of posture, appraisal of scapulo-humeral rhythm & impact on activities of daily living.
Special Testing	11. Describe features contributing to mobility & stability at the shoulder complex.	To inform & underpin clinical test interpretation & evaluation at the shoulder complex.
Elbow joint and forearm		
Osteology	12. Name & identify the bones & bony points of the elbow joint & forearm.	To complete an accurate musculoskeletal assessment & treatment using appropriate underpinning structural knowledge.
	13. Describe the significance of the carrying angle at elbow for normal function across sexes.	To identify cubitus valgus/varus on a patient.
Joints: Humeroulnar, humeroradial and proximal radioulnar joints	14. Describe types of joints at the elbow joint; including joint classification, articular surfaces & shapes, available movements (refer to planes/axes/degrees of freedom/ open & close packed positions).	To safely perform assessments & treatment of for example, an elbow dislocation or radial head fracture & test joint mobility.
	15. Describe the soft tissue structures (including bursae, capsule, ligaments & intra & extra-articular features) & discuss their functions.	To use knowledge of structure & function to inform clinical reasoning of signs, symptoms & assessment findings or (under supervision) imaging findings
	16. Palpate important bony points, locate joint surface anatomical marking & attachments of joint soft tissue structures at the elbow, for example, epicondyles of the humerus, olecranon & head of radius.	To accurately palpate surface landmarks to guide the assessment of posture, active/passive joint range & pathology, for example, potential fracture.
	17. Conduct passive movement testing of the elbow joint utilizing anatomical knowledge to inform appropriate patient positioning for optimal ergonomic handling	To apply optimal ergonomic principles to ensure health & safety during the assessment of the elbow joint, for example, awareness of potential for bicipital myositis ossificans.

(Continues)

TABLE 1 (Continued)

Anatomical region	Learning objective: A newly qualified level Band 5 physiotherapist should be able to	Clinical Situations/Scenarios/Cases/Assessment/ Analysis[a] that a newly qualified level Band 5 physiotherapist will encounter & would require the objective
Muscles pertaining to elbow and forearm movement	18. For the muscles in following compartments around the elbow joint & forearm: a. Arm: anterior & posterior compartments b. Forearm: anterior & posterior compartments to include common extensor/flexor origin respectively. The Learning Objectives are: i. Describe origin, insertion, action, functional (applied) anatomy & innervation of each named muscle in each compartment. ii. Accurately palpate accessible muscle bellies & tendons iii. Instruct a model patient to perform manual muscle testing using appropriate lay terms & application of resistance if necessary.	To use knowledge of muscle structure, function & assessment strategies to inform functional analysis & specific muscle testing during assessment, including, for example, tennis & golfer's elbow. To identify & palpate named muscle & tendon structures during musculoskeletal assessment & clinical grading of muscle. To interpret & document muscle strength testing using MRC/Oxford scales and/or 1RM & 10RM protocols.
Nerve supply	19. Describe the basic course & supply of the radial, ulnar & median nerves through the elbow joint & forearm region.	To conduct an accurate musculoskeletal assessment to be able to recognize common peripheral nerve lesions, for example, posterior interosseous nerve syndrome, & palpate accessible peripheral nerves.
Other factors	20. Describe the relational anatomy of important structures around the elbow joint & forearm & their roles.	To diagnose & treat peripheral nerve entrapment, such as posterior interosseous/ulnar/median nerves, for example, cubital tunnel syndrome.
	21. Describe the fascia, compartments & blood supply (brachial, radial & ulnar pulses).	To be able to take accurate brachial, radial, ulnar pulses, observe blood pressure during assessment.
	22. Discuss & demonstrate the factors limiting movements of the joints of the elbow joint, including active & passive insufficiency.	To test systematically any abnormal movement limitations (end feel) & interpret to identify relevant structure.
Functional anatomy of the elbow and forearm	23. Describe normal biomechanical function of the elbow & forearm; including both active & passive physiological movements possible.	To conduct patient assessment to diagnose the source of abnormal movement, for example, biceps tendon tear.
Special Testing	24. Describe joint stability & discuss contributions to joint stability at the elbow & forearm.	To interpret musculoskeletal clinical tests & their relationship to pathology for example, Elhers Danlos syndrome.
	25. Perform clinical testing or apply differential test procedures for instability & diagnostic testing for common pathologies of the elbow joint.	To complete an appropriate & repeatable testing regime to identify instability & pathologies (e.g., valgus/varus stress tests or Mills' & Cozen's tests).
Wrist joint and hand		
Osteology	26. Name & identify the bones & bony points of the wrist & hand.	To complete an accurate musculoskeletal assessment & treatment using appropriate underpinning structural knowledge.
Joints: Wrist, mid-carpal, metacarpo-phalangeal, proximal and distal interphalangeal joints:	27. Describe the types of joints at the wrist, mid-carpal joint, metacarpophalangeal & proximal & distal interphalangeal joints; including joint classification, articular surfaces & shapes, available movements (refer to planes/axes/ degrees of freedom/open & close packed positions).	To safely perform an assessment of the wrist & hand & differentiate the contribution of each joint to overall movement, for example, following wrist fracture.
	28. Describe the soft tissue structures (including bursae, capsule, ligaments & intra & extra-articular features) & discuss their functions.	To use knowledge of structure & function to inform clinical reasoning of signs, symptoms & assessment findings.
	29. Palpate important bony points, locate joint surface anatomical marking & attachments of joint soft tissue structures of the wrist & hand, for example, anatomical snuff box.	To use anatomical knowledge to inform & guide the assessment of posture, active & passive joint range & quality of movement, for example, pain related to scaphoid fracture.

TABLE 1 (Continued)

Anatomical region	Learning objective: A newly qualified level Band 5 physiotherapist should be able to	Clinical Situations/Scenarios/Cases/Assessment/ Analysis[a] that a newly qualified level Band 5 physiotherapist will encounter & would require the objective
	30. Conduct passive movement testing of the wrist & hand joints utilizing anatomical knowledge to inform appropriate patient positioning for optimal ergonomic handling.	To apply optimal ergonomic principles to ensure health & safety during the assessment of wrist & hand joints, for example, assessing 1st CMC trauma.
Muscles pertaining to wrist & hand movement	31. For the muscles in following muscle groupings of the wrist joint & hand: a. Intrinsic muscles of hand: thenar, hypothenar eminences, lumbricals & interossei b. Tendons crossing the wrist joint. The Learning Objectives are: i. Describe origin, insertion, action, functional (applied) anatomy & innervation of each named muscle in each compartment. ii. Accurately palpate accessible muscle bellies & tendons. iii. Instruct a model patient to perform manual muscle testing using appropriate lay terms & application of resistance if necessary.	To use knowledge of muscle structure, function & assessment strategies to inform functional analysis & specific muscle, including importance of tendon mechanics in digits & relationship between extrinsic & intrinsic muscles of the hand during function. To identify & palpate named muscle & tendon structures during musculoskeletal assessment & clinical grading of muscle. To interpret & document muscle strength testing using MRC/Oxford scales.
Nerve supply	32. Describe the basic course & supply of the radial, ulnar & median nerves through the hand.	To recognize common peripheral nerve lesions, for example, carpal tunnel syndrome, ulnar nerve palsy. To palpate accessible peripheral nerves.
Other factors	33. Describe the relational anatomy of important structures around the wrist & hand & their roles.	To understand the intrinsic connections between extensors & flexors to inform accuracy in clinical reasoning.
	34. Describe the blood supply to the hand (radial & ulnar pulses).	To take accurate radial/ulnar pulses during assessment, monitor blood flow to tissues using the capillary refill test.
	35. Discuss & demonstrate the factors limiting movements of the joints of the wrist joint & hand, including active & passive insufficiency.	To test systematically any abnormal movement limitations (end feel) & interpret to identify relevant structures, for example, De Quervain's syndrome.
Functional anatomy of the wrist & hand	36. Describe normal biomechanical function of the wrist & hand; including classification of grips.	To understand anatomical & biomechanical relationships to inform clinical reasoning & diagnosis, for example, intersection syndrome.
Special Testing	37. Describe joint stability & discuss contribution to joint stability at the wrist & hand.	To understand anatomy & biomechanics to inform interpretation of musculoskeletal clinical tests, for example, peri-lunate or CMC instability.
	38. Perform clinical testing or apply differential test procedures for instability & diagnostic testing for common pathologies of the wrist & hand.	To complete appropriate & repeatable testing to identify pathology (e.g., carpal tunnel syndrome, volar plate injury).
Lower limb anatomical region		
Hip joint and pelvic region		
Bones & bony points	1. Name & identify the bones & bony points of the hip joint & pelvic region, for example, greater trochanter/ ischial tuberosity.	To identify pelvic fractures & explain sex differences in pelvic osteology.
Joints	2. Describe types of joints at the hip, sacroiliac & public symphysis; including joint classification, articular surfaces & shapes, available movements (refer to planes/axes /degrees of freedom/open & close packed positions).	To interpret signs & symptoms of degenerative changes of anatomical structures in hip osteoarthritis.
	3. Describe the soft tissue structures of the hip, sacroiliac & public symphysis (including bursae, capsule, ligaments & intra & extra-articular features) & discuss how their structures justify their functions.	Same as point 2 above.

