


Graphic medicine meets human anatomy: The potential role of comics in raising whole body donation awareness in Italy and beyond. A pilot study

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Abstract

Cadaver dissection has always played a fundamental role in medical education. However, especially in Italy, the topic of body donation has remained partially unknown for years. The current study analyses graphic medicine as a new possible communication tool, evaluating and reflecting, with second-year students enrolled in the International School of Medicine and Surgery at the University of Bologna, about its potentialities for body donation awareness-raising in both the scientific community and the general population. For the first time in an Italian University, two graphic medicine workshops were organized focusing on human anatomy and body donation. Seminars were positively evaluated by students using a four items Likert-scale question: mean 3.54 (\pm SD 0.73) for the Likert question about the experiences of the workshops; 3.88 (\pm 0.33) for the Likert question regarding the use of graphic medicine in body donation awareness campaigns among the general population; 3.59 (\pm 0.65) for the Likert question regarding the use of graphic medicine in body donation awareness campaigns among the scientific community. Furthermore, the open-ended questions included in the anonymous questionnaire were analyzed using the constructivist grounded qualitative analysis, whence various themes emerged. Finally, five graphic medicine projects about body donation were created by students, proving their interest in testing this method to promote body donation, focusing the attention on different communicative aspects. Considering the results of this pilot study, the co-creative collaborative use of graphic medicine could be evaluated as an additional strategy to increase body donation awareness-raising in Italy and beyond, especially in the non-experts' community.

KEYWORDS

body donation, graphic medicine, gross anatomy education, medical education, medical students, workshop

Ms. Alessia De Stefano and Dr. Isabella Rusciano contributed equally to this work.

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INTRODUCTION

A deep understanding of anatomy is considered one of the milestones of medical curricula and it is fundamental for clinicians' clinical skills development (Turney, 2007). Body donation plays a pivotal role in medical education (Saw, 2018), in which cadaver dissection represents the "gold standard" (Chytas et al., 2020) during students' anatomical training (Kerby et al., 2011) and it is fundamental for advanced professional education worldwide (Zuckerman et al., 2009; Kumar & Rahman, 2017). Although new technology and non-biological alternatives have been explored in recent years, they cannot yet replace cadaver dissection (Macchi et al., 2011). At the beginning of the Covid pandemic, virtual education became the primary modality of teaching, and traditional cadaveric dissection was largely replaced by technological substitutes (Italian Ministry of Justice, 2020; Shin et al., 2022; Tschernig et al., 2022), which according to several studies are unable to offer the same learning efficacy (Jiang et al., 2020; Chytas et al., 2022). Indeed, for anatomists, the replacement of gross anatomy teaching tools, such as cadavers, bones, specimens, embryology models, and microscopic slides has been a difficult challenge (Patel & Moxham, 2008; Jiang et al., 2020). Furthermore, with the use of virtual body dissection, spatial perception and visualization of neurovascular structures will never be as clear as in cadaveric dissection (Jiang et al., 2020). According to several studies, cadaverless anatomy education might negatively affect the clinical skills of future surgeons, since dissection allows the practice of novel surgical techniques before they are performed on living patients (Ok & Gürses, 2021; Jiga et al., 2022). However, the shortage of donated bodies, in Italy and elsewhere, is currently an issue, especially compared with the increased number of medical students (Porzionato et al., 2012; Estai & Bunt, 2016; Boscolo-Berto et al., 2020). Previous regulations, in Italy (Pallocci et al., 2020; De Caro et al., 2021) as in various country (Kahn et al., 2017), allowed the use of unidentified bodies. The incompatibility of this practice with the current ethics standards (McHanwell et al., 2008; Riederer et al., 2012), led the anatomists to encourage an end of this practice and promote changes toward the implementation of body donation programs around the world. (Jones & Whitaker, 2012; Kahn et al., 2017). In Italy, the Italian National Bioethics Committee established that body donation must be the expression of a liberal and conscious decision, demonstrated with the donor's informed consent (Italian National Bioethics Committee, 2013). New laws require the consent of donors, the identification of national reference centers, and the specific management of donors' bodies (Maghin & Conti, 2020; De Caro et al., 2021). This represents a step forward in the regulation of a process that has been neglected for long. The aim of the new law is to increase the number of donors who choose to join the body donation program for scientific research, educational activities, and medical-surgical training (Ciliberti et al., 2021). The Centre of Human Anatomy of the University of Bologna, recently recognized as one of the national reference centers for body donation by the Italian Ministry of Health (Italian Ministry of Health, 2021), combined its ancient tradition of human

body dissection with innovative and technological developments (Cercenelli et al., 2022) in medical education. The body donation program of the University of Bologna has strived to increase donors' enrollment and the number of bodies received, which are used for medical courses students, post-graduate courses, and masterclasses in surgical dissection workshops (Orsini et al., 2021b). Nevertheless, in Italy, the practice of body donation is still very limited and only a few centers are able to promote and maintain an active body donation program (De Caro et al., 2021; Orsini et al., 2021b). According to the literature, reasons that lead people to donate their bodies after death depend on the cultural heritage. In the United States the main reason for body donation is altruism (Mueller et al., 2021), whereas in China, body donation is motivated by factors such as the desire to support medical education and reduce the family's funeral burden (Jiang et al., 2020). In other countries, body donation is hampered by institutional and individual reluctance due to adverse publicity and lack of information (Ok & Gürses, 2021). Different factors were responsible for decreased input of human post-mortem bodies to medical schools during the Covid-19 pandemic: some medical schools across the countries suspended body donation programs or did not accept donated bodies (Brasnett et al., 2020; Pather et al., 2020; Manzanares-Céspedes et al., 2021), and donors registration lowered due to the fear of approaching the medical schools (Rajasekhar & Dinesh Kumar, 2021). Beyond the pandemic, the main limit on the supply of cadavers in Italy is the low percentage of spontaneous donors (Jones & Whitaker, 2012; De Caro et al., 2021). For all these reasons, the Centre of Human Anatomy of the University of Bologna decided to introduce and test graphic medicine as a possible tool to talk about body donation with second year-medical students of the human anatomy course.

