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High Price of Perfection that Is Anatomy: Why Studying and Teaching the Human Body Is a Financial Muscle

Akunna Godson Gabriel[1] & Saalu Linus Chia[1]

[1] Department of Anatomy, Faculty of Basic Medical Sciences, Benue State University, Benue, Nigeria

Correspondence: Akunna Godson Gabriel, Department of Anatomy, Faculty of Basic Medical Sciences, Benue State University, Benue, Nigeria.

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Abstract

The Anatomy Department is often viewed as one of the most expensive to maintain within Basic Medical Sciences, a reality not unique to any particular institution but consistent globally. This mini-review examines the factors contributing to the high costs of maintaining an Anatomy Department, including specialized infrastructure, safety regulations, ethical considerations, and the resources required for cadaveric dissection. The separation of anatomy buildings from other departments is driven by safety and hygiene needs, psychological and ethical concerns, and space requirements for specialized labs. Unlike other departments, Anatomy requires multiple dedicated labs, such as dissection, microscopic anatomy, and model/simulation labs, which add to the financial burden. Additionally, the procurement, preservation, and ethical management of human specimens incur significant ongoing costs. The rise of digital tools like the Anatomage table, though beneficial in some ways, presents high initial and maintenance costs that may exacerbate financial challenges, particularly for institutions in resource-constrained settings. While digital dissection tools offer educational advantages, they cannot replace the hands-on experience of working with human cadavers, which is essential for developing ethical and professional medical practices. This review calls for sustainable funding models and innovative solutions to reduce financial pressures while ensuring the continued success and efficacy of anatomy education.

Keywords: anatomy department, medical education, cadaveric dissection, budget, gross anatomy, histology, embryology, anatomical models, digital tools, tissue preservation, educational costs, sustainable funding

1. Introduction

A highly respected colleague at the University once asked why the Anatomy Department appears more expensive to maintain compared to other departments in the Basic Medical Sciences. I provided a thoughtful and well-considered response, which I believe would be valuable to share in your esteemed journal, in case anyone else faces a similar inquiry in the future.

It's important to recognize that this situation isn't unique to any particular institution, it aligns with global and international standards for Anatomy Departments across various continents.

The strategic placement of anatomy buildings, the specialized lab requirements, and the cost implications of alternatives like the Anatomage table reflect a combination of historical, practical, ethical, and technical considerations within medical education and research. These factors are influenced by several aspects of medical teaching, space utilization, safety regulations, and financial constraints (Sandler, 2017).

2. Anatomy Buildings Are Usually a *Long Stretch* Away from Other Departments

Back at my alma mater, the University of Ilorin, I once asked one of my lecturers, Professor Bernard Enaibe, why the Anatomy department, especially the gross anatomy lab was so far from the rest of the departments. His response was quick and confident: "Because we are special." Sure, everyone says they're special, right? But

years later, as an anatomist, I finally understood exactly what he meant, because in our field, the distance is as much about safety and, let's face it, a little bit of "preserved" exclusivity.

The placement of anatomy buildings away from other departments is driven by several key factors, primarily related to safety, ethical concerns, and institutional requirements.

Safety and Hygiene: Anatomy departments are tasked with handling cadavers, preserved human tissues, and other biological materials that can pose significant health risks if not properly contained. The handling of cadavers involves the use of formaldehyde and other chemicals for preservation, which emit strong odors and can be hazardous to human health if not properly managed (Tortora & Derrickson, 2014). As such, anatomy buildings are often situated away from high-traffic academic spaces to reduce exposure to these substances. Proper ventilation and containment systems are essential in anatomy labs to prevent contamination or the spread of hazardous materials, necessitating a controlled environment distinct from other academic units (Williams et al., 2017).

