Received: 17 March 2026 | Revised: 18 June 2026 | Accepted: 14 July 2026

DOI: 10.1002/ase.70316

Anatomical Sciences Education | American Association for Anatomy | Wiley

DISCURSIVE ARTICLE

MAPPing out the future: Modified autopsy prosection protocol for gross anatomy in medical education

Chelsea M. Lohman[1,2] | Briauna Blezinski Johnson[1,2] | Danielle F. Royer[3] | Lisa M. J. Lee[1,2]

[1]Cell & Developmental Biology, University of Colorado Anschutz Medical Campus, Aurora, Colorado, USA

[2]Modern Human Anatomy Program, University of Colorado Anschutz Medical Campus, Aurora, Colorado, USA

[3]Independent Researcher

Correspondence
Chelsea M. Lohman, Cell & Developmental Biology, University of Colorado Anschutz Medical Campus, Aurora, CO, USA.
Email: chelsea.lohman@cuanschutz.edu

Abstract

Contact hour reduction and elimination of dissection in gross anatomy in the increasingly systems-based curricula have reshaped medical education in the United States. While prosection-based anatomical instruction enhances efficiency, regional dissection protocols may no longer be optimally aligned with systems-based curricula. Clinical autopsy protocols may provide an alternative approach that aligns with contemporary medical education needs. The Modified Autopsy Prosection Protocol (MAPP), derived from clinical autopsy procedures, was developed and implemented in a systems-based medical curriculum. MAPP integrated structured external exam, modified Y-incision, en masse viscera removal, preservation of body wall and pelvic floor anatomy, and systemic separation of organ blocs. Students encountered the MAPP donors throughout the year with clinically framed external examination and engagement using a flipped laboratory approach. The MAPP preserved inter-systemic anatomical relationships, enhanced clinical relevance, supported spaced and interleaved learning, and enabled customization based on donor variation and pathology. Challenges included increased resource demands, the need for faculty expertise, and enhanced donor care to preserve tissue integrity throughout prolonged curricular use. Despite the challenges, MAPP simultaneously accommodated the reduction of contact hours and demonstrated strong alignment with the clinically oriented, integrated medical curriculum. Implementation provided meaningful early exposure to autopsy techniques, with potential implications for interest in pathology training. MAPP is a novel, clinically oriented approach to gross anatomy prosection that supports pedagogical, temporal, and clinical demands of modern systems-based curricula. While resource intensive, it is a promising model. Ongoing analyses will continue to evaluate its short- and long-term educational impact.

KEYWORDS
autopsy, clinical integration, dissection, gross anatomy, medical education, prosection, systems-based curriculum

INTRODUCTION

Medical curricula in North America have shifted substantially over the course of the last few decades.[1–3] One major change in the basic sciences has been a considerable reduction in gross anatomy contact hours and a marked shift toward the use of prosected human donors as a primary instructional resource.[4] This pedagogical adaptation reflects the growing need to deliver core anatomical knowledge efficiently within compressed timeframes, while still preserving the educational value of interaction with human donors. By replacing traditional student-led dissections with expertly prepared prosections, donor anatomical integrity and clinical relevance are preserved, supplementing the evolving constraints of reduced contact hours in modern medical education.[5–7]

Regardless of the benefits of prosection-based instruction, additional challenges in gross anatomy education remain in adapting to the widespread implementation of systems-based medical curricula.[8] Systems-based curricula are designed to integrate multiple basic science disciplines such as anatomy, physiology, biochemistry, and pathology with clinical relevance within each organ system. In contrast to the previous model of individual subjects being taught in silo, organ system-based courses allow for a more cohesive and clinically relevant learning experience.[2,9] While this approach enhances interdisciplinary understanding and better mirrors medical practice, it often fragments the delivery of anatomical content, limiting opportunities for comprehensive anatomical instruction.[8,10] Furthermore, most contemporary dissection and prosection protocols utilize a regional approach that destroys critical anatomic relationships within and between organ systems, making clinical integration difficult.[8,11–13] Finally, logistical complications have arisen secondary to the shift toward a longitudinal systems-based curricula and subsequent extended use of donors. An increased risk of tissue desiccation, decomposition, and microorganism growth that may pose health risks for students and educators must be considered.

It is necessary to explore innovative pedagogical methods and resources to ensure that students acquire a solid foundation in gross anatomy, despite the compartmentalized and prolonged nature of systems-based curricula. While a regional prosection approach is still applicable and relevant for some systems (e.g., nervous, musculoskeletal), the progressive disruption of anatomic relationships between organ systems fragments content that is critical in a systems-based course. It is becoming clear that prosecting donors using traditional regional dissection protocols may no longer be the best option for all courses in a rigorous systems-based gross anatomy curriculum in medical education.[8,11–13] Rather than retrofitting existing regional dissection protocols for the evolving medical curricula, the current clinical protocol for post-mortem investigation of the body may be a good option to address the gross anatomy educational conundrum. Specifically, clinical autopsy may offer a blueprint from which to derive gross anatomy prosection protocols that may better serve the learners and educators in the evolving medical curricula.

Clinical autopsy is a process through which disease and causes of death are explored to enhance medical knowledge and clinical practice.[14] While the practice of clinical autopsy dates back over 4000 years, its relevance in the field of medical science persists today through elucidation of pathological process and the disease course that leads to mortality.[15] Clinical autopsy provides an avenue for improving medical science in a way that patient care cannot and improves patient outcomes by way of quality assurance, confirmation or refutation of diagnosis, public health data, forensic exploration, and family counseling.[16] Furthermore, the practice of medical autopsy facilitates problem-based learning within multiple foundational sciences including anatomy, pathology, pathophysiology, clinical reasoning, and medical ethics and fosters integration and interprofessional collaboration across medical specialties throughout multiple career stages.[17]