The term "graphic medicine" was coined in 2007 by Ian Williams, a British comics artist and physician to denote "the intersection between the medium of comics and the discourse of healthcare" (Czerwec et al., 2015). The use of the word 'medicine' was not meant to privilege the role of medical doctors over that of other healthcare professionals, patients, or comics artists, but rather to suggest that comics might have some sort of therapeutic role to play in healthcare (Green & Myers, 2010; Green & Czerwec, 2016). A purpose of graphic medicine is to describe healthcare and illness through the use of comics (Green & Wall, 2020), focusing on the therapeutic approach (Doan, 2021) and the improvement of the clinician/patient relationship. Several studies demonstrated that reading health-related comics can help medical students and clinicians better understand illness and improve interpersonal skills such as empathy, attention to non-verbal cues, and communication (Tsao & Yu, 2016; Myers et al., 2019). In 2019, researchers found that reading a graphic memoir created by an individual with Parkinson's disease helped clinicians to better appreciate disease from the patient's perspective (Myers et al., 2019). Furthermore, the book helped to facilitate a deeper understanding of patients' experiences and promoted greater empathy and self-reflection (Myers et al., 2019; Allison et al., 2021; Greene & Rosen, 2021). In the context of medical education, this new field emerged as a novel way to educate, through comics, on a variety

of medical themes (Anand et al., 2018; Chung & Chung, 2018). As an accessible medium for patient education and public outreach (McNicol, 2017), graphic medicine is used to raise awareness on numerous current topics such as the barriers for people with disabilities (Manohar, 2022), heart diseases (Swanson, 2016), and the Covid-19 pandemic (Mirza, 2021; Thekkekarott Kuruvila & Hegde, 2022a,b). Graphic medicine's potential is based in the simplicity, clarity, and immediacy of visual storytelling to disclose health-education messages and social issues that are often difficult to understand (Irwin et al., 2020). Moreover, recent research acknowledges the use of graphic medicine as potential in scientific education in improving understanding of clinical concepts (Joshi et al., 2019; Hoffman, 2021). Nonetheless, even for gross anatomy education, graphic medicine has also showed benefits for gross anatomy education (Park et al., 2011; Shin et al., 2013; Kim et al., 2017). The use of comics may also help to talk about topics considered taboos, such as death and cadaver dissection (Irwin et al., 2020; Zumwalt, 2021). Therefore, the aims of this pilot-project were: to introduce graphic medicine to the medical students of the University of Bologna that entered in a dissecting room for the first time, focusing the attention on the potentialities of this means of communication and exploring its value in medical education; and to evaluate and reflect on the capability of this innovative communicative tool for the dissemination of thorny topics, such as whole body donation awareness raising, before using it in the general population.

MATERIALS AND METHODS

Overall study design

During the first semester of 2020/2021 and 2021/2022 academic years, a total of one hundred thirty-three ($n = 133$) second-year degree medical students attending the human anatomy course at the International School of Medicine and Surgery of the University of Bologna were included in this study. Volunteer participants attended a seminar entitled "Graphic medicine meets anatomy" (Part I and Part II respectively for each year).

The objective of the seminar was to introduce the topic of graphic medicine, to improve medical students' knowledge about body donation, and to reflect with the students about the possibility of using comics to present this topic both to the general and scientific community. After each workshop, qualitative data were collected using a volunteer questionnaire submitted to the students. Furthermore, at the end of the second seminar, data deriving from the projects of the students who had participated in the first session were collected, described, and discussed focusing their feedbacks.

Course description and student demographics

The medical gross anatomy experience at the University of Bologna consists of two semester anatomical classes and laboratories during

all second year of the six ($n = 6$) total years of medical school. During the second year, the curriculum is presented in five integrated blocks: (1) Cardiovascular and Respiratory systems (2) Musculoskeletal system and Movement (3) Gastrointestinal System, Nutrition, and Metabolism, (4) Genito-Urinary and Reproductive Systems, and (5) Nervous system and Sensory Organs. These blocks are integrated with the Physiology and Semiotics. Students spent one hundred and twenty ($n = 120$) hours in anatomy theoretical classes, thirty-four ($n = 34$) hours in didactic laboratories with anatomical models, and thirty-four ($n = 34$) hours in dissection laboratory on human cadavers. In 2020 and 2021, due to the pandemic situation, the conventional schedule was changed and many of the anatomy classes and laboratories were given through virtual or hybrid modalities. Moreover, during the dissection class, the University of Bologna adopted near-peer teaching (NPT) approach with senior medical students teaching and assisting junior students. The NPT program allows junior students to be introduced to cadaver dissection by their senior colleagues creating a comfortable and encouraging educational environment. Furthermore, tutors allow the management of such a large number of students organized into small groups, guaranteeing high-quality anatomical education (Orsini et al., 2021a).

At the end of each Integrated block, students are assessed, for the anatomical part through anatomy oral examinations.

Students involved in "Graphic Medicine meets Anatomy" (Parts I and II) seminars attended the first semester of the second year at the University of Bologna School of Medicine in 2020 and 2021. The demographic data are shown in Table 1.