Ethical and Psychological Considerations: The study of human cadavers also presents significant ethical and psychological concerns. I remember that I couldn't eat beef for more than a year after seeing and feeling the cadaver. Imagine what a non-anatomy student will face in ame circumstance. Institutions may place anatomy buildings in isolated areas to provide students with a respectful, dedicated space for the study of human remains. This separation helps minimize the emotional impact of working with cadavers by distancing these sensitive areas from more public spaces, thus ensuring the dignity of the bodies used for educational purposes (MacDougall et al., 2015).

Space and Infrastructure: The anatomy department requires specialized facilities, including cadaver storage rooms, dissection labs, and bone maceration areas, which are best situated in spaces separate from other academic units. These facilities require substantial space and complex ventilation systems, which can be more easily managed in a separate building (Sandler, 2017). Additionally, the equipment used in anatomy labs, such as dissection tools, microscopes, and tissue processors, requires a specific layout that is not suitable for general classrooms or offices.

3. Anatomy Departments Require Three Labs to Operate, Unlike Other Departments

Anatomy departments require multiple specialized labs, often more than other departments, due to the diverse and complex activities involved in studying human anatomy. The need for different labs helps address the specific demands of various educational, research, and practical applications.

Dissection Labs: The most basic of these labs is the dissection lab, where students engage directly with cadavers to learn about the structure of the human body. Dissection is a hands-on activity that involves close interaction with human tissues, requiring a controlled, sterile environment to ensure safety and hygiene. These labs must be large enough to accommodate multiple students working simultaneously and must be equipped with sinks, sterilizers, and proper waste disposal systems (Rizzolo et al., 2019).

Microscopic Anatomy Labs: Anatomy education also involves studying tissues and cells at the microscopic level. For this, anatomy departments often have a separate histology lab where students learn to identify different tissue types and structures using microscopes and prepared slides. These labs are typically equipped with high-powered microscopes and slides, as well as staining equipment that enables detailed examination of cellular structures (Drake et al., 2014).

Model and Simulation Labs: In addition to cadaveric dissection and the study of tissue slides, modern anatomy departments incorporate digital models and simulations into their curriculum. This approach is particularly useful for teaching complex structures, such as the brain or heart, in ways that would be difficult with cadavers alone. Anatomical models, 3D simulations, and virtual dissection tools are increasingly being used to complement traditional cadaveric dissections, requiring dedicated spaces for both the equipment and teaching (Sullivan et al., 2018).

Thus, while other departments may only require a single lab to serve multiple functions (e.g., lectures, practicals, or seminars), anatomy departments require multiple specialized labs to support their comprehensive to teaching human anatomy.

4. Use of Human Specimens

Anatomy Departments: These departments require human tissue for dissection, which involves the procurement of specimens, legal compliance, preservation chemicals, and the necessary storage infrastructure. These are ongoing costs, as new tissue must be procured regularly due to the perishable nature of biological specimens.

Other Departments: In contrast, other departments focus primarily on tissue samples, cell cultures, or synthetic models, which are less expensive to maintain and do not require the same extensive facilities as human tissues.

Some people have argued that the use of Cadavers should be replaced with digital dissection tools. While the use of digital dissection tools, such as the Anatomage table, offers impressive technological advancements in anatomy education, there are several compelling reasons why they should not replace the conventional use of cadavers.

Hands-on Learning and Real-World Experience: Digital tools, while highly detailed, cannot replicate the tactile experience of working with actual human tissue. Dissecting a cadaver provides students with a unique, hands-on understanding of the body's structures and their relationships, which is crucial for developing essential surgical and diagnostic skills. The sensation of cutting through real tissue, identifying anatomical landmarks, and understanding the textures and variations in human bodies can't be simulated digitally (Rizzolo et al., 2019).

Ethical and Psychological Development: Working with cadavers also fosters an ethical understanding and respect for human life, as students are required to approach their work with reverence and professionalism. The direct interaction with human remains encourages students to consider the dignity of the body, a perspective that digital simulations cannot provide (MacDougall et al., 2015). The psychological benefits of learning from real human specimens, developing emotional resilience and maturity in medical practice, are essential for future healthcare professionals.