(Continues)

TABLE 1 (Continued)

Anatomical region	Learning objective: A newly qualified level Band 5 physiotherapist should be able to	Clinical Situations/Scenarios/Cases/Assessment/ Analysis[a] that a newly qualified level Band 5 physiotherapist will encounter & would require the objective
	4. Palpate important bony points, locate joint surface anatomical marking & attachments of joint soft tissue structures of the hip, sacroiliac & public symphysis.	To palpate surface landmarks to guide the assessment of static/dynamic posture & active/passive joint range.
	5. Conduct passive movement testing of the hip joint utilizing anatomical knowledge to inform appropriate patient positioning for optimal ergonomic handling.	To apply optimal ergonomic principles to ensure health & safety during the assessment of hip joint, for example, assessing osteoarthritis.
Muscles	6. For the muscles in following compartments that support the hip joint complex: a. Gluteal compartment b. Anterior compartment of the thigh c. Medial compartment of the thigh d. Posterior compartment of the thigh The Learning Objectives are: i. Describe the origin, insertion, action, functional (applied) anatomy & innervation of each named muscle. ii. Accurately palpate accessible muscle bellies & tendons. iii. Instruct a model patient to perform manual muscle testing using appropriate lay terms & application of resistance if necessary.	To interpret the signs & symptoms of a quadriceps grade 2 strain, a hamstring tear, adductor scissors gait or Trendelenburg sign To identify & palpate named muscle & tendon structures during musculoskeletal assessment & clinical grading of muscle. To interpret & document muscle strength testing using MRC/Oxford scales.
Nerve supply	7. Describe the roots, basic course & supply of major terminal branches of the lumbar plexus & lumbosacral plexus: sciatic, gluteal, femoral & obturator nerves in the abdomen & pelvis.	To assess sensory & motor supply in patients with lumbar/sacral spinal nerve root pathology. To understand the proximity of terminal branches to common trauma locations.
Other factors	8. Discuss the factors limiting movements of the joints of the hip joint & pelvic region, including active & passive insufficiency.	To test systematically any abnormal movement limitations (end feel) & interpret to identify relevant structures.
Knee joint region		
Bones & Bony points	9. Name & identify the key knee bony landmarks: for example, medial femoral epicondyle & tibial tuberosity.	To identify knee fractures, or Osgood Schlatter presentation on x-rays.
Joints: Tibiofemoral, superior tibio-fibular & patellofemoral joints	10. Describe types of joints at tibiofemoral, patellofemoral joints & superior tibio-fibular joints; including joint classification, articular surfaces & shapes, available movements (refer to planes/axes/ degrees of freedom/open & close packed positions).	To recognize common conditions, such as patella alta & baja, mal-tracking patella or tibial torsion.
	11. Describe the soft tissue structures of the tibiofemoral, patellofemoral joints & superior tibio-fibular joints (including bursae, capsule, ligaments & intra & extra-articular features) & discuss how their structures justifies their functions.	To interpret signs & symptoms of patients presenting with painful knees.
	12. Palpate important bony points, locate joint surface anatomical marking & attachments of joint soft tissue structures of the tibiofemoral, patellofemoral joints & superior tibio-fibular joints.	To palpate surface landmarks to guide the assessment of static/dynamic posture & active/passive joint range.
	13. Conduct passive movement testing of the knee joint utilizing anatomical knowledge to inform appropriate patient positioning for optimal ergonomic handling.	To apply optimal ergonomic principles to ensure health & safety during the assessment of knee joint, for example, assessing osteoarthritis.
Muscles	14. The Learning Objectives for the muscles of the following compartments that support the knee joint complex are found indicated sections in brackets: a. Anterior, medial & posterior compartments of the thigh (located in the hip joint complex section) b. Posterior compartment of the leg (located in the ankle joint complex section).	To interpreting signs & symptoms of abnormal movement, for example, strain on the medial gastrocnemius muscle.

TABLE 1 (Continued)

Anatomical region	Learning objective: A newly qualified level Band 5 physiotherapist should be able to	Clinical Situations/Scenarios/Cases/Assessment/ Analysis[a] that a newly qualified level Band 5 physiotherapist will encounter & would require the objective
Nerve supply	15. Describe the course & innervation of tibial & common, superficial & deep fibular nerves in the thigh & leg.	To conduct accurate musculoskeletal assessment testing to assess complex peripheral nerve lesions, for example, dropped foot resulting from finular nerve entrapment.
Other factors	16. Discuss the factors limiting movements of the joints of the knee joint region, including active & passive insufficiency.	To test systematically any abnormal movement limitations (end feel) & interpret to identify relevant structure, for example, fixed flexion deformity.
Ankle joint and foot region		
Bones & Bony points	17. Name & identify the following bony landmarks: for example, tuberosity of navicular bone/calcaneal tuberosity.	To interpret, under supervision, imaging of calcaneal spur & mortice disruption.
Joints: Inferior tibio fibular, ankle, subtalar, talo-calcano-navicular, mid-tarsal, tarsal metatarsal, metatarsal-phalangeal & interphalangeal joints	18. Describe types of joints at ankle joint & foot region; including joint classification, articular surfaces & shapes, available movements (refer to planes/axes/ degrees of freedom/open & close packed positions).	To identify pes planus, pes cavus, hallux valgus, hallux rigidus, Morton's neuroma.
	19. Describe the soft tissue structures of the ankle joint & foot region (including bursae, capsule, ligaments, intra & extra-articular features) & discuss how their structures align with their functions.	Same as point 18 above.
	20. Palpate important bony points, locate joint surface anatomical marking & attachments of joint soft tissue structures of the ankle joint & foot region.	To palpate surface landmarks to guide the assessment of static/dynamic posture & active/passive joint range.
	21. Conduct passive movement testing of the ankle joint & joints of the foot utilizing anatomical knowledge to inform appropriate patient positioning for optimal ergonomic handling.	To apply optimal ergonomic principles to ensure health & safety during the assessment of ankle joint & joints of the foot, for example, assessing osteoarthritis.
Muscles	22. For the muscles in following compartments that support the ankle joint complex: a. Posterior compartment of the leg b. Anterior compartment of the leg c. Lateral compartment of the leg d. Four layers of the plantar compartment of the foot: 1st, 2nd, 3rd, & 4th layers. The Learning Objectives are: i. Describe the origin, insertion, action, functional (applied) anatomy & innervation of each named muscle. ii. Accurately palpate accessible muscle bellies & tendons. iii. Instruct a model patient to perform manual muscle testing using appropriate lay terms & application of resistance if necessary.	To interpret the signs & symptoms a patient with a leg compartment syndrome. To identify & palpate named muscle & tendon structures during musculoskeletal assessment & clinical grading of muscle. To interpret & document muscle strength testing using MRC/Oxford scales.
Nerve supply	23. Describe the basic course & supply of the tibial & fibular nerves & their branches through the foot.	To conduct a basic musculoskeletal assessment & be able to recognize common peripheral nerve lesions/postures for example, common fibular nerve lesion & foot drop.
Other factors	24. Discuss the factors limiting movements of the ankle joint & joints of the foot region, including active & passive insufficiency.	24. To test systematically any abnormal movement limitations (end feel) & interpret to identify relevant structures, for example, loss of plantigrade foot position due to gastrocnemius shortening.
Spine region		
Cervical spine		
Bones & bony landmarks	1. Name & identify the bones & bony landmarks of the cervical spine.	To accurately palpate cervical landmarks during assessment to interpret abnormal clinical findings.
	2. Distinguish between typical & atypical cervical vertebrae & provide anatomical justification for the differences	To identify specific cervical vertebrae on imaging, & during assessment & treatment.