Despite the clear medical, scientific, and educational benefits of clinical autopsy, autopsy rates are declining significantly, secondary to societal stigma associated with disturbing the deceased, medicolegal costs, and many other factors.[18] The consequences of reduction in autopsies are just as many, including diminished educational opportunities associated with human disease progression and systemic presentation, limited exploration for best individualized clinical care, and inability to train qualified pathologists.[19] Currently, the minimum number of autopsies required by the Accreditation Council for Graduate Medical Education (ACGME) during pathology residency training is 30, which, up to two residents may share each case. This is a significant decrease from 50 individual cases before the recent change in 2022.[20] Proponents of the reduced autopsy requirement cite the advent of technology that allows high-resolution imaging and lab tests that can replace autopsies in determining cause of death and systemic changes from diseases.[21] Regardless, hands-on examination and gross anatomical knowledge of the human body remains an essential competency for pathology residents and an entrustable professional activity.[22,23] Furthermore, there may be an unexplored opportunity to incorporate autopsy techniques and procedures in gross anatomy education to increase clinical context and familiarity or experience with autopsy techniques. Previous preliminary data suggest that the integration of clinical autopsy with gross anatomy dissection may enhance students' understanding of spatial relationships.[24]

The flexibility of autopsy dissection is well suited for the gross anatomy laboratory to accommodate anatomic variation and donor pathology. A variety of autopsy approaches exist depending on the goal for each case: en masse (Letulle), en bloc (Ghon), individual organ (Virchow), and in situ (Rokitansky).[25] The en masse (Letulle) approach involves removing the cervical, thoracic, abdominal, and pelvic viscera in a single en masse bloc.[25,26] This approach is well suited for adaptation for the gross anatomy laboratory as it preserves vascular supply and relationships between organ systems. The en bloc (Ghon) technique involves removal of four separate organ blocs: thoracic (neck structures, heart, lungs, and mediastinum), celiac (liver, stomach, spleen, pancreas, and duodenum), intestinal, and urogenital.[25,27] The combination of these autopsy techniques with certain adapted elements for gross anatomy education resulted in a modified autopsy prosection protocol (MAPP),

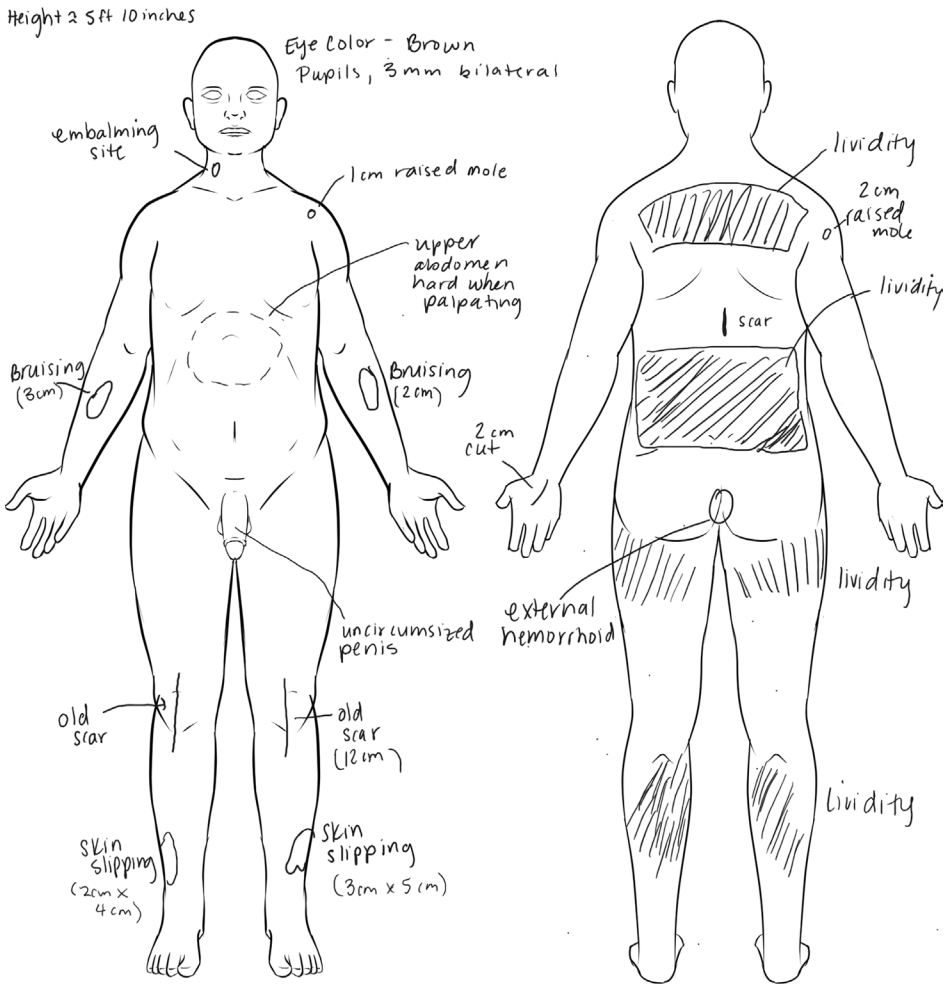

FIGURE 1 Completed whole body inspection sheet. All observed features on the donor's body are marked, including measurements, color, and other relevant information.

which may offer a superior alternative to a regional-based prosection approach in medical education.[28] The MAPP allows for the preservation of many anatomic relationships within and across organ systems while facilitating longitudinal, integrated, and clinically relevant medical education in the anatomy laboratory.

DESCRIPTION

To address the challenges in the current climate for gross anatomy in medical education, MAPP was created and implemented for use in an integrated curriculum for first-year medical students in the gross anatomy laboratory.

MAPP overview

Consistent with a clinical autopsy protocol, MAPP begins with a thorough external exam of a donor and documentation of key findings, followed by opening the body cavity to visualize and extract the en masse organ bloc, and then dissection of individual systemic organ blocs for detailed examination.