"Graphic Medicine meets Anatomy": Workshops description

A total of one hundred thirty-three ($n = 133$) participants attended the first Italian graphic medicine interactive online seminar entitled "Graphic medicine meets Anatomy" on December 1st 2020 (part I), and December 13th 2021 (part II), delivered via Zoom videoconferencing platform, version 5.0 (Zoom Video Communications, Inc., San Jose, CA). The workshop participants included second-year international medical students from the University of Bologna of the current year. Previously, all students were provided a detailed list of materials for the workshop and a description of its goals: (1) Appreciation of visual narrative's value in the anatomical and medical field and (2) Reflection on the possible use of comics in relation to body donation program awareness raising.

The seminar was structured in four parts:

- Introduction (20minutes): explanation about graphic medicine and drawing warmup.
- Common Activity (30minutes) on the theme "Careful observation of others": participants were asked to read "Pink", a wordless comic about a medical student's profound encounter with a donated body in the anatomy laboratory, and then to make a list of remembered details and to draw some of them.

TABLE 1 Demographics of the International School of Medicine and Surgery of the University of Bologna workshops.

Demographics	Graphic medicine meets anatomy (Part I)		Graphic medicine meets anatomy (Part II)		Students involved in graphic medicine projects
	Workshop participants	Survey participants	Workshop participants	Survey participants	
Gender					
Female	68	30	26	11	12
Male	25	8	14	10	3
Other	-	-	-	-	-
Age					
20–21-year-old	59	34	35	20	15
22–23-year-old	19	4	1	1	-
Other	15	-	4	-	-
Nationality					
Italian	81	34	38	21	13
Other	12	4	2	-	2
Academic status					
2nd year medical student	80	38	36	21	15
Other (Seminars organizers)	13	-	4	-	-
Experience in a dissection room					
Yes	93	38	40	21	15
No	-	-	-	-	-
Previous knowledge about body donation					
Yes	13	-	4	-	-
No	80	38	36	21	15
Interest in comics					
Yes	78	35	37	20	15
No	15	3	3	1	-
Previous experience with graphic medicine in the medical school					
Yes	-	-	-	-	-
No	93	38	40	21	15
Total	93	38	40	21	15
	Graphic medicine meets anatomy (Parts I and II) Workshops		Graphic medicine meets anatomy (Parts I and II) Survey		Students involved in graphic medicine projects
Student participants	133		59		15

- Smaller session (30 minutes): participants were divided into smaller groups. Facilitators asked them to re-read “Pink” and to analyze it together, talking about personal experience and their emotions.
- Explanation of the Italian body donation system (10 minutes): state of the art and difficulties.

At the end of the seminars, a total of fifty-nine ($n = 59$) students chose to fill in the anonymous online questionnaire (see Supplementary material Document S1 for the questionnaire and Supplementary material Document S2 for students' responses).

Survey design and data analysis

An anonymous “feedback” survey, performed using Google Forms (Google LLC, Mountain View, CA), was administered to participants. The questionnaire (see Supplementary Document S1) contained eight ($n = 8$) questions in the demographic section (gender, age, nationality, academic status, experience in a dissection room, previous knowledge about body donation, interest in comics, previous experience with graphic medicine), one ($n = 1$) Likert scale four-items question and one ($n = 1$) open-ended question related to the workshops experience, and two ($n = 2$) Likert scale four-items question and two ($n = 2$)

open-ended questions related to the students' perceptions about the potentialities of graphic medicine as means of dissemination:

- (1) The use of graphic medicine could bring benefits in a citizenry awareness campaign on body donation programs. Please, justify your choice to the previous question, and
- (2) The use of graphic medicine could contribute to the promotion of the body donation programs within the scientific community. Please, justify your choice to the previous question.

The study, including no sensitive nor personal or clinical data, received ethical approval by the University of Bologna School of Medicine review board. The study was conducted in agreement with EU-GDPR and the Helsinki Declaration. All data were collected anonymously (EU-GDPR, last line of whereas 26), stored, and analyzed without any possibility to identify the students. Student participation was voluntary and without any compensation (Helsinki Declaration, art. 25), and they were given full explanation about the aims and contents of questionnaires (Helsinki Declaration, art.26).

Data from the demographic section and from the three ($n = 3$) Likert questions were analyzed using SPSS statistical package, version 25.0 (IBM Corp., Armonk, NY). Kendall's Tau b and Chi Square test analyses were performed, and statistical significance was defined at $p < 0.05$. Average scores of Likert statements were expressed in means \pm standard deviation (\pm SD) in Figure 1. The internal consistency of the emerged themes in Likert statements was established by calculating Cronbach's alpha to confirm reliability. The alpha value 0.70 and above were considered as good internal reliability.

The open-ended questions from the survey were analyzed using constructivist grounded analysis. Authors employed thematic analysis to understand and interpret data (Miller & Brewer, 2003). Using the Nvivo12 software (QSR International, Melbourne, Australia), each characteristic of a text was coded and were inductively developed categories through a process of constant comparison (Charmaz, 2003). From the initial coding process, fifty ($n = 50$) codes emerged. Most were repetitive codes, which needed to be clustered. Therefore, a second step was performed according to the main principles of Grounded Theory. An axial coding was performed allowed the authors to group the previous codes into categories: twenty ($n = 20$) macro-categories

emerged. The third and last level of analysis involved the selective coding with a total of ten ($n = 10$). The content analysis led to the theoretical sensitivity (Glaser & Strauss, 1967; Strauss & Corbin, 1998), based on the researcher's ability to use personal and professional experiences as well as methodological knowledge and thereby see data in new ways and think abstractly about data in the process of developing theory.

Students' projects focused session

After the "Graphic Medicine meets Anatomy (Part I)" workshop, students were invited to prepare graphic projects about body donation. Authors asked students to think about an awareness campaign for the citizenry regarding the importance of body donation for medical training and scientific research, focusing on personal feelings about body donation and its significance, related doubts, and importance.

Students were given a two-month deadline (February 2020) to develop the project that could be elaborated either digitally or by hand drawing, in English or Italian.