(Continues)

TABLE 1 (Continued)

Anatomical region	Learning objective: A newly qualified level Band 5 physiotherapist should be able to	Clinical Situations/Scenarios/Cases/Assessment/ Analysis[a] that a newly qualified level Band 5 physiotherapist will encounter & would require the objective
Joints of the cervical spine	3. Describe joints of the cervical spine; atlantooccipital, atlantoaxial, intervertebral joints, apophyseal joints & joints of Luschka: joint classification, articulations, capsules, ligaments & movements.	To assess & treating signs, symptoms & movement problems associated with cervical vertebrae.
	4. Describe the anatomy & function of the cervical ligaments & fascia; anterior longitudinal, posterior longitudinal ligaments & thoracolumbar fascia.	To assess & treat signs, symptoms & movement problems associated with cervical ligamentous instability.
	5. Palpate the bony landmarks & joint soft tissue structures of the cervical spine.	Same as Point 1 above
	6. Locate the joint surface anatomical markings of the cervical apophyseal joints.	Same as Point 1 above
	7. Discuss the structure & function of the intervertebral discs of the cervical spine & relate to disc pathology.	To assess & treat signs, symptoms & movement problems associated with cervical intervertebral discs.
	8. Safely perform passive cervical intervertebral movements relating to anatomical & biomechanical knowledge.	To competently & safely assess & perform passive intervertebral movements of the cervical spine & justify grading/dosage of treatment.
Muscles of the cervical spine	9. For the muscles of the cervical spine & neck: i. Describe the basic muscle attachments, functional anatomy & innervation. ii. Accurately palpate muscle bellies. iii. Instruct a model patient to perform basic manual muscle group tests using appropriate laymen terms & application of resistance.	To recognize cervical muscles pathology associated with spondylosis, arthrosis, trauma or whiplash associated disorders. To inform accurate physical examination of the neck.
Nerves plexuses in the cervical spine	10. Describe the location, surface anatomy & parts (roots, superficial & deep branches) & dermatomes/myotomes of the cervical plexus.	To perform a basic clinical assessment of the cervical nerve roots & peripheral nerve neurodynamics with accurate documentation & interpretation of abnormal findings.
Other factors	11. Describe the anatomy of major cervical arteries, for example, carotid arteries & vertebral-basilar arteries.	To recognize the risk factors, signs & symptoms of deteriorating vascular supply to the brain during neck movements.
Functional anatomy of the cervical spine	12. Describe normal anatomical movements of the cervical spine; including differentiating between upper & lower cervical regions.	To describe & differentiate normal movements of the upper & lower cervical regions & relate to abnormal clinical findings.
	13. Describe cervical posture in relation to the upper & lower cervical spine & contribution towards upright head posture.	To explain abnormal movements of the cervical regions found in clinical assessments using biomechanical factors.
	14. Complete a basic assessment of head posture & relate to the anatomy of the cervical spine.	To perform a basic assessment of head & neck posture & explain abnormal findings using potential anatomy & biomechanics causes.
Thoracic spine		
Osteology	15. Name & identify the bones & bony landmarks of the thoracic spine.	To accurately palpate thoracic landmarks during assessment to interpret abnormal clinical findings.
	16. Identify typical & atypical thoracic vertebrae & relate to distinguishing anatomical features.	To identify specific thoracic vertebrae on imaging, & during assessment & treatment.
Joints of the thoracic spine	17. Describe joints of the thoracic spine (intervertebral joint, apophyseal joints, costotransverse joint, costovertebral joint & sternocostal joint): classification, articulations, capsule, ligaments & movements.	To assess & treat signs, symptoms & movement problems associated with thoracic vertebrae.
	18. Palpate the bony landmarks of the thoracic spine, ribs & sternum.	To accurately palpate thoracic landmarks during assessment to interpret abnormal clinical findings.
	19. Locate the joint surface anatomical markings of the thoracic apophyseal joints & relate to spinous processes.	Same as Point 17 above

TABLE 1 (Continued)

Anatomical region	Learning objective: A newly qualified level Band 5 physiotherapist should be able to	Clinical Situations/Scenarios/Cases/Assessment/ Analysis[a] that a newly qualified level Band 5 physiotherapist will encounter & would require the objective
	20. Describe the basic anatomy & function of the thoracic ligaments/fascia; anterior/posterior longitudinal ligament, ligamentum flavum & thoracolumbar fascia.	To assess & treat signs, symptoms & movement problems associated with thoracic ligamentous instability/ reduced mobility.
	21. Discuss the structure & function of the intervertebral discs of the thoracic spine & relate to disc pathology.	To assess & treat signs, symptoms & movement problems associated with intervertebral discs.
	22. Safely perform passive thoracic intervertebral movements relating to anatomical & biomechanical knowledge.	To assess & perform passive intervertebral movements of the thoracic spine competently & safely, & justify grading/dosage of treatment.
Muscles of the thoracic spine	23. For the muscles of the thoracic spine: i. Describe the basic muscle attachments, functional anatomy & innervation. ii. Accurately palpate muscle bellies. iii. Instruct a model patient to perform basic manual muscle group tests using appropriate laymen terms & application of resistance.	To recognize thoracic back muscles with associated trigger points during treatment with massage techniques.
Functional anatomy of thoracic spine	24. Describe normal anatomical movements of the thoracic spine & thoracic cage.	To describe the normal movements of the thoracic spine & thoracic cage & relate to abnormal clinical findings.
	25. Describe normal biomechanics & function of the thoracic spine & thoracic cage, including both active & passive physiological movements & breathing mechanics.	To explain abnormal movement of the thoracic region found in clinical assessments using biomechanical factors.
	26. Complete a basic assessment of thoracic spinal posture & relate it to potential anatomy & biomechanics causes.	To perform a basic assessment of cervicothoracic & thoracolumbar spinal posture to potentially explain abnormal findings.
Lumbar spine		
Osteology	27. Name & identify the bones & bony landmarks of the lumbar spine, sacrum & coccyx.	To accurately palpate key bony landmarks during assessment to interpret abnormal clinical findings.
	28. Identify the features of typical lumbar vertebrae & compare & contrast with cervical & thoracic vertebrae.	To identify specific lumbar vertebrae on imaging, & during assessment & treatment.
Joints of the lumbar spine	29. Describe joints of the lumbosacral spine (intervertebral joints, apophyseal joints & sacroiliac joint): joint classification, articulation, capsules, ligaments & movements.	To assess & treat signs, symptoms & movement problems associated with lumbar vertebrae.
	30. Identify & palpate bony landmarks on the lumbar & sacral regions.	To accurately palpate lumbar landmarks during assessment to interpret abnormal clinical findings.
	31. Locate the joint surface anatomical markings of the lumbar apophyseal joints.	Same as Point 30 above.
	32. Describe the anatomy & function of the lumbar & lumbosacral ligaments.	To assess & treat signs, symptoms & movement problems associated with lumbar ligamentous instability.
	33. Discuss the structure & function of the intervertebral discs of the lumbar spine & relate to disc pathology.	To understand the potential signs & symptoms of disc pathology. To assess & treat signs, symptoms & movement problems associated with lumbar intervertebral discs.
	34. Safely perform passive lumbar intervertebral movements relating to anatomical & biomechanical knowledge.	To competently & safely assess & perform passive intervertebral movements of the lumbar spine & justify grading/dosage of treatment.
Muscles of the lumbar spine	35. For the muscles of the thoracic spine: i. Describe the basic muscle attachments, functional anatomy & innervation. ii. Accurately palpate accessible muscle bellies. iii. Instruct a model patient to perform basic manual muscle group tests using appropriate laymen terms & application of resistance.	To competently perform appropriate muscle strength tests using the MRC/Oxford Scale with accurate documentation. To competently perform an assessment of lumbo-pelvic stability with accurate documentation.