External exam

Holistic observation of the donor on the dissection table is consistent with the first step in autopsy procedure and allows for documentation of physical status, with verification of height, weight, and any available health records. The exam is conducted methodically from superior to inferior, thoroughly documenting all observable features such as moles, scars, lividity, contusions, abrasions, and other injuries or marks on a body chart (Figure 1), including measurements and detailed descriptions such as color, texture, and shape.

Incisions and bloc exposure

Y-shaped incision, typically used in clinical autopsy, is modified for MAPP to preserve the relative anatomical structures associated

FIGURE 2 Modified Y-incision used in MAPP. Instead of the standard Y-incision in clinical autopsy procedure, in MAPP, superior incisions were started at the acromion rather than the coracoid process and were made superficially to preserve the underlying neurovasculature and pectoralis muscles. From the xiphoid process, the incision to the pubic symphysis was curved to the left to preserve anatomic structures surrounding the umbilicus.

with the umbilicus while exposing the viscera for in situ examination (Figure 2). Incisions may be further modified based on body habitus, pathology, presence of breast tissue, and scars associated with major surgical procedures. Unlike the clinical autopsy procedure, in MAPP, skin flaps are reflected superiorly and laterally to expose the body wall musculature, which are then carefully dissected layer by layer to access the chest plate and peritoneal cavity (Figure 3A). The anterior chest plate is removed to allow full inspection of the viscera in situ (Figure 3B). Variations and pathologies present are documented, and any necessary modification of further dissection for en masse organ bloc removal can be planned at this stage.

En masse organ bloc removal

During en masse organ bloc removal in clinical autopsy, the superior margin of the larynx is commonly used as the superior end of the organ bloc which destroys many anatomic structures in the neck that are important in medical education. The MAPP allows for maximized preservation of the regional neck anatomy by careful dissection of the structures passing from the neck to the superior mediastinum (trachea, esophagus, vagus nn., etc.). These structures are cut below the level of the larynx, which then serves as the superior margin of the en masse organ bloc. This modification leaves the anatomic structures of the neck undisturbed for regional dissection at the appropriate time in the curriculum.

Inferiorly, if present, the left testis is retracted from the scrotum to the peritoneal cavity through the inguinal canal, while the right testis is preserved within the scrotum, ensuring that one of the testes is removed with the organ bloc and one remains in anatomical position within the body. Pelvic viscera are bluntly dissected away from the walls and floor of the pelvic cavity, then transected superior to the pelvic diaphragm, leaving the anatomic structures of the pelvic floor and perineum intact for regional prosection. After cutting the superior and inferior margins in the mediastinum and pelvis, respectively, the en masse organ bloc is removed from the body cavity following the same steps as clinical autopsy (Figure 4A–C).

Organ systems bloc separation

After removal, the en masse bloc is separated into the following systemic organ blocs with focal dissections to demonstrate anatomic relationships and clinically relevant structures: (1) Gastrointestinal organ bloc including all viscera of the gastrointestinal tract from esophagus to rectum and accessory organs (Figure 5A); (2) cardiovascular/urogenital bloc including the heart, aorta, kidneys and suprarenal glands, IVC, ureters, bladder, and if present, prostate, left testis, and/or uterus, uterine tubes, and ovaries (Figure 5B); and (3) respiratory bloc including lungs and trachea (Figure 5C).

Educational implementation

In 2021, the University of Colorado School of Medicine (CUSOM) implemented a new systems-based curriculum in which 10 systems-based courses with clinical and basic sciences are integrated throughout the first year. Courses include an introductory, 5-week foundational principles course followed by the nine systems courses that range between 3 and 6 weeks in the following sequence: hematologic & lymphatic, gastrointestinal, pulmonary & cardiovascular, renal & urinary, nervous, musculoskeletal & integumentary, mind & behavior, endocrine & metabolic, and reproductive. Gross anatomy curriculum within the first year spans 12 months, from August to July, with 30 lecture and 40 laboratory contact hours. The gross anatomy contact hours in lecture and laboratory vary in each course, but typically, gross anatomy sessions are scheduled at the beginning of the week throughout most courses, the majority of which are held in the wet laboratory utilizing prosected human whole body donors for study. To accommodate laboratory space limitations, half of the 172 first-year

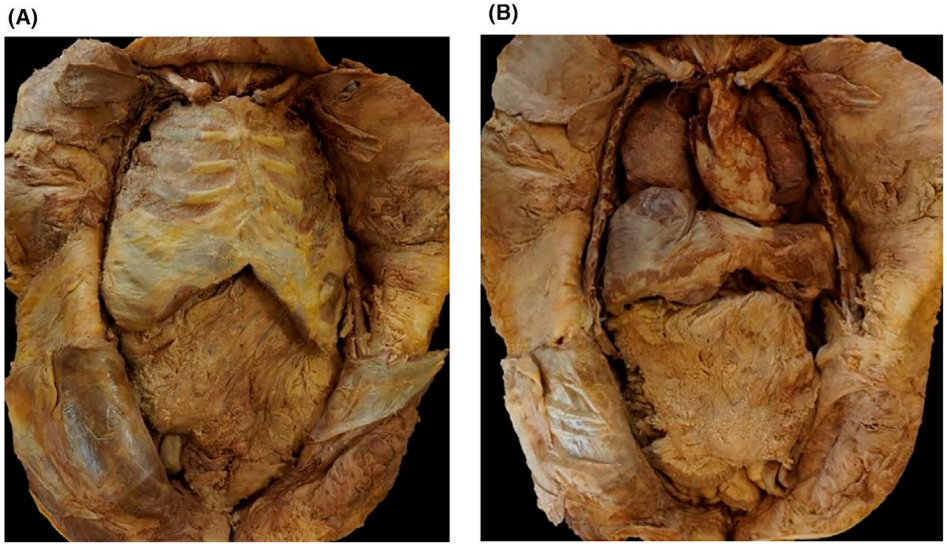

FIGURE 3 Exposure of viscera for in situ observation. (A) After reflecting the body wall flaps. (B) After removing the chest plate.