A total of fifteen students: female ($n = 12$), and male ($n = 3$), divided into five groups ($n = 5$), developed their own project:

- Three groups developed a hand-drawn comic in English language;
- One group developed a hand-drawn comic in Italian language;
- One group developed a digital comic using the Procreate 5.0 illustration application, in Italian language (Apple Inc., Cupertino, CA).

At the end of "Graphic Medicine meets Anatomy (Part II)" workshop, the five projects, were shown and described by the students collecting their feedback and work experience.

RESULTS

Workshops perception

This section contains the analysis of the results obtained from the four-items Likert scale question and its correlated open-ended question of the feedback survey. A total of fifty-nine ($n = 59$) students chose to fill in the anonymous online questionnaire.

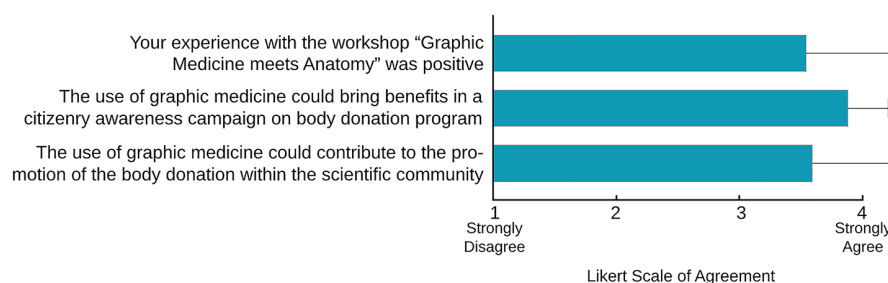


FIGURE 1 The bar graph depicting the responses to the anonymous questionnaire from the second-year students in the International School of Medicine and Surgery at the University of Bologna ($n = 59$) in the four-items Likert scale questions (1 = strongly disagree; 2 = disagree; 3 = agree; 4 = strongly agree). The bars represent the mean of each Likert scale question and the error bars shown \pm standard deviation (\pm SD).

The average score of the Likert statement was expressed in means \pm standard deviation (\pm SD) in the first bar of the Figure 1. The supplementary material Figure S1 encapsulated the common categories emerged from the open-ended question related to the Likert 1. The relationship between the answer to the Likert-scale statement and the theme is shown from the color code. The Kendall's τ coefficient and its p value were reported in Table 2. The Cronbach's alpha for these emerged themes in Likert statements was found to be 0.757 (Table 2). The demographic analyses revealed no significant difference in the students' rating between the two genders. Overall, the students evaluated the workshops positively. From the participants, 51% of students strongly agreed and 35% agreed that workshops were a positive experience (3.54 ± 0.73 ; $p = 0.026$ for students who reported a positive interest in comics; $p = 0.020$ for students whose age is 22–23 years old; Supplementary material Document S3). Only the 14% disagree with the statement. From the constructivist grounded qualitative analysis of the open-ended question related to the workshops' experience, common themes emerged.

Formative value

One of the main points underlined by the analysis of the results concerns the formative value ($p = 0.035$ for students who reported a positive interest in comics; $p = 0.026$ for non-Italian students. See supplementary material Document S3) of the seminars that showed as graphic medicine can be useful in medical field for both students and general population. Here is a sample of the open-ended answers regarding the category commented above: "The seminar was really eye opening, it not only made us reflect on the big life choices we made that made us choose this field, but also showed us that graphic and comics can be a very important tool in both our education in the medical field and also the education of public in terms of health" (Student 8).

Empathy

At the same time, students' responses focused the attention on the great emphatic power of the graphic medicine to promote an effective communication focusing on empathy (Ronan & Czerwicz, 2020). Here is a sample of the open-ended answers regarding the category commented above: "It has surprised me: even if I'm not able to draw, it made be notice that thing of comics has a great emphatic power, and helps people to communicate their feelings, their experiences in a very simple but efficient way" (Student 6).

De-stress

An important theme, which emerged from the responses, was the ability of the graphic medicine to reduce stress. Indeed, medical students are constantly under pressure and in this context, the use of graphic medicine was recognized in the open-ended responses as useful to reduce stress and anxiety (Maatman et al., 2022). Here is a sample of the open-ended answers regarding the category commented above: "I loved the exercise about drawing with our eyes closed. It was funny and a moment of silliness to destress as well. I liked the professor's comment that sometimes his drawings are better when he doesn't even look, because I think we are the most critical people against ourselves" (Student 21).

Proudness

Moreover, some students' responses focused the attention on a specific feeling of proudness in belonging medical school, emerged during the workshop. Here a sample of the open-ended answers regarding the category commented above: "I believe that this activity was really important too because it makes me feel proud of studying medicine" (Student 38).

TABLE 2 Cronbach α for the emerged themes in four-items Likert scale questions, and Kendall's τ coefficient and its p -value referred to each emerged theme.

Likert scale statements	Emerged themes	Cronbach α	Kendall's τ coefficient	p -Value
Your experience with the workshop "Graphic Medicine meets anatomy" was positive	Formative value	0.757	0.664	<0.01
	Empathy		0.295	0.02
	De-stress		0.403	<0.01
	Proudness		0.296	0.01
	Critical aspects		-0.472	<0.01
The use of Graphic Medicine could bring benefits in a citizenry awareness campaign on body donation programs	Simplicity of the communication	0.703	0.386	<0.01
	Reduction of biases		0.273	0.04
	Overcome of worries and fears		-1.000	<0.01
The use of Graphic Medicine could contribute to the promotion of the body donation programs within the scientific community	Alternative perception	0.766	0.585	<0.01
	Human side of medicine		0.368	<0.01
	Perplexities		-0.678	<0.01

Critical aspects

Few students reported troubles with the online mode or disliked the drawing part of the workshop due to a personal aptitude for drawing. Here is a sample of the open-ended answers regarding the category commented above: *"I also liked the reflection parts and hearing the stories of my classmates, but I did not particularly enjoy drawing. We did not improve our skills in drawing. I would love to see more reflection activities about dissections and medical school, but it does not have to be framed within Graphic Medicine"* (Student 20).