(Continues)

TABLE 1 (Continued)

Anatomical region	Learning objective: A newly qualified level Band 5 physiotherapist should be able to	Clinical Situations/Scenarios/Cases/Assessment/ Analysis[a] that a newly qualified level Band 5 physiotherapist will encounter & would require the objective
Functional anatomy of the lumbar spine	36. Describe normal anatomical movements of the lumbar spine.	To describe & differentiate normal movements of the lumbar spine & pelvis relate to abnormal clinical findings.
	37. Describe factors that contribute to lumbar posture.	To explain abnormal movement of the lumbar & pelvic regions found in clinical assessments using biomechanical factors.
	38. Complete a basic assessment of lumbo-pelvic posture & relate to potential anatomy & biomechanics causes.	To perform a basic assessment of thoracolumbar, lumbar & pelvic posture to potentially explain abnormal findings.
Neuroanatomy system		
General	1. Define frequently used neuroanatomical terms: for example, gray/white matter/tract/commissure/ pathway/chiasm/decussation/nucleus/ganglion/ fissure/lemniscus/cistern/hemianopia/sulci/gyrus.	To develop basic neuroanatomical language to communicate with other health professionals & understand written texts.
	2. Describe the arrangement of the layers of the meninges covering the central nervous system & the spaces/potential spaces they create.	To understand the normal function of meninges & the impact of pathology, for example, meningitis, treating post-surgical patients with sub/epidural haematomas & following lumbar puncture.
Specific regions and systems	3. Identify major divisions & subdivisions of the brain, for example, cerebral hemispheres/diencephalon/ brainstem/cortical structures/basal ganglia.	To establish a structural foundation for learning neuroanatomy & neurology.
	4. Identify the major sulci & gyri of the cerebral hemispheres to locate the five cerebral lobes.	Same as point 3 above.
	5. Describe the functional roles of the different areas of the cerebral hemispheres, for example, pre-motor area & Broca's area, & how they can be assessed.	To assess, diagnose & treat impaired cortical surfaces due to epilepsy, trauma & vascular accidents.
	6. Describe the upper & lower motor neurones (UMN & LMN) of the major descending pathways (corticospinal, corticonuclear, vestibulospinal, tectospinal & reticulospinal tracts): information transmitted, decussation levels, location of the cell bodies of the UMN & LMN in the cerebrum, brainstem & spinal cord.	To assess, diagnose & treat motor pathway lesions.
	7. Describe how major descending pathways (corticospinal, corticonuclear, vestibulospinal, tectospinal & reticulospinal tracts) contribute to spasticity, hypotonia, decorticate rigidity & decerebrate rigidity.	Same as point 6 above.
	8. Describe the three order neurones of the ascending pathways (lateral & anterior spinothalamic, dorsal column & spinocerebellar tracts): information transmitted, decussation levels, location of the cell bodies of the neurones in the cerebrum, brainstem & spinal cord.	To assess, diagnose & treat sensory pathways lesions, for example, the Romberg test.
	9. Describe the location, pathway & roles of the main motor neurones (e.g., alpha & gamma efferent neurones, muscle spindle, Golgi neurone, Renshaw cell, UMN 1st order) controlling the intrafusal & extrafusal muscle fibers & Golgi tendon.	To interpret the signs & symptoms when assessing the knee jerk reflex, clasp-knife reflex & Golgi tendon reflex.
	10. Describe the basic normal pediatric reflexes & their clinical significances: reflex placing/ stepping/tonic neck/parachute responses, vertical suspension & primitive/landau/sucking/palmar/ plantar/grasp reflexes.	To assess common pediatric reflexes & understand the clinical significance of the results of the reflex tests.

TABLE 1 (Continued)

Anatomical region	Learning objective: A newly qualified level Band 5 physiotherapist should be able to	Clinical Situations/Scenarios/Cases/Assessment/Analysis[a] that a newly qualified level Band 5 physiotherapist will encounter & would require the objective
	11. Describe the anatomical basis of pyramidal versus extrapyramidal signs & UMN versus LMN damage signs.	To explain poliomyelitis, motor neurone disease, Bell's palsy, peripheral neuropathy.
	12. Use anatomical knowledge of ascending & descending pathways to work out the site of lesion.	To explain Brown-Sequard syndrome & syringomyelia.
	13. Describe the roles & locations of the basal ganglia nuclei & their projections & neurotransmitters.	To explain Huntington's chorea, athetosis & Parkinson's disease.
	14. Describe the location of the lobes of the cerebellum & their roles & neural input & outputs.	To explain cerebellar ataxia, finger-to-nose test, heel–knee-shin test, dysdiadochokinesia.
	15. Describe the major neuroanatomical structures forming the limbic system.	To explain the impact of the hippocampus of the limbic system in patients with dementia.
	16. Describe the neural pathway for vision & relate it to the different types of hemianopias & explain the significance of light & accommodation reflexes.	To know where to stand in front of a patient, designing exercise therapy that accounts for visual deficits.
	17. Describe the vestibular apparatus: bony location, shape & parts, & mechanism of action.	To be able to provide vestibular rehabilitation through habituation & gaze stabilization exercise. To recognize when to refer to a vestibular specialist.
	18. Describe the course & distribution of the main arteries & veins of the brain, brainstem & spinal cord & relate vessels' field of supply to neurological deficits.	To assess & treat different types of strokes.

Abbreviations: 10RM, 10 repetition maximum; 1RM, 1 repetition maximum; CMC joint, carpometacarpal joint; MRC, Medical Research Council.
[a]The suggested Clinical Situations/Scenarios/Cases/Assessment/Analysis refer to patients and clinical assessment and treatment, though may equally refer to clients or other service users receiving physiotherapy in different settings.

appendicular structures. Lastly, Anat-LOs related to neuroanatomy are organized as a systems-based series of Anat-LOs, reflecting its level of integrated function across the body. Where needed, important interfaces between neuroanatomy and other systems are highlighted within regional subsections, to highlight specific common clinical presentations (e.g., brachial plexus lesions). Across the specialities, there are differences in the number of Anat-LOs, which reflects the balance between required levels of anatomy and physiology knowledge to effectively underpin each subset of physiotherapy practice.

4 | DISCUSSION

An anatomy syllabus for undergraduate physiotherapy students in the UK has been created for the first time, in response to earlier calls in the UK (Darcus & Parry, 1955) and USA (APTA, 2020; Carroll, McKenzie, & Tracy-Bee, 2022; Carroll, Tracy-Bee, & McKenzie, 2021; Worthingham, 1968). This contextualized anatomical knowledge provides part of the scaffolding that underpins clinical reasoning to inform developing clinical assessment, diagnosis, rehabilitation prescription and progression. The proposed syllabus was arranged by body regions, like the other syllabi for both medical (McHanwell et al., 2007; Smith, Finn, Stewart, Atkinson, et al., 2016) and dental practice (Matthan et al., 2020). In contrast, health professional students that use relatively more limited anatomical knowledge like pharmacy and nursing students, have anatomy syllabi arranged according to body systems (Connolly et al., 2018; Finn et al., 2018).