Contextual Learning: While digital tools provide detailed images, they often lack the context that comes with real anatomy. For example, anatomical variations between individuals, such as the presence of anomalies or variations in vascular structures can only be fully appreciated through direct dissection. Digital tools can only show what's programmed into them and may not present these real-world complexities that students might encounter in actual clinical practice (Sullivan et al., 2018).

Integration with Other Learning Modalities: While digital tools can certainly complement cadaveric dissections by offering a virtual representation of the body that's easier to manipulate and explore, they lack the multi-sensory engagement that cadaver-based dissection provides. The combination of touch, sight, and smell during dissection is critical for a comprehensive understanding of human anatomy. Using both digital and traditional methods together provides a more well-rounded educational experience (Drake et al., 2014).

Cost and Accessibility: Digital dissection tools like the Anatomage table are extremely expensive, both in terms of initial purchase and ongoing maintenance (Balkaran et al., 2020). Not all medical schools, particularly in low-resource settings, can afford such technologies, whereas cadavers, though costly in terms of preservation, can be more accessible and manageable for many institutions. Replacing cadavers with digital tools could create a divide in medical education, further widening the gap between well-funded institutions and those in resource-constrained environments.

5. Why Is the Anatomage Table So Expensive

The Anatomage table, a highly advanced 3D digital dissection tool, represents a modern alternative to traditional cadaver-based anatomy education. However, its high cost presents a challenge for many educational institutions.

Advanced Technology: The Anatomage table uses state-of-the-art technology to create interactive, life-size 3D images of human anatomy. These images are based on real CT scans and MRIs of human bodies, which are digitally reconstructed to allow students to explore human anatomy in great detail. The table's large, high-resolution touch screen, complex software, and integration with anatomical data make it a cutting-edge tool that requires substantial investment in both hardware and software (Sullivan et al., 2018). The development and maintenance of such technology significantly contribute to the high price of the table.

High Initial and Maintenance Costs: The cost of purchasing an Anatomage table includes not only the device itself but also the initial setup, software licensing, and ongoing maintenance. Institutions must also train staff to use the system effectively and regularly update the software to keep pace with advances in medical imaging techniques. The combined expenses for installation, maintenance, and personnel make the Anatomage a major financial investment (Balkaran et al., 2020).

Market Demand and Limited Competition: The Anatomage table is one of the most widely recognized and used digital dissection tools, with limited competition in the market. This scarcity of alternatives allows manufacturers to set high prices, as educational institutions seeking to modernize their anatomy programs view the table as a necessary investment despite its substantial cost (Schroeder et al., 2020).

6. Specialized Infrastructure

Anatomy Departments: Dissection halls, embalming rooms, and mortuary facilities, which require strict ventilation, temperature control, and biohazard management systems, are essential. These facilities necessitate significant initial investment and ongoing operational expenses.

Other Departments: While other departments may require advanced equipment (e.g., electrophysiology setups in Physiology or spectrophotometers in Biochemistry), they generally do not need the complex infrastructure

required for the preservation and dissection of human tissues.

6.1 Consumables

Anatomy Departments: High demand for chemicals like formalin, phenol, and ethanol for embalming and preservation results in the regular purchase of these consumables. Dissection tools, personal protective equipment (PPE), and models are also in constant use and require frequent replacement.

Other Departments: Consumables like reagents, glassware, and kits are necessary but generally less costly on a per-student basis compared to the preservation and maintenance needs of human tissues.

6.2 Teaching Resources

Anatomy Departments: These departments require expensive physical and virtual models, plastinated specimens, and skeletons for teaching, in addition to tissue. Large class sizes exacerbate costs, as additional specimens and resources are needed for effective hands-on training.

Other Departments: Use digital simulations, molecular kits, or tissue samples, which are less expensive and reusable across several semesters.

6.3 Student Intake and Resource Scaling

Anatomy Departments: Increasing student numbers directly strain resources, requiring more human tissue, chemicals, and expanded facilities. The physical space required for dissection classes is significant, making scalability more challenging.