Perception of the possible use of graphic medicine for body donation awareness raising

This section contains the analysis of the results obtained from the four-items Likert scale questions and their correlated open-ended question of the anonymous questionnaire. The average scores of the Likert statements were expressed in means \pm standard deviation (SD) in the second and third bar of the [Figure 1](#).

From the analysis of the open-ended questions, interesting ideas emerged regarding the possible use of comics in the dissemination of the theme of body donation, both among the so-called non-experts (citizens) and experts (medical and biomedical professionals belonging to the scientific community). Keeping the two categories separated, the next sections outline the main themes.

Awareness among non-experts

Overall, the students evaluated that graphic medicine could bring benefits in a citizenry awareness campaign on body donation program. From the participants, 88% of students strongly agreed and 12% agreed with the statement (3.88 ± 0.33 , $p = 0.015$ for students who reported a positive interest in comics. Supplementary material Document S3). The supplemental material [Figure S2](#) encapsulated the common categories emerged from the open-ended question related to the Likert 2. The relationship between the answer to the Likert-scale statement and the theme is shown from the color code. The Kendall's τ coefficient and its p -value were reported in [Table 2](#). The Cronbach's alpha for these emerged themes in Likert statements was found to be 0.703 ([Table 2](#)). From the constructivist grounded qualitative analysis of the related open-ended question, common themes emerged.

Simplicity of the communication

One of the main points underlined by the analysis of the results concerns the simplicity of the graphic medium in communicating with citizens ($p = 0.029$ for students who reported a positive interest in comics. Supplementary material Document S3). Comics might fill the gap of the "knowledge deficit model": a traditional

top-down approach to science communication whereby information is provided to fill gaps in knowledge, under the assumption that this will result in people acting rationally once they understand it (Simis et al., 2016).

The juxtaposition of images and text can simplify the communication over some part of the population. As stated by our participants, comics are easier to read and can be accessible also for laypeople. Here are some samples of the open-ended answers regarding the category commented above: *"A campaign made by the use of graphic medicine would be a very good way of arriving in an easier way to every kind of listener, because for example a "comic" kind of medical journal gets the attention much more than just a normal written manifesto"* (Student 26); *"I think graphic medicine would help a lot in sensitization of people, because it is a simple and comprehensible way to explain things and get the observer attention on the problem you want him to think about. So, it should be effective in presenting the issue and convince people to make a choice, rather positive or negative"* (Student 5); and *"I think it is a kind of information medium that could reach a wider range of people, being more comprehensible and straightforward, maybe easier to read instead of some long review or article that not everybody might be able to read or fully understand"* (Student 15).

Reduction of biases

At the same time, comics might be also useful in reducing some biases and misinformation deeply connected to body donation. Graphic stories addressing scientific topics can be seen as a way to develop an innovative awareness campaign intervention addressing key barriers and social biases experienced by citizens. Here is a sample of the open-ended answers regarding the category commented above, a student highlights the lack of information, confusing body donation with organs donation: *"Body donation programs are terribly managed and carried out globally because the subject is poorly explained to many people. I know there are people who worry they may be "allowed to die" if they are on the organ donation list which is shocking to consider. Graphical medicine would be a great way to effectively communicate in a manner that makes the sensitive subject of donation of one's body more accessible"* (Student 30).

Overcome of worries and fears

At the same time, students' responses focused the attention on how the use of graphic medicine can also help to overcome worries and fears ($p = 0.015$ for students who reported a positive interest in comics. Supplementary material Document S3). Here are some samples of the open-ended answers regarding this category: *"It would help people to understand what really body donation is. Many people are afraid or against it only because they are not informed on what really happens. I think graphic medicine could really help in educating people about how body donation works and the importance that body donation can have, not only for students but also for research purposes"* (Student 9); and *"In my*

opinion, nothing is more intimate than what you can touch and then what you can see with your eyes. Body donation may seem dreadful to some. By depicting it through art as a simple act to help humanity and health, we can get rid of that type of dread and taboo" (Student 40).

Awareness among experts

In line with what was expressed with respect to non-experts, the students showed a high propensity to use graphic medicine also in promoting body donation among experts (68% strongly agreed, 25% agreed and 7% disagreed) but for different reasons.

The supplementary material Figure S3 encapsulated the common categories emerged from the open-ended question related to the Likert 3. The relationship between the answer to the Likert-scale statement and the theme is shown from the color code. The Cronbach's alpha for these emerged themes in Likert statements was found to be 0.766 (Table 2). From the constructivist grounded qualitative analysis of the related open-ended question common themes emerged.

Alternative perception

Despite the experts are more probably aware of what body donation is than the general population, comics can be an additional way of approaching the topic, as stated by one of participants. Here a sample of the open-ended answers regarding the category commented above: "The scientific community is aware of what body donation is but putting it in a different and funny way can help for sure the promotion of body donation" (Student 10).

Human side of medicine

Additionally, some responses were focused on how it is possible to show the human side of medicine (and science) through comics. Here is a sample of the open-ended answers regarding the category commented above: "I think so. We should remember that scientific community is made of people, as well as donors are" (Student 13).

Perplexities

However, and unlike the use meant for non-experts, some students showed perplexity on the use of comics. Here some samples of the open-ended answers regarding the category commented above: "I'm unsure, to be honest. I would imagine most professionals in the scientific community would be well acquainted with the topic and would not need such an introduction" (Student 46); and "It can be maybe a little less effective because the scientific community knows the benefits already, but it can be a good way to promote body donation" (Student 48).