The musculoskeletal system dominated the 182 Anat-LOs in line with literature (Latman & Lanier, 2001; Mattingly & Barnes, 1994). The current syllabus has more Anat-LOs than the 163 of the original 2007 anatomy syllabus for medical students containing 19 neuroanatomy Anat-LOs (McHanwell et al., 2007) and the 156 Anat-LOs in a later revised medical syllabus that excluded neuroanatomy (Smith, Finn, Stewart, Atkinson, et al., 2016). The recent IFAA core musculoskeletal syllabus for physiotherapy had a much higher and granular list than all the other studies with 1700 items (Woodley et al., 2022). The high number was in part because they used a much lower core consensual threshold of 60% (Woodley et al., 2022), rather than the common 80% (Connolly et al., 2018; Matthan et al., 2020; McHanwell et al., 2007; Moxham et al., 2014; Smith, Finn, Stewart, Atkinson, et al., 2016). The 18 neuroanatomy Anat-LOs in the current physiotherapy syllabus aligns with the number of neuroanatomy Anat-LOs for medicine (McHanwell et al., 2007). The core anatomy syllabus for nursing students contained 64 Anat-LOs (Connolly et al., 2018) while the anatomy syllabus for dental practice had 147 Anat-LOs (Matthan et al., 2020).

There are some notable differences between the core musculoskeletal anatomy syllabus lists recently created by the IFAA (Woodley et al., 2022) with this study. The IFAA study was meant for a global

audience studying undergraduate physiotherapy degree level qualifications and used an international Delphi panel, where 68% of them were based in the USA and Canada (Woodley et al., 2022), where a doctoral degree qualification is the entry-level physiotherapy qualification. The doctoral level of qualification may make it difficult to differentiate the needs of an undergraduate degree programme when directly compared to a doctoral physiotherapy degree, and potentially impact on the rating of relevant items. The current study targets undergraduate physiotherapy degree programmes in the UK, and the entire Delphi panel was based in the UK and understood the local national training terrain, while the IFAA study had no UK representation on its Delphi panels. The IFAA study generated highly granular lists of often anatomical structures without verbs (Woodley et al., 2022), whereas the current study created learning objectives with clear verbs to better clarify what is to be learnt. The IFAA research is limited to musculoskeletal concepts, vertebral column, upper limb and lower limb regions (Woodley et al., 2022), while this study was much broader in scope, and also included the head, neck, thorax, abdomen, pelvis and neuroanatomy. The learning objectives in the current study generally have more integrated basic anatomy and clinical physiotherapy content, while the items in the IFAA study generally had listed items with either basic anatomy or clinical physiotherapy content. Overall, the current study has a more comprehensive anatomy syllabus for undergraduate physiotherapy teaching specifically designed for the UK setting than the IFAA study.

The Anat-LOs associated with specific body regions vary in their importance according to the learning needs of different health professions. In the current study, Anat-LOs from the "Head and Neck" Region and "Abdomen", "Pelvis and Perineum" Regions received most rejections, largely because the content was felt to be pitched at postgraduate physiotherapy level, and mirrors the reduced relevance of abdominal (Mattingly & Barnes, 1994; Shead et al., 2019) and pelvic region assessment (Mattingly & Barnes, 1994) to entry-level physiotherapy practice. Similarly, Matthan et al. (2020) also experienced heavy rejection rates for those anatomy learning outcomes, which were perceived as irrelevant to daily dental work.

Teaching anatomy integrated with clinical physiotherapy knowledge and skills aids deeper learning through association (Shead et al., 2020) and will be useful in the foreseeable future. Alongside the availability of teaching resources, the availability of anatomy teachers with clinical physiotherapy training is therefore an important aspect of physiotherapy education, just as clinically trained medical teachers are essential for medical curricula (Koens et al., 2006; McCrorie, 2000). Clinician anatomists also provide useful links, blending anatomy and clinical knowledge together to highlight the importance and relevance of each Anat-LO. The current study placed clinical rationales alongside the Anat-LOs to provide justification according to the work of entry-level clinicians. Generally, studies on Anat-LOs tend not offer these types of examples though nursing and pharmacy Anat-LOs syllabi are rare exceptions (Connolly et al., 2018; Finn et al., 2018). For the future, the inclusion of clinical rationales may help reduce levels of disagreement between members of Delphi panels. Notably, these Anat-LOs typically went beyond knowledge and included key anatomical skills, such as palpation and conducting manual tests on model patients, thus aligning with recommendations by Kneebone (2009), and differing from other core curricula for health professions that are largely focused on descriptive anatomical knowledge (McHanwell et al., 2007; Smith, Finn, Stewart, Atkinson, et al., 2016).

Those directly involved in teaching are encouraged to consider the 182 Anat-LOs and provide academic justification for omitting or modifying certain Anat-LOs in their curriculum. For example, when asking students to model for each other in surface anatomy classes, teaching some of the applied Anat-LOs may need to be modified, in line with students' reasonable requests, where students have concerns about exposing their bodies to other students for personal, cultural, or religious reasons (Shead et al., 2019). Equally, the 182 Anat-LOs are available to guide students who are expected to be independent learners. Therefore, it would be reasonable for students to request teachers provide learning opportunities for any omitted Anat-LOs. If programme review revealed this had been repeated across several student cohorts, teaching staff may elect to formally incorporate the omitted Anat-LOs. The proposed core syllabus has left it up to those skilled teachers to use their professional judgment when deciding on instructional delivery and resources, as suggested by Berman (2014). At the early stages of clarifying relevant Anat-LOs for physiotherapy, the 182 Anat-LOs are intended to initiate more debate on what to learn.

The timing of anatomically informed teaching is a crucial factor when considering physiotherapy curricula. Students will have a reinforced learning habit when anatomical teaching sits alongside related physiological and clinical learning. Some anatomical knowledge might require students to learn preceding underpinning anatomy concepts, while the availability of facilities, timetables and staffing will influence when disciplinary knowledge is best taught.

The tradition is to teach anatomy modules in the first 2 years of a physiotherapy degree programme in the USA (Abdur-Rahman, 2007; Berube et al., 1999; Latman & Lanier, 2001; Mattingly & Barnes, 1994; Reimer et al., 2013; Thomas et al., 2011) and South Africa (Shead et al., 2018). The tradition started in the early 1900s, where anatomical teaching arranged in the first two preclinical years before the latter three clinical years, was celebrated as the gold standard for anatomical teaching in the Flexner Report (Flexner, 1910). The last two decades has witnessed the breakdown of this tradition through the intercalation of clinical teaching during anatomy teaching in the first 2 years alongside formal timetabled anatomy teaching in the later years (Bergman et al., 2011; Estai & Bunt, 2016). Within the UK, anatomy is learned throughout the physiotherapy undergraduate years, with the bulk in the earlier years (Gangata & Vigurs, 2017). The timing and sequencing of the 182 Anat-LO has not been specified, and gives institutions and teachers flexibility, but all ought to be achieved by the time students graduate. It is hoped that the 182 Anat-LOs will become guidance for teachers to assist in supporting requests for adequate teaching time slots and the provision of necessary human and alternative teaching resources to ensure graduates are able to achieve the 182 Anat-LO standards.

Two modified Delphi rounds were used in the current study, which compares to other studies for medical (Smith, Finn, Stewart, & McHanwell, 2016), dental (Matthan et al., 2020), pharmacy (Finn et al., 2018) and nursing studies (Connolly et al., 2018) on Anat-LOs. The current study had fewer participants (four in the RTEP and nine in the TEP) than physiotherapy Delphi panel (Woodley et al., 2022), the medical Delphi panel (Smith, Finn, Stewart, & McHanwell, 2016), the dental Delphi panel (Matthan et al., 2020) and the nursing Delphi panel (Connolly et al., 2018) with 53, 49, 62 and 48 individuals respectively. However, this panel size was smaller to reflect the precise inclusion criteria where all participants had to have practiced physiotherapy and have taught anatomy to physiotherapy students. This particular panel was selected to ensure sufficient physiotherapeutic knowledge and experience to interpret the clinical rationale used to justify the Anat-LOs and their clinical context. All the members of the RTEP of the current study were clinically trained, to facilitate adjudication over disputed Anat-LOs (Smith, Finn, Stewart, & McHanwell, 2016).