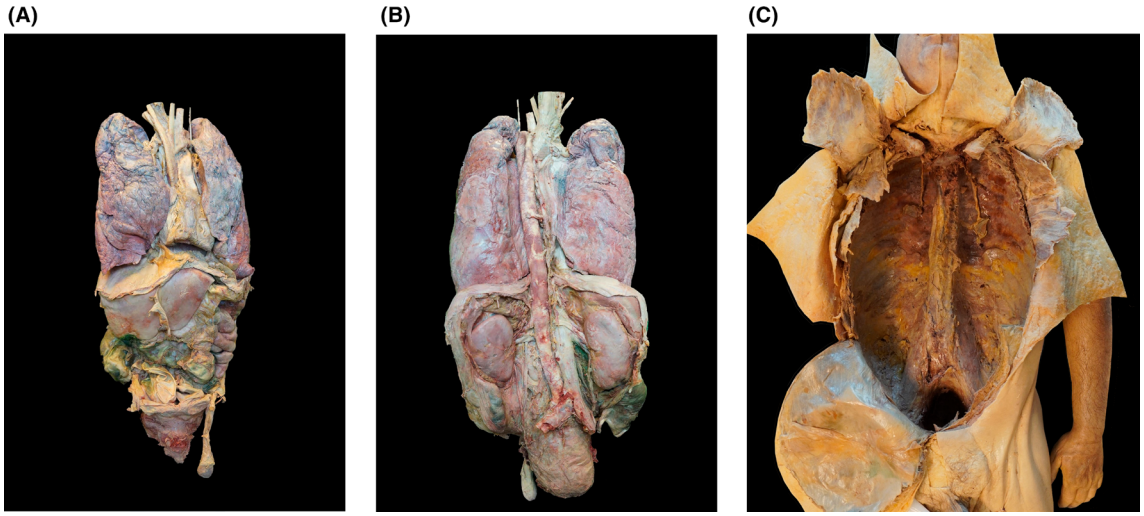

FIGURE 4 En masse organ bloc removed from the donor. (A) Anterior view of the en masse organ bloc. (B) Posterior view of the en masse organ bloc. Posterior renal fascia and perinephric fat removed to expose kidneys and suprarenal glands. (C) Body cavity after removal of the en masse organ bloc.

medical students ($n = 86$) attend each wet lab session facilitated by up to 15 teaching team members comprised of five faculty, three-to-four teaching assistants, and up to six student physicians (MS3 or MS4s) interested in pursuing medical education. Each lab session is repeated for the second half of the cohort to maintain an approximately 1:6 educator:student ratio.

Each academic year, 16 donors (1:6 donor:student ratio) are prosected using MAPP described above for internal organ systems courses such as hematology & lymphatic, gastrointestinal, pulmonary/cardiovascular, renal/urinary systems, and regional dissection protocol to supplement for appropriate systems (e.g., nervous and musculoskeletal). To ensure the preservation of donor tissues, the prosection process is temporally synchronized for each course. At CUSOM, en masse organ bloc removal and separation occur prior to the first laboratory in September, with organ systems bloc and regional prosections taking place throughout the year to align with the systems-based coursework. Generally, prosections for relevant organ systems laboratories are completed approximately 1 week before the scheduled course.

First introduction to the prosected donors in a clinical context

The first introduction to the MAPP prosected donors occurs in the first laboratory session during the second course in the first-year medical curriculum (Hematology & Lymphatics course). Students are introduced to the laboratory setting and instructed to perform their

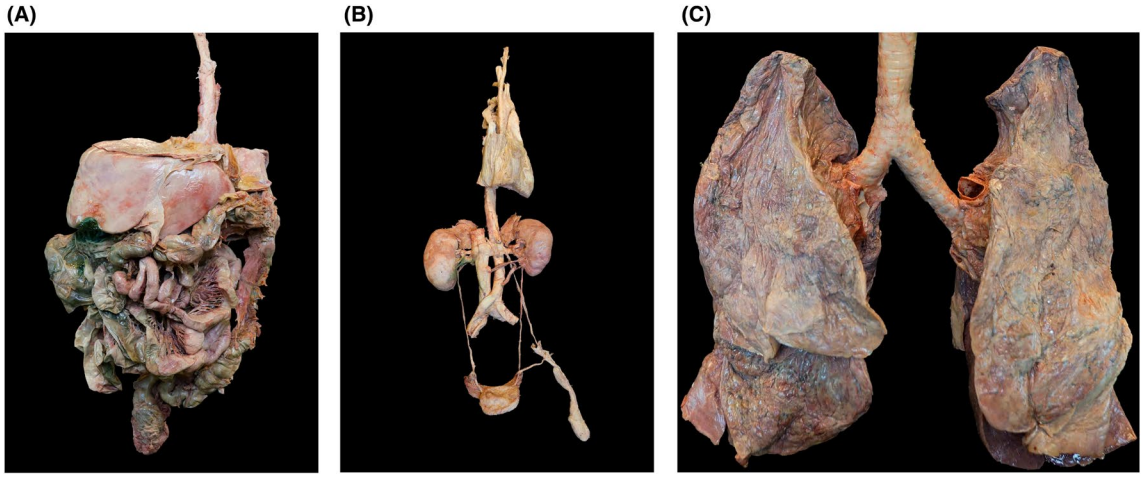

FIGURE 5 Systems organ blocs separated from the en masse bloc. (A) Gastrointestinal system bloc. (B) Circulatory and urinary systems bloc. (C) Pulmonary system bloc.