According to some students, comics can be a valid tool but limited to the "evidence-based" use.

Here a sample of the open-ended answers regarding the category commented above: "I don't think that graphic medicine would be helpful in the communication within the scientific community, it would be more helpful to show data and to bring some experience of colleagues that find the body donation useful for the community and the society in general" (Student 7).

Projects on body donation awareness-raising realized by the students of medicine and surgery

The class of Anatomy of Cardiovascular and Respiratory systems of the year 2020/2021 of the School of Medicine and Surgery of the University of Bologna created five ($n = 5$) different projects for body donation awareness-raising in Italy. The projects were based on voluntary participation by individuals or groups of students. The projects were discussed during "Graphic Medicine meets Anatomy Part II". A description of each project is reported together with the rationale behind it. The rationale emerged during the focused discussion with the students on the last part of the second seminar dedicated to the projects' feedbacks.

- **Bits and Pieces (Figure 2A):** The story is a fiction about a time-traveling laboratory technician who takes the reader on a journey through the key points in history in which cadavers were used for scientific purposes or advancements. Each period reflects positive developments in modern medicine, such as efficient treatment and the accumulation of medical and anatomical knowledge. The technician takes a piece of history with him from each period he visits, appearing as a symbolic "Frankenstein" by the end of the comic with different pieces of different eras along with him in his rucksack. (Whole comic is available in the supplementary material Figure S4). The aim of the comic was to raise awareness and focused the audience's attention on all positive aspects into the scientific fields, occurred thanks to the body donation.
- **Hic Mors Gaudet Succurrere Vitae (Figure 2B):** The title means: "This is the place where death delights in helping life". This project creates a visual connection between the quote "Hic Mors Gaudet Succurrere Vitae", written on the wall of many dissecting rooms (as on that of Bologna University), with a graphic representation of it. Indeed, even if "succurrere" is used metaphorically in the quote, the image represents "Death" helping a doctor to stand up from the floor. This act is linked to the importance of body donation programs to medical education and also to scientific research. Moreover, it empathizes with the medical community, showing their weaknesses. (Whole comic is available in the supplementary material Figure S5). The aim was to raise awareness in the audience on an emotional level.
- **Ava on the ward (Figure 2C):** This project describes a fictional story about a young cardiac surgeon named Ava. Ava performs a



FIGURE 2 Examples of students' projects. (A) sample image from “Bits and Pieces”. The main character of the story is a time-traveling laboratory technician (shown in the figure). The comic is about a journey through key points in history in which cadavers were used for scientific purposes; (B) sample image from “Hic Mors Gaudet Succurrere Vitae”. The comic shows the positive relationship between a surgeon and death as allegory of body donation; (C) sample image from “Ava on the ward”. The comic is about Ava's life during her medical career and her link to body donation. The sample image shows the contrast between Ava's eyes open and her patients' eyes closed; (D) sample image from “Without fear”. The comic showed different images on doubts and fears about body donation. In the sample image is shown a hypothetical conversation between two people and the reason that led the left one to not prefer the body donation (I prefer to be cremated than to donate my body—Calm down—After donating your body you can still be cremated); (E) sample image from “Mortui prosumus vitae”. The comic is about two ghosts that end up agreeing that body donation is crucial. In the sample image is shown the ghost who decided to donate his body to science and one of his memories about the operation room.

heart surgery procedure that ends well, then she starts to recall the moment she decided she wanted to become a cardiac surgeon when she held, for the first time, a human heart during Human Anatomy laboratories. This memory pushes her to give back what she received; therefore she decides to donate her body to a post-mortem body donation program. Ava then retires and eventually dies. The cycle continues as young medical students start to study anatomy directly on her body, having the same experience she had. The story ends with a celebration to thank Ava for her contribution and to remember that life does not end with death. (Whole comic is available in supplementary material Figure S6).

- **Mortui prosumus vitae (Figure 2E):** The title means “Even in death do we serve life” and it is organized in two interconnected columns: one represents a reality in which the possibility of whole body donation is not of common knowledge, while the other one represents an ideal future in which body donation is widely practiced. Through a persuasive story integrating dialogue, rhymes, and drawings, the two ghost protagonists end up agreeing that body donation is crucial, and it brings benefits to the scientific, medical, and global communities. The comic is framed by

a limerick, a humorous five-line poem, that allows to better follow the stories. The language is simple, the message is conveyed frankly, and the rhythm and the flow increase the pleasure that may result from reading through the graphics.

As for example, in the first panel (representing a world without dissection laboratories), a student during the examination tries to remember the page number of the anatomy book instead of the anatomy concepts, meanwhile in the interconnected panel (representing a world with dissection laboratories), the student is confident during the examination thanks to the anatomy dissection laboratory, and he is thankful to the donor. The panels are framed by the limerick: *When I was young and keen to learn, I found the doctors mostly stern; They asked me where I should expect, To find the lungs and liver kept. I flushed and blushed, and I forgot, Lectures and books? What have I got?* (Panel representing a world without dissection laboratories)—*Indeed, I had a better time, Following real vessel lines. They asked me to show our precious brain: Describe external carotid and basal vein. I knew it; I got it; I saw it all: Our useful valuable donor soul* (Interconnected panel representing a world with dissection laboratories). Whole comic is available in

Supplementary Figure S7). The purpose of these two projects was to raise awareness, highlighting the formative value of body donation for both physicians and medical students.