Specialist anatomists are often responsible for preparing high quality teaching materials, including prosection specimens, and provide highly detailed pure anatomical content, but have no specific first-hand clinical expertise to draw upon to illustrate its relevance. In contrast, clinically trained anatomy teachers are able to provide highly pertinent examples of clinical relevance, but are likely to have less detailed anatomical knowledge (Koens et al., 2006; McCrorie, 2000; Scott, 1993). It is possible that non-clinically trained anatomists may find some of the Anat-LOs harder to interpret where there is significant clinical context. These points suggest that an optimum solution is to create a culture of close cross-professional collaboration and knowledge sharing. Furthermore, the 182 Anat-LOs core syllabus will offer non-clinical anatomists ideas on the physiotherapy clinical relevance of anatomical structures (Carroll, Tracy-Bee, & McKenzie, 2021). As physiotherapists tend to specialize as they progress in their careers, their knowledge may weaken over time across other physiotherapy specialist areas of practice. It is hoped that qualified physiotherapists will also benefit by being given further clarity on what anatomy to teach (Carroll, Tracy-Bee, & McKenzie, 2021), especially when they can be reminded of its clinical relevance via the proposed 182 Anat-LOs.

Should anatomy teachers for physiotherapy teach the strict core anatomy syllabus and no further, or teach the strict core anatomy syllabus and beyond? Moxham et al. encouraged both: either by teaching the strict core anatomy syllabus with higher examination pass marks or teaching beyond the core anatomy syllabus with a lower examination pass marks (Moxham et al., 2020). Teachers should be allowed to inspire students with supra-core content reflecting their clinical (Carroll, Tracy-Bee, & McKenzie, 2021) or research interests. Appropriate textbooks will need to extend a little further than the Anat-LOs to encourage deep learning, and encourage curiosity, rather than encouraging rigid rote learning by students or "learning to order". It is clear that students learning anatomy experience a natural decay in their learning, according to the Ebbinghaus knowledge forgetting curve (D'Eon, 2006; Mateen & D'Eon, 2008). This knowledge decay has been observed in physiotherapy students in the UK (Gangata & Vigurs, 2017) and Australia (Manisha et al., 2017). The 182 Anat-LOs are expected to represent the final residual knowledge and skills achieved by the end of the undergraduate degree programme and are not seen as the maximum that may be learned. Ideally, anatomy teachers should be free to teach more than the proposed anatomy syllabus to account for the Ebbinghaus forgetting curve, so students qualify with the 182 Anat-LOs intact. Earlier, forgotten knowledge will require refreshing in the latter part of the undergraduate programme to ensure that at graduation, students are capable of the 182 Anat-LOs, as indicated in the Figure 4. Figure 5 is not based on data collected from the current study but shows potential future implications for knowledge retention levels of the proposed 182 Anat-LOs. For example, the Anat-LO "The basic course & supply of the tibial & fibular nerves & their branches" might be taught in greater detail as more complex clinical reasoning is undertaken, so that by the time the students graduate, they will retain the "basics". The emphasis is to inform

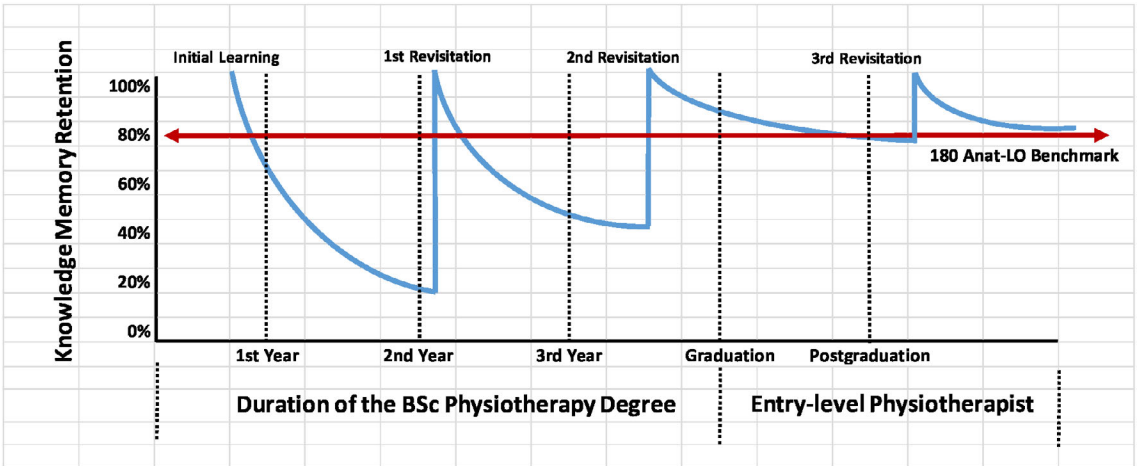

FIGURE 5 An illustrative suggestion of how anatomical knowledge suffers from exponential decay with time, according to the Ebbinghaus forgetting curve

the residual knowledge that physiotherapy graduates take into their career rather than focus on any temporary spike in anatomical knowledge and/or skills during a teaching session or anatomical test. Thus, the core syllabus focuses on the required level of knowledge to be retained at the time of graduation (Matthan et al., 2020). Revisitation of anatomical knowledge offers some protection against the Ebbinghaus forgetting curve in physiotherapy students (Anderson & Conley, 2000).

The following recommendations associated with the anatomy syllabus for entry-level physiotherapists are being proposed. Further research is now due to clarify the roles of entry-level physiotherapists to better influence undergraduate curricula. Some Anat-LOs initially proposed by the RTEP were deemed beyond the scope of entry-level physiotherapist expectations. However in the absence of literature specifically documenting a required range of anticipated entry-level physiotherapist roles, this set of clinically orientated 182 Anat-LOs has been compiled in preference to Anat-LOs designed purely to satisfy an academic judgment of learning (Carroll, Tracy-Bee, & McKenzie, 2021).

The 182 Anat-LOs are intended to influence the undergraduate training of entry-level physiotherapists and follow-on work would be necessary to translate the new Anat-LOs into undergraduate curricular documents and continuing professional development courses targeting the early development of newly qualified physiotherapists. Within the nursing profession, there is a reluctance by clinical mentors to incorporate bioscientific principles into clinical practice (Molesworth & Lewitt, 2015) and support might be needed for supervisors of entry-level physiotherapists to encourage more integration of anatomy with clinical physiotherapy practice.

Learning outcomes/objectives are widely used in medical education and the practice has extended into anatomical education (Smith, Finn, Stewart, & McHanwell, 2016). Philosophical and theoretical interrogation of the practice on using learning objectives in anatomical education and how we structure syllabuses, and their impact on teaching assessments and clinical practice is now due, perhaps as a doctoral thesis.

UK employers tend to equally value all entry-level physiotherapist staff from various the types of qualifying pre-registration UK physiotherapy qualifications, and it seems reasonable to propose the agreed 182 Anat-LOs as guidance for all the various UK qualifying programmes. More work will be needed to establish a broad consensus at a national level on an anatomy curriculum for physiotherapy and the proposed syllabus will be offered as a discussion document for the CSP. It is suggested that a national anatomy syllabus with a general consensus will need reviewing regularly, perhaps every 4–7 years alongside the CSP programme review (CSP, 2020), similar to the 5-to-8 year period recommended by Carroll et al. (Carroll, Tracy-Bee, & McKenzie, 2021). Regular review will need to accommodate feedback from anatomy and physiotherapy teachers (Carroll, Tracy-Bee, & McKenzie, 2021), changes in professional scope of practice and the ever-expanding physiotherapy knowledge base, changes in employment patterns for entry-level physiotherapists and changing dominant conditions, for example, the Covid-19 coronavirus may require changes in required underpinning anatomical knowledge and skills for an entry-level physiotherapist. In the UK, there are 28 physiotherapy sub-discipline specialties affiliated to the CSP, such as hand therapy, sports physiotherapy and neurology (CSP, 2022) and many other physiotherapy sub-discipline specialties not affiliated with the CSP. It would be fitting to consider a follow-on study to consult with the UK physiotherapy sub-discipline specialties on the proposed anatomy syllabus for entry-level physiotherapists and take their views into consideration in a balanced manner. Certain Anat-LOs rejected from the current study for being too detailed could be the starting point for creating Anat-LOs for postgraduate physiotherapy specialties.