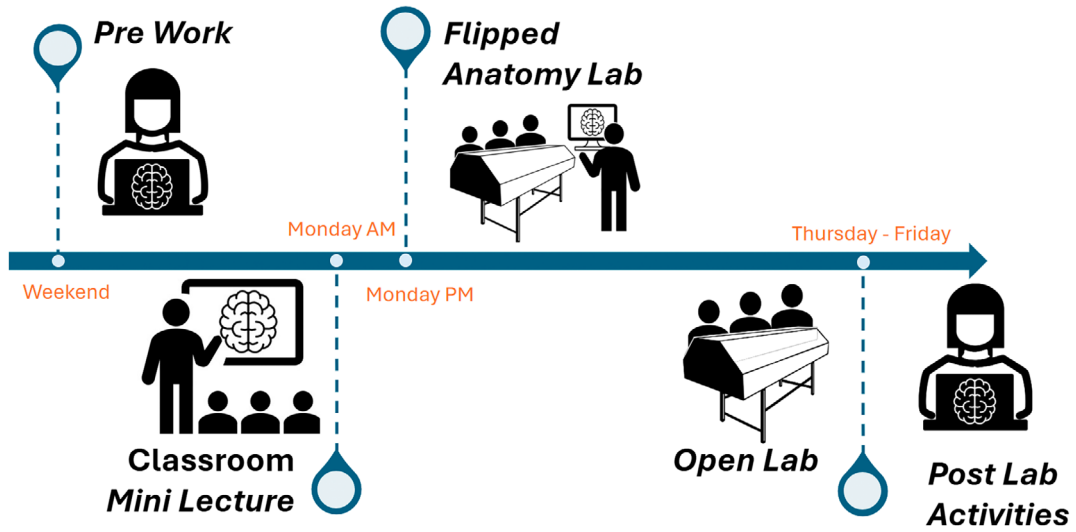

FIGURE 6 Gross anatomy learning experience with MAPP, a Self-Regulated Cognitively-ALigned Practice for Enhanced Learning (SCALPEL). Students complete the required prework on Sunday, attend a mini lecture (15–20 min) then participate in a flipped laboratory experience on Monday, and then attend optional open laboratory sessions and complete post-laboratory review activities on Thursday and Friday.

first patient encounter with their donor. Donor information including age at death, causes of death, and sex as listed on the donor's death certificate are provided. Students are prompted to discuss what they are most curious to learn about their donor given this information, and what they would like to ask the donor if they were their patient. Then, students are tasked to conduct the same visual inspection that was performed in the MAPP and are provided with the body chart completed by the prosectors for their specific donor (Figure 1). They corroborate each finding and are prompted to discuss how the visual inspection findings align with the cause of death, and what they would like to ask the patient's physician given the findings. Finally, students are prompted to explore various tissue types, employ strategies for differentiating tissues, examine anatomic relationships, and discuss how these skills aid in identifying anatomic structures.

Gross anatomy experience with MAPP donors in a typical curricular week

The remaining 19 gross anatomy laboratory sessions are distributed across the systems-based courses throughout the remainder of the academic year. For each of these laboratory sessions, students engage in Self-Regulated Cognitively-Aligned Practice for Enhanced Learning (SCALPEL)—a series of activities throughout the week to master learning objectives (Figure 6). First, students complete required prework for each laboratory session which provides broad overviews of relevant topics and concepts. Next, students attend 15–20 min mini lectures centered around the most complex concepts and structures for that week. Following lectures, students engage in a flipped gross anatomy laboratory

experience accompanied by a customized laboratory reference and self-regulated learning guide. Circulating educators are present in the laboratory to troubleshoot structure identifications, answer content questions, provide immediate feedback, and help facilitate challenging hands-on activities for clinical application of anatomy with the MAPP donors. Following each flipped laboratory, students are provided asynchronous review opportunities and resources to reinforce spaced learning, including practice practicals, post-laboratory review activities, and student-directed open laboratory hours staffed with faculty.

DISCUSSION

A novel prosection approach (MAPP) has been created for the evolving medical curricula that require a significant reduction in contact hours while increasing clinical context in gross anatomy education.[1–3,7] At the CUSOM, before the curricular revision in 2021, anatomy contact hours were 117 (79 dissection laboratory; 38 lecture); whereas in the new curriculum, contact hours are 70 (40 prosection laboratory; 30 lecture). The development and implementation of MAPP has been effective in adapting gross anatomy education to the highly clinical and integrated medical curriculum within the confines of reduced contact hours. The MAPP has been refined over the past five years and is now a well-established protocol at CUSOM.

Lessons learned: Benefits of MAPP

Flexibility and adaptability

In addition to affording a temporally spaced prosection process spanning several months, the MAPP is customizable for individual curricular needs and systems-based course sequences unique to various schools or programs.[29] The sequential scaffolding of content with MAPP in a longitudinal curriculum allows for student progression through each organ system and reduction of redundant content across courses. Furthermore, MAPP is ideal for case-by-case modifications depending on the cause of death, comorbidities, and anatomic variations of the donors. This flexibility is consistent with that of clinical autopsy processes in which diagnosis, comorbidities, surgical interventions, and other factors necessitate alternate autopsy techniques.[30]

Extensive clinical context

While adopting any prosection-based approach may satisfactorily address the demand for a reduction of contact hours, the MAPP is inherently clinical, lending itself to the application of anatomy to medical practice.[31] The MAPP offers substantial opportunities to incorporate clinical context while aligning with the objectives of a systems-based medical curriculum. The first contact with an anatomic donor is often described as the first clinical encounter and a medical student's first patient in many medical curricula; however, in most gross anatomy laboratory sessions, the dissection or prosection proceeds without detailed external examination, documentation, or discussion of the whole body.[32–34] The validation of external exam findings conducted by students and the interaction with the MAPP Y-incision when students first encounter a donor in laboratory frame this important experience in a clinical context and afford opportunities to encourage professional competency and identity formation.[35]

Additionally, the MAPP deliberately preserves anatomic relationships within and between organ systems that are often disrupted with traditional regional dissection approaches. This preservation facilitates hands-on observation and interaction with clinically relevant relationships across different organ systems. For example, during the gastrointestinal course, students mimic performing the FAST exam on the donors then identify and palpate the hepatorenal recess when the blocs are in the donor's body cavity. Such clinically oriented experience in anatomy curriculum has been shown to foster student engagement with the curriculum and perceived content relevance.[36]

Influence on graduate medical education

Graduate medical education (GME) in pathology has seen a reduction in interest and residency application in the past several decades. Autopsy requirements for GME in pathology have also been reduced significantly.[37,38] The implementation of MAPP in the anatomy laboratory lends itself to early exposure and familiarity with autopsy procedures. Furthermore, it provides learning opportunities to explore medical care, medical science, societal factors, and family counseling considerations associated with pathology specialty.[39] This early exposure has the potential to reverse trends in pathology GME interest by building familiarity and raising awareness of the values of autopsy, which should be examined in greater detail in subsequent studies.