- **Without fear (Figure 2D):** This is a graphic poster that tries to dispel the myths fueling the fear of donating one's body to science. The poster is based on everyday situations and uses irony and pop images in order to inform possible donors about the procedure for, and importance of, donating their bodies. This project is based on a survey (created and organized by authors) of the Italian population concerning their knowledge about the body donation program in Italy, and the reasons that lead people not to donate their bodies. From this survey emerged five doubts related to the most common fears about donating one's body: personal reasons related to family affection; burial; unethical and illegal reasons; irrational reasons without motivation; and preference for organ donation. The authors decided to represent five rooms, each associated with one doubt. (Whole comic is available in the supplementary material Figure S8). The aim of the comic was to create a reflection and to encourage the audience to examine in depth the topic of body donation.

DISCUSSION

In Italy, knowledge about whole body donation is still very limited and only a few centers have an active body donation program (Orsini et al., 2021b). Recently, new legislation (Law No. 10/2020) introduced a more detailed process for whole body donation with the creation of a national digital database for the collection of donors' data, the identification of specific body donation centers, and the activation of a whole-body donation awareness campaign (Italian Ministry of Justice, 2020). Nevertheless, these procedural and organizational innovations have not yet been put into practice, creating limitations to health education and scientific research based on cadaver dissection (De Caro et al., 2021). Medical students, who need a solid anatomical education, are the primary beneficiaries of whole-body donation and therefore of the possibility to study and practice directly on cadavers, in Italy as in many parts of the world (Cahill & Ettarh, 2008; Green, 2015). For this reason, the graphic medicine-based method of communicating information about body donation was investigated directly with medical students, introducing it into an anatomical class at an Italian university for the first time with two ($n = 2$) seminars entitled "Graphic Medicine meets Anatomy, Part I and II". The participation in the seminars was very active and collaborative as showed by the interest emerged from these experiences. As resulted in the workshop perception questions, most of the students showed excitement for this new approach to anatomical instruction and found the activity enjoyable and engaging, especially the students who had never heard about graphic medicine before. Among the categories emerged from the related open-ended question, students highlighted the formative value of graphic medicine in medical education. Indeed,

according to various studies, Graphic Medicine could help medical students develop a broader concept of health and illness (Anand et al., 2018; Joshi et al., 2019), but it is also useful for educating people on medical themes (McNicol, 2017). An additional theme emerged was the great emphatic power of the graphic medicine to promote an effective communication. According to Ronan and colleagues in a study conducted in 2020, Graphic medicine is a well-received format that may build communication skills and increase empathy (Ronan & Czerwiec, 2020). These kinds of positive results were also reported in various studies focused on clinicians' empathy for patients affected by diseases, such as Parkinson's disease (Myers et al., 2019) or diabetes (Tsao & Yu, 2016). The third theme, emerged from the open-ended question about the workshops' perceptions, was the ability of the graphic medicine to reduce stress. Indeed, it is well known that medical students are constantly under pressure and medical school pose a challenge to personal wellness for physicians in training, leading to high rates of anxiety, depression, and personal distress (Dyrbye et al., 2006; Ludwig et al., 2015; McKerrow et al., 2020). Moreover, even the practical training in the dissection of human cadavers can generate a certain amount of anxiety in medical students (Romo Barrientos et al., 2019). In this scenario, the use of graphic medicine was recognized in the open-ended responses as useful to reduce stress and anxiety, as also reported in literature (Zumwalt, 2021). The last theme, emerged from the open-ended question about the workshops' perceptions, was the feeling of proudness emerged thanks to the workshop. Indeed, graphic medicine has already been used to help students to explore their emotions before anatomy dissection exercise (Zumwalt, 2021). Interestingly, in this case, the student's reported specifically an increase in proudness of belonging to in the medical community.

The few students who disagreed with the statement on the Likert question about the positive perception of the seminar (14% disagree) reported troubles with the online mode, well known as a cause of frustration in students (Dirzyte et al., 2021), or disliked the drawing part of the workshop due to a perception that they lacked a personal aptitude for drawing. Moreover, after the seminars, two different aspects were investigated using the questionnaire. The open-ended question, regarding if graphic medicine could bring benefits in a citizenry awareness campaign, was used by authors to investigate students' perceptions, to have first feedback before approaching the general population. Whereupon, in the open-ended question regarding the use of graphic medicine in the promotion of body donation within the scientific community, students focused on their future medical role in relation to the usefulness of body donation.

The second-year medical students, that just started their medical career, are a bridge between the general and scientific population. They belong to a young scientific community, but they just entered for the first time into a dissection room, and they are just beginning to think as physicians (Park & Hong, 2022). They also still belong partially to the general population as many scientific and medical aspects still remain unrevealed to them.

Students' responses follow the idea of Houts and colleagues (Houts et al., 2006) about the role of pictures in improving body donation communication based on four ($n = 4$) axes/aspects: 1. drawing attention to the message; 2. helping people comprehend the information being presented; 3. increasing recall of the message, and 4. increasing the likelihood that people will act in accordance with the message (adherence).