In conclusion, a core anatomy syllabus of 182 Anat-LOs has been proposed for entry-level physiotherapists in the UK and are the first ever Anat-LOs for the physiotherapy profession worldwide. The core anatomy syllabus is the first created by a Delphi panel consisting of clinicians who also teach anatomy. It is hoped that the 182 Anat-LOs will provide guidance for anatomy teachers, students, student clinical supervisors, clinical supervisors for entry-level physiotherapists and physiotherapy regulatory bodies when considering what anatomical knowledge and skills are core for the profession in the UK. The core anatomy syllabus synthesizes anatomical knowledge and core clinical physiotherapy skills to foster better vertical integration of learning. The Anat-LOs are designed to suit, primarily, UK frameworks and terrain for training physiotherapists. The proposed core anatomy curriculum intends to stimulate debate on what anatomy should be taught to physiotherapy students and hopefully raise anatomical standards. The core syllabus may inspire other health professions to undertake similar work.

5 | NOTES ON CONTRIBUTORS

Dr Hope Gangata, BSc Anatomy, BSc Physiotherapy, MSc Anatomy, MA Education, EdD, SFHEA, M.C.S.P., HCPC-Registered Physiotherapist, is a Senior Anatomy Lecturer at the University of Exeter, United Kingdom. He has taught anatomy on health degree programmes for over 20 years. Hope has a research interest in anatomical education.

Dr Stuart Porter, BSc. Hons, Ph.D., SFHEA, PGCAP, Grad. Dip. Phys, M.C.S.P., HCPC, MLACP, HCPC-Registered Physiotherapist, is a Lecturer in Physiotherapy at the University of Salford, United Kingdom. He has taught anatomy to physiotherapy students for over 30 years and has authored several anatomy and physiotherapy textbooks.

Dr Neil Artz; BSc Anatomical Sciences, BSc Physiotherapy, Ph.D., FHEA, M.C.S.P., HCPC-Registered Physiotherapist, is the Academic Course Leader for Physiotherapy at the University of Gloucestershire, United Kingdom. He lectures anatomy, musculoskeletal physiotherapy and research methods to physiotherapy students. His research interest is on the cervical spine and knee arthroplasty.

Mrs Kim Major, BSc Physiotherapy, MSc Physiotherapy, SFHEA, M.C.S.P., HCPC-Registered Physiotherapist, is a Lecturer at Keele University, United Kingdom. She is the Programme Director Post-Graduate Taught Programmes and has taught anatomy and

physiotherapy for over 25 years on undergraduate/postgraduate physiotherapy degree programmes. Her research interest lies in musculoskeletal clinical assessment/diagnosis.

ACKNOWLEDGMENTS

We would like to thank all the nine physiotherapists in the Delphi Teacher-Expert-Panel who spent time reviewing Anat-LOs. The manuscript was proofread by Jessica Porter. Preliminary abstracts were poster presented at the 13–14 November 2020 Virtual Physiotherapy Conference of the CSP of the United Kingdom and orally presented at the 6–8th January 2021 Virtual Anatomical Society Conference of the Anatomical Society of Great Britain and Ireland.

ORCID

Hope Gangata https://orcid.org/0000-0002-2085-6848

REFERENCES

Ab Latif, R., Mohamed, R., Dahlan, A., & Mat Nor, M. Z. (2016). Using Delphi technique: Making sense of consensus in concept mapping structure and multiple-choice questions (MCQ). *Education in Medicine Journal*, *8*(3), 89–98.

Abdur-Rahman, A. (2007). *Anatomy education in physical therapy programs (A thesis for a doctor of physical therapy degree)*. Springfield College.

Ambler, S. B. (2020). The debt burden of entry-level physical therapist. *Physical Therapy*, *100*(4), 591–599.

Anderson, J. C., & Conley, L. K. (2000). Retention of anatomical detail. *Journal of Physical Therapy Education*, *14*(1), 44–47.

APTA. (2020). *American Physical Therapy Association. 100 years, 1921–2021, 100 milestones of physical therapy*. American Physical Therapy Association.

Barclay, J. (1994). *In good hands: the history of the Chartered Society of Physiotherapy, 1894–1994*. Butterworth-Heinemann.

Bergman, E. M. M., Van Der Vleuten, C. P. M., & Scherpbier, A. J. J. (2011). Why don't they know enough about anatomy? A narrative review. *Medical Teacher*, *33*(5), 403–409.

Berman, A. C. (2014). Anatomy of curriculum: Digging to the core. *Anatomical Sciences Education*, *7*(4), 326–328.

Berube, D., Murray, C., & Schultze, K. (1999). Cadaver and computer use in the teaching of gross anatomy in physical therapy education. *Journal of Physical Therapy Education*, *13*(2), 41–46.

Carroll, M. A., McKenzie, A., & Tracy-Bee, M. (2022). Movement system theory and anatomical competence: Threshold concepts for physical therapist anatomy education. *Anatomical Sciences Education*, *15*(2), 420–430.

Carroll, M. A., Tracy-Bee, M., & McKenzie, A. (2021). Call for consistency: The need to establish gross anatomy learning objectives for the entry-level physical therapist. *Medical Science Educator*, *31*, 1193–1197.

Chernikova, O. (2020). Facilitating diagnostic competences in higher education: A meta-analysis in medical and teacher education. *Educational Psychology Review*, *32*(1), 157–196.

Connolly, S. A., Gillingwater, T. H., Chandler, C., Grant, A. W., Greig, J., Meskell, M., Ross, M. T., Smith, C. F., Wood, A. F., & Finn, G. M. (2018). The anatomical society's core anatomy syllabus for undergraduate nursing. *Journal of Anatomy*, *232*(5), 721–728.

CSP. (2020). *CSP accreditation of qualifying programmes in physiotherapy: quality assurance processes of the Chartered Society of Physiotherapy*. Chartered Society of Physiotherapy. https://www.csp.org.uk/documents/csp-accreditation-qualifying-programmes-physiotherapyqualityassuranceprocesses

CSP. (2022). *The 28 professional networks recognised by the Chartered Society of Physiotherapy*. Chartered Society of Physiotherapy. https://www.csp.org.uk/networks/professional-networks

Darcus, H. D., & Parry, C. B. W. (1955). Anatomy and physiology in the teaching and practice of physiotherapy and occupational therapy. *Rheumatology*, *2*(7), 242–247.

D'Eon, M. F. (2006). Knowledge loss of medical students on first year basic science courses at the University of Saskatchewan. *BMC Medical Education*, *6*, 5.

Drake, R. L., McBride, J. M., & Pawlina, W. (2014). An update on the status of anatomical sciences education in United States medical schools. *Anatomical Sciences Education*, *7*(4), 321–325.

Estai, M., & Bunt, S. (2016). Best teaching practices in anatomy education: A critical review. *Annals of Anatomy-Anatomischer Anzeiger*, *208*, 151–157.

Fakoya, F. A., Emmanouil-Nikoloussi, E., Sharma, D., & Moxham, B. J. (2017). A core syllabus for the teaching of embryology and teratology to medical students. *Clinical Anatomy.*, *30*, 159–167. https://doi.org/10.1002/ca.22802

Finn, G. M., Hitch, G., Apampa, B., Hennessy, C. M., Smith, C. F., Stewart, J., & Gard, P. R. (2018). The Anatomical Society core anatomy syllabus for pharmacists: Outcomes to create a foundation for practice. *Journal of Anatomy*, *232*(5), 729–738.