Hands-on and spaced self-regulated learning

The MAPP requires students to recognize and interact with anatomic relationships across organ systems, regardless of which system was the primary focus of study. Most anatomy laboratory sessions at CUSOM require students to remove the organ blocs to access the desired area of study and then to return them back to the donor in anatomically accurate orientations. The interaction with all organ blocs throughout the academic year reinforces anatomic relationships and facilitates spaced practice, interleaving, and retrieval practice, which have been associated with improved learning outcomes.[40]

Learning efficiency

The reduction of contact hours in the new curriculum at CUSOM prompted the faculty to create MAPP and leverage it to promote

flipped self-regulated learning in the gross anatomy laboratory using SCALPEL amid drastically reduced contact hours.

Despite the reduction of contact hours, early results indicate student performance remained consistent with historic norms of the number of students who pass. This is consistent with metadata analyses of prosection versus dissection-based gross anatomy curricula with no difference in learning outcomes.[31,41] Further analyses on learning outcomes in the new anatomy curriculum at CUSOM are currently ongoing.

Lessons learned: Challenges with MAPP

Although many benefits have been observed during and after implementation of the MAPP, there are also inherent challenges in executing and implementing MAPP in a medical curriculum.

Integrity of organ blocs

While the MAPP promotes spaced practice by encouraging students to handle and interact with the organ blocs consistently and repetitively, over time, fragile structures tend to be damaged. Therefore, it is important to reinforce donor care procedures often and consistently. This provides an opportunity to relate donor interaction in gross anatomy curriculum to key patient care competencies such as prevention of harm and acting with compassion.[42,43]

Resource burden

There is an inherent resource burden associated with donor-based gross anatomy curricula and MAPP is no exception.[4] At CUSOM, it takes approximately 100 total hours, on average, to complete MAPP and regional dissections on a single donor. At CUSOM, all prosections are completed by two highly experienced faculty. Each sequential organ system dissection is completed approximately 1 week prior to each course to meet year-long gross anatomy curricular requirements.

The MAPP is a new and technical procedure with a steep learning curve. The initial MAPP training time for an experienced gross anatomist with robust regional dissection experience averages about 2–3 days (or 16–24 h) for the en masse bloc removal and organ systems separation. However, once trained, and after prosecting about three to five donors, completing the en masse bloc removal and complete organ systems separation of one donor takes between 6 and 8 h total. Additionally, supervision by faculty with a high skillset and knowledge base is required to customize the MAPP secondary to pathology and/or variation to complete all prosections for a single academic year.

Lastly, the prolonged gross anatomy curriculum with MAPP requires laboratory space and associated resources including storage, waste footprint, chemicals, and other materials necessary for donor preservation. Careful consideration must be given to these challenges, especially on campuses where anatomy laboratory resources are shared with other programs. Under these circumstances, dedicated faculty time may be necessary to coordinate the laboratory space, expenditures, and resource allocation among various educational programs.

Despite these challenges, carefully planned stepwise completion of the MAPP, synchronized with the sequence of organ systems courses, can promote deliberate scaffolding of content. This incremental approach, when combined with targeted donor care, can enhance donor tissue integrity and delay dessication associated with extended exposure, a critical consideration in longitudinal medical curricula. Through exploratory methods, optimized protocols for donor preservation and maintenance were developed to support extended use.[44] These protocols are essential in a systems-based curriculum where students engage with whole body donors for several hours weekly over a period ranging from 6 months to more than a year. This is in stark contrast to, at most, 3 months of nearly weekly access to donors in a silo-ed medical gross anatomy course.[45]

CONCLUSIONS AND FUTURE DIRECTIONS

The MAPP is a unique clinical approach to gross anatomy education that lends itself well to the evolving medical curricula. A textbook detailing the MAPP and a discursive manuscript on SCALPEL are currently under preparation for publication. Despite the significant reduction in contact hours for gross anatomy in the new curriculum at CUSOM, no deleterious effects are noted in learning outcomes from adopting MAPP. Rigorous learning analyses are currently ongoing from the past 5 years of systems-based curricular data. Implementation of MAPP takes a significant investment in time, space, training, and other resources; however, once implemented and integrated into the systems-based curriculum, MAPP holds significant potential to shape the evolution of gross anatomy education in both undergraduate and graduate medical curricula.

AUTHOR CONTRIBUTIONS

Chelsea M. Lohman: Conceptualization; writing – original draft, review, and editing; methodology; project administration; supervision. **Briauna Blezinski Johnson:** Methodology; writing – review and editing; resources. **Danielle F. Royer:** Conceptualization. **Lisa M. J. Lee:** Conceptualization and development of MAPP; writing – review and editing; supervision.