Other Departments: Scaling is easier in other departments, as lectures, small lab experiments, and virtual tools can accommodate larger groups with less additional expense.

6.4 Research Costs

Anatomy Departments: Research often involves human tissue studies, which require significant funding for ethical compliance, specimen procurement, and advanced imaging equipment.

Other Departments: Research in other departments tends to focus on molecular or cellular levels, often utilizing pre-packaged kits and digital tools, which are comparatively cheaper.

6.5 Biohazard and Safety Compliance

Anatomy Departments: These departments must comply with strict biohazard disposal and occupational safety protocols for human tissues, involving specialized training and waste disposal services.

Other Departments: While safety protocols are also stringent in other departments, especially when handling chemicals or live samples, they are less logistically complex compared to handling human tissue waste.

7. Anatomy for Students, the Only Class That Will Really Cost You an Arm and a Leg

A popular lecturer of mine, Dr. Akunna G.G. (yes, that's me! *smiles*), once humorously remarked, "Anatomy is the only course that will leave you feeling poorly." And believe me, you read that right – because the real dissection and surgery happen in our wallets!

Studying anatomy for students is often much more expensive compared to other basic medical sciences, largely due to the multiple specialized textbooks and resources required for a comprehensive understanding of the subject. Unlike other disciplines that may only require a single textbook, anatomy demands a broader range of texts for various subfields. For example, to study gross anatomy, students typically need at least three textbooks to cover the complexities of human body structures in detail. A common choice for this subject is *Gray's Anatomy for Students* by Richard L. Drake, A. Wayne Vogl, and Adam W. M. Mitchell, which provides an extensive look at the human body's structures (Drake et al., 2014). Additionally, *Netter's Atlas of Human Anatomy* by Frank H. Netter, a highly regarded visual reference, and *Clinically Oriented Anatomy* by Keith L. Moore, are often used to deepen understanding of anatomical relationships and clinical relevance (Moore et al., 2014; Netter, 2014).

For histology, students require at least two textbooks to grasp both the microscopic and functional aspects of tissues. Key texts include *Junqueira's Basic Histology: Text and Atlas* by Anthony L. Mescher, which offers comprehensive coverage of tissue types and their structures (Mescher, 2018), and *Wheater's Functional Histology* by Barbara Young and John W. Heath, which focuses on the functional aspects of histological tissues and their importance in health and disease (Young & Heath, 2000).

Finally, to study embryology, students typically rely on a single textbook, such as *Larsen's Human Embryology* by Gary C. Schoenwolf and Steven B. Bleyl, which provides in-depth coverage of human development from fertilization to birth (Schoenwolf et al., 2015). This textbook is often complemented by other resources that discuss the clinical aspects of embryology, but generally, one book is sufficient for mastering the subject.

In contrast, many other basic medical sciences such as physiology, biochemistry, or pathology often require only one textbook, making anatomy an outlier in terms of both cost and resource allocation. This additional expenditure on textbooks for anatomy is just one aspect of the overall higher costs associated with anatomy education, which also includes specialized lab equipment, cadaver acquisition, and preservation materials.

8. Conclusion

While other departments within the basic medical sciences across Nigeria also face significant costs due to specialized equipment and reagents, Anatomy Departments are uniquely burdened by recurring and substantial expenses related to tissue maintenance, specialized infrastructure, and consumables. These ongoing financial demands make Anatomy Departments some of the most expensive to maintain in the medical sciences. Given these challenges, it is crucial for Anatomy Departments to explore sustainable funding models to alleviate financial strain. Potential revenue-generating strategies, such as tissue analysis, diagnostic services, and commercial embalming, could be considered to help mitigate the financial burden on institutions (Balkaran et al., 2020).

And yes, it's not just the department's budget that's affected, students' pockets and wallets feel the pinch too. Cutting costs in the Anatomy Department goes beyond just the knife; it's a balancing act that impacts everyone involved.

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