Indeed, according to the questionnaire responses, students think that comics can get the attention of the audience. A study conducted by Delp and Jones investigated how the given instructions with or without cartoons could catch people's attention (Delp & Jones, 1996). Results showed that the patients who received a handout with pictures were significantly more likely to read it, compared to the patients who received the written one. Furthermore, in 2010, researchers from a Canadian university, investigated if the inclusion of graphic images, in warning messages in tobacco advertising, could increase visual attention, as measured by eye movement patterns and fixation density (Peterson et al., 2010). Even in this case, the use of graphic images increased the attention and the warning messages, that included the graphic images, generated higher levels of visual attention directed specifically toward the message, based on average dwell time and fixation frequency. Regarding the experts, that already had information about the topic of body donation, students' responses underline how comics could give different prospective taking advantage of their humorous nature. Indeed, according to a study (Schmidt, 2002), if designed to have a humorous nature, comic materials can trigger an affective or physiological response that enhances effectively the attention. The second aspect, highlighted by students, regarded the easy way to increase people's comprehension using comics. Krasnoryadtseva and colleagues investigated the use of different styles of medical illustration on information comprehension, compared to using the text alone (Krasnoryadtseva et al., 2020). Their results showed that pictures significantly increased the understanding of health information and increased the visual appeal of materials. Numerous studies over the years proved the usefulness of visual materials in health topic comprehension (Michielutte et al., 1992; Austin et al., 1995; Mansoor & Dowse, 2003), but only recently studies focused the attention on the visual medium universality. Indeed, according to Cohn visual narratives are "universal" in the sense that human brains innately have the cognitive structures necessary to gain fluency in their understanding (Cohn, 2020). Not only comprehension is enhanced by graphic content, but also memory is, as reported by Houts and colleagues (Houts et al., 2006) in the third aspect. As resulted from the study of Kools, pictures showed significant positive effects both on the understanding of medical procedures and recall of instructions (Kools et al., 2006). Indeed, a striking characteristic of human memory is that pictures are remembered better than written words or spoken (Houts et al., 1998; Zeng-Treitler et al., 2014; Hill et al., 2016). In particular, pictures presented in colorful and humorous styles are most effective for enhancing memory retention (Schmidt, 2002; Dzulkifli & Mustafar, 2013) and can lead people to think more often about the shown topic (Summerfelt et al., 2010).

Nevertheless, the fourth aspect regarding the behavior or "adherence" is the most important outcome for an effective raise awareness campaign, carrying out the recommended actions. In 2012, Hollands and Marteau assessed the addition of a visual image led to small but significant increases in intentions to undertake the recommended activity (Hollands & Marteau, 2013), and the same results were obtained in previous studies too (Whatley et al., 2002). As hypothesized also by some students that participated to the workshops, some studies reported that the use of illustration can decrease the perceived level of fear regarding a specific procedure (Whatley et al., 2002) or topic (Lefrère & Danic, 2013). Interestingly, from the students' responses, perplexities about the use of graphic medicine in an awareness campaign emerged only for the scientific population, that is mainly related to scientific-based dissemination (Krasnoryadtseva et al., 2020). According to them (25% agreed with the statement) the use of graphic medicine could contribute to the promotion of the body donation, but to a lesser extent compared to the general population. Further, a small percentage of the students reported that the use of graphic medicine could not be effective to promote the body donation within scientific community because it would be more helpful to show information supported by data (Rawat & Meena, 2014).

Therefore, students' responses revealed their appreciation of the importance of graphic medicine as an innovative teaching method, its potential in addressing mostly the general public on issues considered taboo or that often arouse fear, such as body donation, but also its usefulness for the scientific community. Moreover, graphic medicine projects, which were developed voluntarily by students, proved participants' enthusiasm about the graphic medicine usefulness in body donation raising awareness. The projects were deeply different at a visual level and focused the attention on various communicative aspects, even if developed by a group apparently homogeneous (students with the same age and education, instructions, and background on graphic medicine topic). Comics were the outcome of students' sensitivity and creativity. The various purposes that emerged during the projects' descriptions, showed some important facets of the theme.

In "Bits and pieces" the main character, going back in time, discovers how human bodies were used for scientific purposes in various eras and for positive developments in modern medicine. The focus on positive aspects of the theme in the scientific community hints that knowledge is fundamental for progress. In "Hic Mors Gaudet Succurrere Vitae" there is a clear contrast, both visual and concept, between the doctor, dressed in a white coat in a rainbow background, and the Death, surrounded by black color, but with positive intentions to help. This can both touch the audience on an emotional level and influence memory performance through the use of color (Dzulkifli & Mustafar, 2013). In "Ava on the ward" and "Mortui prosumus vitae", the students highlighted a common theme: the usefulness of learning from a cadaver in medical training, spreading it using an emotional or humorous way respectively, both remembered better than neutral events according to literature (Schmidt, 2002; Yonelinas & Ritchey, 2015). Unlike these narrative

projects, "Without fear" is a poster intended to stimulate public interest in body donation and debunk myths surrounding the topic. The various focus highlighted by comics brought the authors to continue the project on a larger scale and investigate the use of a non-common communication tool, as graphic medicine, in a collaborative model.

This new co-creative method, between anatomists, sociologists, and medical students may increase knowledge about whole body donation in Italy, currently very limited, underlining its great value.

Limitation of the study

A limitation of this pilot experience with medical students about Graphic medicine and its potential use in Body Donation reflection, was the limited number of participants. The reason behind it was the choice to earmark the online workshops specifically to small anatomical classes, in order to increase the interactivity of the workshops. A further limitation was the virtual modality of the seminars and of the questionnaire, obliged by the severe restrictions due to the pandemic situation. Indeed, technical difficulties, such as audio or connection problems, may have reduced satisfaction and engagement of the participants especially in the questionnaires (He et al., 2021).

CONCLUSIONS

Overall, the results of this pilot experience suggest that the use of Graphic Medicine may be a valid tool in raising awareness about body donation both in the general and scientific population, especially in the first category. The significant interest observed in medical students, related to the positive feelings about the use of graphic medicine in medical education, motivated the authors to continue the project by creating a collaborative model with them. Indeed, from both the emerged themes and the focus of the developed projects, it is clear how important the role of students is. Therefore, the collaboration between students, anatomists, and sociologists might increase knowledge about body donation, using graphic medicine as a valid means of dissemination. Future studies might collect data on the efficacy of comics in changing the public's attitude toward body donation, such as for example, by measuring attitudes before and after reading the comics. Considering the promising results of this pilot project and the need to increase the common and scientific knowledge about this theme, the use of graphic medicine could be an additional strategy to increase whole body donation awareness-raising in Italy. Finally, considering the universal value of body donation, this new communicative strategy could be adopted in other countries focusing on the specific aspects of different cultures.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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