ACKNOWLEDGMENTS

The authors would like to thank illustrator Zach Stetter M.S., the anatomical donors, the Colorado State Anatomical Board, the University of Colorado Medical Students, all prosectors that have contributed to our efforts in creating the MAPP, and Hailey Wilkinson M.S., and Ruby Martini M.S.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

ORCID

Chelsea M. Lohman https://orcid.org/0009-0007-5404-5713

REFERENCES

1. Drake RL, McBride JM, Lachman N, Pawlina W. Medical education in the anatomical sciences: the winds of change continue to blow. Anat Sci Educ. 2009;2(6):253–9. https://doi.org/10.1002/ase.117
2. Drake RL, McBride JM, Pawlina W. An update on the status of anatomical sciences education in United States medical schools. Anat Sci Educ. 2014;7(4):321–5. https://doi.org/10.1002/ase.1468
3. McBride JM, Drake RL. National survey on anatomical sciences in medical education. Anat Sci Educ. 2018;11(1):7–14. https://doi.org/10.1002/ase.1760
4. Curran SN, Schaefer AF. Prosections in anatomy education: establishing a definition and describing preparation, use, and educator perceptions. Med Sci Educ. 2023;33(2):385–93. https://doi.org/10.1007/s40670-023-01745-8
5. Coker C, Rogers RS, Freed B, Steele R, Kinde MN, Danilova G, et al. Battle of the sections: student outcomes and course feedback support combined prosection and dissection laboratory formats to maximize student success. Anat Sci Educ. 2024;17(5):1012–25. https://doi.org/10.1002/ase.2420
6. Williams SR, Thompson KL, Notebaert AJ, Sinning AR. Prosection or dissection: which is best for teaching the anatomy of the hand and foot? Anat Sci Educ. 2019;12(2):173–80. https://doi.org/10.1002/ase.1808
7. Emanuel EJ. The inevitable reimagining of medical education. JAMA. 2020;323(12):1127–8. https://doi.org/10.1001/jama.2020.1227
8. Brooks WS, Woodley KTCP, Jackson JR, Hoesley CJ. Integration of gross anatomy in an organ system-based medical curriculum: strategies and challenges. Anat Sci Educ. 2015;8(3):266–74. https://doi.org/10.1002/ase.1483
9. Rizzolo LJ, Rando WC, O'Brien MK, Haims AH, Abrahams JJ, Stewart WB. Design, implementation, and evaluation of an innovative anatomy course. Anat Sci Educ. 2010;3(3):109–20. https://doi.org/10.1002/ase.152
10. Phitayakorn R, Stearns D, Kim E. Is cadaver dissection still necessary in surgical education? ACS [Internet]. 2024 [cited 2025 Jul 22]. Available from: https://www.facs.org/for-medical-professionals/news-publications/journals/rise/articles/cadaver-dissection-still-necessary/
11. Arslan O. Region vs. system-based anatomy: efficacy and implementation. Am Int J Biol. 2014;2:3–4. https://doi.org/10.15640/aijb.v2n3-4a1
12. Bolender DL, Ettarh R, Jerrett DP, Laherty RF. Curriculum integration = course disintegration: what does this mean for anatomy? Anat Sci Educ. 2013;6(3):205–8. https://doi.org/10.1002/ase.1320
13. Vugampore MFI, Alor EV, Hoffman GR, Wiltgen RJ, Szuster D, Frank PW, et al. A video dissection guide for the en bloc extraction of the human central nervous system. Anat Sci Educ. 2025;18(11):1289–300. https://doi.org/10.1002/ase.70130
14. Kotabagi R, Charati S, Jayachandar D. Clinical autopsy vs medicolegal autopsy. Med J Armed Forces India. 2005;61(3):258–63. https://doi.org/10.1016/S0377-1237(05)80169-8
15. Dehner LP. The medical autopsy: past, present, and dubious future. Mo Med. 2010;107(2):94–100.
16. Buja LM, Barth RF, Krueger GR, Brodsky SV, Hunter RL. The importance of the autopsy in medicine: perspectives of pathology colleagues. Acad Pathol. 2019;6:2374289519834041. https://doi.org/10.1177/2374289519834041
17. Campos FPFD, Rocha LOS. The pedagogical value of autopsy. Autops Case Rep. 2015;5(3):1–6. https://doi.org/10.4322/acr.2015.011
18. Nelson DM, Rowe SJ, Trytell A, Fahy L, Freedman K, Pflaumer A, et al. Trends and differences in the rates of autopsy in the United States, 2003 to 2020: a nationwide analysis. Heart Rhythm O2. 2025;6:1165–74. https://doi.org/10.1016/j.hroo.2025.05.020
19. Scherpelz KP, Marshall D, Williamson AK, Jackson NR. Challenges in autopsy training for pathology residents: a survey of autopsy directors. Acad Pathol. 2025;12(1):100156. https://doi.org/10.1016/j.acpath.2024.100156
20. Requirements for Certification. American Board of Pathology [Internet]. [cited 2025 Aug 4]. Available from: https://abpath.org/requirements/
21. Cergan R, Taciuc IA, Dumitru M, Vrinceanu D, Manole F, Sanda N, et al. The current status of virtual autopsy using combined imaging modalities: a scoping review. J Clin Med. 2025;14(3):782. https://doi.org/10.3390/jcm14030782
22. Amiel JM, Andriole DA, Biskobing DM, Brown DR, Cutrer WB, Emery MT, et al. Revisiting the core entrustable professional activities for entering residency. Acad Med. 2021;96(7S):S14–S21. https://doi.org/10.1097/ACM.0000000000004088
23. Lomis KD, Ryan MS, Amiel JM, Cocks PM, Uthman MO, Esposito KF. Core entrustable professional activities for entering residency pilot group update: considerations for medical science educators. Med Sci Educ. 2016;26(4):797–800. https://doi.org/10.1007/s40670-016-0282-3
24. Lee L, Hight M, Wagner M, Wahl L, Fiebig C, Lohman Bonfiglio C. Flipping the script – adopting autopsy protocol for cadaveric dissection in gross anatomy. FASEB J. 2021;35(S1). https://doi.org/10.1096/fasebj.2021.35.S1.02471
25. Sheaff MT, Hopster DJ, editors. Evisceration techniques. Post mortem technique handbook [Internet]. London: Springer; 2005 [cited 2026 Jun 10]. p. 82–118. https://doi.org/10.1007/1-84628-090-7_3
26. Skowronek R, Chowaniec C. The evolution of autopsy technique—from Virchow to Virtopsy. Arch Med Sadowej Kryminol. 2010;60(1):48–54.
27. Menezes RG, Monteiro FN. Forensic autopsy. StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 [cited 2025 Dec 9]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK539901/
28. Lohman C, Lee L, Johnson B, Royer D, Stetter Z. Modified autopsy prosection protocol for gross anatomy in medical education. in press.
29. Burton JL. The external examination: an often-neglected autopsy component. Curr Diagn Pathol. 2007;13(5):357–65. https://doi.org/10.1016/j.cdip.2007.08.001
30. Ludwig J. Principles of autopsy techniques, immediate and restricted autopsies, and other special procedures. In: Ludwig J, editor. Handbook of autopsy practice [Internet]. Totowa, NJ: Humana Press; 2002 [cited 2026 Feb 24]. p. 3–6. https://doi.org/10.1007/978-1-59259-286-9_1
31. McWatt SC, Newton GS, Umphrey GJ, Jadeski LC. Dissection versus prosection: a comparative assessment of the course experiences, approaches to learning, and academic performance of non-medical undergraduate students in human anatomy. Anat Sci Educ. 2021;14(2):184–200. https://doi.org/10.1002/ase.1993
32. Ferguson KJ, Iverson W, Pizzimenti M. Constructing stories of past lives: cadaver as first patient: "clinical summary of dissection" writing assignment for medical students. Perm J. 2008;12(2):89–92. https://doi.org/10.7812/tpp/07-145
33. Robertson KA, Organ JM, Yard M, Byram JN. First patient project: engaging pathology through the donor dissection experience and its role in professionalism. Anat Sci Educ. 2024;17(1):199–212. https://doi.org/10.1002/ase.2341

