

# Global Collaboration to Modernize Advanced Trauma Life Support Training



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**BACKGROUND:** Each year, thousands of surgeons and other trauma health care providers participate in the American College of Surgeons' Advanced Trauma Life Support (ATLS) program, which historically has allowed trainees to practice cricothyroidotomy, chest tube insertion, pericardiocentesis, venous cutdown, and diagnostic peritoneal lavage on live dogs, pigs, sheep, and goats. However, more than 99% of ATLS programs in the United States and Canada have now ended animal use, driven primarily by simulation technology advancements.

**OBJECTIVE:** This review details an international survey of animal versus simulation use in ATLS programs and summarizes the surgical training impact of a novel collaboration between the industry manufacturer of the TraumaMan human simulator, Simulab Corporation (Seattle, Washington), and an animal protection nongovernmental organization (NGO) based in Norfolk, Virginia, to replace animal use in ATLS programs with human simulators.

**METHODS:** From 2012 through 2017, the NGO e-mailed formal surveys concerning program statistics and animal use practices to ATLS officials in various countries (N = 64). The survey response rate was 87.5% and included pre- and post-comparison surveys relative to the industry-NGO simulation collaboration.

**RESULTS:** Eighteen ATLS programs (32.1%) initially replied that they use nonanimal training methods, whereas 38 ATLS programs (67.8%) replied that they use animals for surgical skills training and cited financial constraints as the primary barrier to adopting human simulation methods. Through the industry-NGO collaboration, the NGO donated 119 TraumaMan models valued at nearly \$3 million (USD) to ATLS programs in 22 countries,

such that 75% of those ATLS programs surveyed by the NGO now use exclusively nonanimal simulation models.

**CONCLUSIONS:** The industry-NGO collaboration successfully transformed the surgical skills laboratories of 22 international ATLS programs to replace animal use with nonanimal simulation models that are more anatomically realistic, cost less, and allow trainees to repeat surgical skills until proficiency. (J Surg Ed 76:487–496. © 2018 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

**KEY WORDS:** animal use alternatives, patient simulation, medical education, biomedical, advanced trauma life support

**COMPETENCIES:** Patient Care, Medical Knowledge, Systems-Based Practice

## BACKGROUND

The American College of Surgeons' (ACS) Advanced Trauma Life Support (ATLS) program was introduced in 1978 and has become the standard of care for the initial assessment and treatment of trauma patients. The course, which involves didactic sessions and skills training, has been taught to more than 1 million physicians and advanced practice health care professionals and is now offered in 86 countries.<sup>1</sup> Historically, the surgical skills station of the ATLS program – which covers invasive procedures such as cricothyroidotomy, chest tube insertion, pericardiocentesis, venous cutdown, and diagnostic peritoneal lavage—was taught by having students each year practice surgical procedures on the chests, throats, abdomens, and limbs of live dogs, pigs, sheep, and goats.

However, since the turn of the last century, the efficacy, practicality and ethics of using animals for ATLS training has been brought into question due to a host of factors. There have been significant improvements in

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the technical accuracy and tactile realism of human simulation models.<sup>2</sup> Animal models are unable to properly simulate human emergency clinical conditions.<sup>3</sup> Institutional education budgets have decreased, yet cost burdens associated with animal laboratories remain.<sup>4</sup> The medical community is focusing more on improving patient safety and reducing clinical errors through simulation-based training.<sup>5</sup> There is also rising public concern for the treatment of animals in laboratories.<sup>6</sup>

### **Institutional ATLS Policy Changes**

In 1993, the American Medical Student Association – the oldest and largest independent association of physicians-in-training in the United States – adopted a paradigm-changing position statement that “ENCOURAGES the utilization of nonanimal teaching materials and methods in Continuing Medical Education,”<sup>7</sup> which includes ATLS training.