Flexner, A. (1910). *Medical education in the United States and Canada*. The Carnegie Foundation for the Advancement of Teaching. https://doi.org/10.1001/jama.1943.02840330031008

Gangata, H., & Vigurs, K. (2017). An analysis of pedagogical concepts used by anatomy teachers to facilitate the teaching and learning of anatomy to physiotherapy undergraduates. *Physiotherapy Journal*, *103*, e47–e48.

HCPC-Register. (2021). *Health and Care Professions Council website of the register of approved physiotherapy degree programmes*. HCPC-Register. https://www.hcpc-uk.org/education/approved-programmes/

Heylings, D. J. A. (2002). Anatomy 1999-2000: The curriculum, who teaches it and how? *Medical Education*, *36*(8), 702–710.

IFAA. (2019). *Federative International Program for Anatomy Education: Core syllabuses project*. International Federation of Associations of Anatomists. https://www.ifaa.net/committees/anatomical-educa%0Ation-fipae/%0Afipae%0A-core-%0Asylla%0Abuses-proje%0Act/

Keeney, S., Hasson, F., & McKenna, H. P. (2011). *The delphi technique in nursing and health research* (1st ed.). Wiley-Blackwell Publishing.

Kneebone, R. (2009). Perspective: Simulation and transformational change: The paradox of expertise. *Academic Medicine*, *84*(7), 954–957.

Koens, F., Custers, E. J. F. M., ten Cate, O. T. J., & ten Cate, O. (2006). Clinical and basic science teachers' opinions about the required depth of biomedical knowledge for medical students. *Medical Teacher*, *28*(3), 234–238.

Latman, N. S., & Lanier, R. (2001). Gross anatomy course content and teaching methodology in allied health: Clinicians' experiences and recommendations. *Clinical Anatomy*, *14*(2), 152–157.

Leonard, R. (1996). A clinical anatomy curriculum for the medical student of the 21st century: Gross anatomy. *Clinical Anatomy*, *9*(2), 71–99.

Ma, C., Tabarsi, N., & Chen, L. (2017). Clinical reasoning and threshold concepts. *Academic Medicine*, *92*(4), 426.

Manisha, D., Owens, J., Gibson, W., & Strkalj, G. (2017). Anatomical knowledge retention in physiotherapy students: A preliminary assessment. *International Journal of Anatomy and Research*, *5*(1), 3474–3479.

Mateen, F. J., & D'Eon, M. F. (2008). Neuroanatomy: A single institution study of knowledge loss. *Medical Teacher*, *30*(5), 537–539.

Matthan, J., Cobb, M., McHanwell, S., Moxham, B. J., & Finn, G. M. (2020). The anatomical society's core anatomy syllabus for dental undergraduates. *Journal of Anatomy*, *236*(4), 737–751.

Mattingly, G. E., & Barnes, C. E. (1994). Teaching human anatomy in physical therapy education in the United States: A survey. *Physical Therapy*, *74*(8), 720–727.

McCrorie, P. (2000). The place of the basic sciences in medical curricula. *Medical Education*, *34*(8), 594–595.

McHanwell, S., Davies, D. C., Morris, J., Parkin, I., Whiten, S., Atkinson, M., Dyball, R., Ockleford, C., Standring, S., & Wilton, J. (2007). A core

syllabus in anatomy for medical students – Adding common sense to need to know. *European Journal of Anatomy*, *11*(Suppl. 1), 3–18.

Molesworth, M., & Lewitt, M. (2015). Preregistration nursing students' perspectives on the learning, teaching and application of bio-science science knowledge within practice. *Journal of Clinical Nursing*, *25*(5–6), 725–732.

Moxham, B., McHanwell, S., Plaisant, O., & Pais, D. (2015). A core syllabus for the teaching of neuroanatomy to medical students. *Clinical Anatomy*, *28*(6), 706–716.

Moxham, B. J., Stephens, S., Sharma, D., & Loukas, M. (2020). A core syllabus for the teaching of gross anatomy of the thorax to medical students. *Clinical Anatomy*, *33*(2), 300–315.

Moxham, B. J., Plaisant, O., Smith, C. F., Pawlina, W., & McHanwell, S. (2014). An approach toward the development of core syllabuses for the anatomical sciences. *Anatomical Sciences Education*, *7*, 302–311. https://doi.org/10.1002/ase.1456

Paalman, M. H. (2000). Why teach anatomy? Anatomists respond. *The Anatomical Record*, *261*(1), 1–2.

Reimer, E., Laurenzano, H., & Tages, M. (2013). *Gross anatomy survey: how do physical therapy schools in the United States teach gross anatomy? (A thesis for a BSc Honours degree)*. Northeastern University. http://hdl.handle.net/2047/d20003266

Scott, T. M. (1993). How we teach anatomy efficiently and effectively. *Medical Teacher*, *15*(1), 67–75.

Shead, D. A., Roos, R., Olivier, B., & Ihunwo, A. O. (2018). Gross anatomy education for South African undergraduate physiotherapy students. *Anatomical Sciences Education*, *11*(6), 554–564.

Shead, D. A., Roos, R., Olivier, B., & Ihunwo, A. O. (2019). Opinions of South African physiotherapists on gross anatomy education for physiotherapy students. *South African Journal of Physiotherapy*, *75*(1), 1–10.

Shead, D. A., Roos, R., Olivier, B., & Ihunwo, A. O. (2020). Curricular and pedagogical aspects of gross anatomy education for undergraduate physiotherapy students: A scoping review. *JBI Evidence Synthesis*, *18*(5), 893–951.

Smith, C. F., Finn, G. M., Stewart, J., Atkinson, M. A., Davies, D. C., Dyball, R., Morris, J., Ockleford, C., Parkin, I., Standring, S., Whiten, S., Wilton, J., & McHanwell, S. (2016). The Anatomical Society core regional anatomy syllabus for undergraduate medicine. *Journal of Anatomy*, *228*(1), 15–23.

Smith, C. F., Finn, G. M., Stewart, J., & McHanwell, S. (2016). Anatomical Society core regional anatomy syllabus for undergraduate medicine: The Delphi process. *Journal of Anatomy*, *228*(1), 2–14.

Thomas, K. J., Denham, B. E., & Dinolfo, J. D. (2011). Perceptions among occupational and physical therapy students of a non-traditional methodology for teaching laboratory gross anatomy. *Anatomical Sciences Education*, *4*(2), 71–77.

Tubbs, R. S., Sorenson, E. P., Sharma, A., Benninger, B., Norton, N., Loukas, M., & Moxham, B. J. (2014). The development of a core syllabus for the teaching of head and neck anatomy to medical students. *Clinical Anatomy*, *27*(3), 321–330.

Webb, A. L., Green, R. A., & Woodley, S. J. (2019). The development of a core syllabus for teaching musculoskeletal anatomy of the vertebral column and limbs to medical students. *Clinical Anatomy*, *32*(8), 974–1007. https://doi.org/10.1002/ca.23319

Wicksteed, J. (1948). *The growth of a profession: being the history of the chartered society of physiotherapy 1894–1945* (1st ed.). Edward Arnold.

Woodley, S. J., Green, R. A., & Webb, A. L. (2022). A core musculoskeletal anatomy syllabus for undergraduate physical therapy student education. *Clinical Anatomy*, 1–34. https://doi.org/10.1002/ca.23953

Worthingham, C. A. (1968). Curriculum patterns for basic physical therapy education compared with six selected undergraduate fields. *Physical Therapy*, *48*, 7–20.

How to cite this article: Gangata, H., Porter, S., Artz, N., & Major, K. (2023). A proposed anatomy syllabus for entry-level physiotherapists in the United Kingdom: A modified Delphi methodology by physiotherapists who teach anatomy. *Clinical Anatomy*, 1–24. https://doi.org/10.1002/ca.24001