34. Bohl M, Bosch P, Hildebrandt S. Medical students' perceptions of the body donor as a "first patient" or "teacher": a pilot study. Anat Sci Educ. 2011;4(4):208–13. https://doi.org/10.1002/ase.231
35. McDaniel KG, Brown T, Radford CC, McDermott CH, van Houten T, Katz ME, et al. Anatomy as a model environment for acquiring professional competencies in medicine: experiences at Harvard Medical School. Anat Sci Educ. 2021;14(2):241–51. https://doi.org/10.1002/ase.2000
36. Lohman CM, Royer D, Johnson BB, Tan R, Lee M. Benefits of autopsy-based Prosection for gross anatomy labs in a clinically integrated medical curriculum. Anat Sci Educ. 2024;17(S1):1–196. https://doi.org/10.1002/ase.2470
37. Jajosky RP, Coulson HC, Lee WS, Chaffin JM, Banks M, Jajosky AN, et al. The medical student's guide to pathology residency, fellowships, and careers. Ann Diagn Pathol. 2021;54:151805. https://doi.org/10.1016/j.anndiagpath.2021.151805
38. Petriceks AH, Salmi D. Trends in pathology graduate medical education programs and positions, 2001 to 2017. Acad Pathol. 2018;5:2374289518765457. https://doi.org/10.1177/2374289518765457
39. Pakanen L, Tikka J, Kuvaja P, Lunetta P. Autopsy-based learning is essential but underutilized in medical education: a questionnaire study. Anat Sci Educ. 2022;15(2):341–51. https://doi.org/10.1002/ase.2073
40. Brown PC, Roediger HLI, McDaniel M. Make it stick: the science of successful learning [Internet]. Cambridge, Massachusetts: The Belknap Press of Harvard University Press; 2014 [cited 2026 Feb 25]. Available from: https://www.bibliovault.org/BV.book.epl?ISBN=9780674729018
41. Wilson AB, Miller CH, Klein BA, Taylor MA, Goodwin M, Boyle EK, et al. A meta-analysis of anatomy laboratory pedagogies. Clin Anat. 2018;31(1):122–33. https://doi.org/10.1002/ca.22934
42. Choi WJ. Teaching respect for body donors: a US medical student perspective. Anat Sci Educ. 2024;17(4):687–92. https://doi.org/10.1002/ase.2373
43. Noel GPJC, Klaus F, Tutjer J, Chun JM, Jinpa T, Chakoumakos MA, et al. Compassionatomy: can compassion contemplative practices Foster student connection with body donors and enhance empathy in anatomy labs? Med Sci Educ. 2025;35:3093–103. https://doi.org/10.1007/s40670-025-02522-5
44. Wigdahl E, Szuster D, Blezinski B, Lohman C. Cadaveric donor care: establishing a protocol for longitudinal integrated curricula in anatomy labs. Anat Sci Educ. 2023;16:1218–348. https://doi.org/10.1002/ase.2344
45. Balta JY, Cronin M, Cryan JF, O'mahony SM. Human preservation techniques in anatomy: a 21st century medical education perspective. Clin Anat. 2015;28(6):725–34. https://doi.org/10.1002/ca.22585

AUTHOR BIOGRAPHIES

Chelsea M. Lohman, PhD, is an associate professor in the Department of Cell & Developmental Biology at the University of Colorado Anschutz Medical Campus. She is the executive vice director of the modern human anatomy program and associate content director of gross anatomy in the School of Medicine. She teaches gross anatomy to medical and graduate students.

Briauna Blezinski Johnson, MS, is a senior instructor in the Department of Cell & Developmental Biology at the University of Colorado Anschutz Medical Campus. She is an assistant course director and assistant content director of gross anatomy in the School of Medicine. She teaches gross anatomy to medical students and graduate students.

Danielle F. Royer, PhD, is a former associate professor in the Department of Cell & Developmental Biology at the University of Colorado Anschutz Medical Campus. She was the content director of anatomy in the School of Medicine and taught gross anatomy to medical and graduate students.

Lisa M. J. Lee, PhD is a professor in the Department of Cell & Developmental Biology at the University of Colorado Anschutz Medical Campus. She is the director of Preclerkship Evidence-Based Learning Strategies and teaches embryology and histology to medical students. She is a board-certified pathologist's assistant, and has performed over 200 autopsies.

How to cite this article: Lohman CM, Johnson BB, Royer DF, Lee LMJ. MAPPing out the future: Modified autopsy prosection protocol for gross anatomy in medical education. Anat Sci Educ. 2026;00:1–10. https://doi.org/10.1002/ase.70316