However, the administrative approval to use nonanimal training methods in ATLS courses did not come until the year 2001, when the ACS – which oversees the ATLS program – approved the use of human cadavers and the TraumaMan system (Simulab Corporation, Seattle, Washington),<sup>8</sup> as full replacements to the use of animals for the ATLS surgical laboratory.<sup>9</sup> The TraumaMan system is an anatomically-correct human torso with life-like skin, tissue, internal organs and bones, as well as simulating bleeding when cut into and airway response using a ventilator. The ACS has since also approved other simulation systems including Synman (Synbone AG, Switzerland) for ATLS training.<sup>10,11</sup>

In 2009, the Minnesota Department of Health’s State Trauma Advisory Council identified several advantages of TraumaMan and concluded that the simulator “is associated with cost savings, portability and flexibility and should be embraced as a sufficient alternative to live tissue training.”<sup>12</sup>

Finally, in 2015, the United States Department of Defense (DOD) issued a memorandum prohibiting the use of animals for ATLS training – among other medical training areas – based on the efficacy of simulation available.<sup>13</sup> The DOD’s policy announcement was significant because nearly a decade earlier, the agency had stated that, “All advanced trauma life support training laboratory procedures were performed with animals under general anesthesia, and they were euthanized . . .”<sup>14</sup>

### **Studies Confirm Efficacy of Simulation-Based ATLS Training**

Studies have shown that TraumaMan performs as well as or better than animal use during the ATLS surgical skills laboratory. A US military study compared the self-efficacy of trainees taught emergency medical skills on

TraumaMan with those taught on live animals and found equivalent results in both groups, concluding that, “if the goal for trainers is to produce individuals with high self-efficacy, artificial simulation is an adequate modality compared with the historical standard of live animal models.”<sup>15</sup>

Another study from the University of Toronto found that training on TraumaMan is superior to animal-based training and those students and instructors overwhelmingly preferred the simulator model. As a result, the researchers ended animal use in their ATLS program, stating that “we could not justify identifying animals as the only suitable source for providing the necessary training in our ethics application for renewal.”<sup>16</sup> An earlier study also found TraumaMan “to be superior to the animal model” for ATLS training.<sup>17</sup>

### **U.S. and Canadian ATLS Programs Replace Animal Use**

Despite the growing acceptance of nonanimal training methods by medical organizations, the use of animals for ATLS training has, until recently, continued to be widespread for many years. In 2007, the Physicians Committee for Responsible Medicine (PCRM) initiated a survey to catalogue which ATLS programs across the United States and Canada use animals or simulators during the surgical skills laboratory in the course. PCRM learned from this survey, as well as from whistleblowers and internal research records, that various facilities used animals in ATLS training. Starting in 2008, PCRM submitted letters to administrators, filed complaints with regulatory agencies citing alleged violations of animal welfare laws that mandate the adequate consideration of nonanimal training methods,<sup>18</sup> held protests calling for transitioning to superior human patient simulators,<sup>19</sup> and erected billboards drawing the public’s attention to the use of animals in this training.<sup>20</sup>

Due in part to advocacy efforts by PCRM and others, and given the numerous studies confirming the efficacy of simulation-based training, today more than 99% of the 270 ATLS training facilities in the United States<sup>21</sup> – and all of the 32 ATLS programs in Canada<sup>22</sup> – now exclusively use TraumaMan and other ACS-approved nonanimal training methods.

### **Review of Animal Use for International ATLS Programs**

Despite the shift from animal use to simulation in ATLS programs in the United States and Canada, little was known about the use of animals versus simulation methods among international trauma training programs. This review details an international survey of animal versus simulation use in ATLS programs and

summarizes the surgical training impact of a novel collaboration between the industry manufacturer of the TraumaMan human simulator, Simulab Corporation (Seattle, Washington), and an animal protection non-governmental organization (NGO) based in Norfolk, Virginia, to replace animal use in ATLS programs with human simulators.

## METHODS

From 2012 through 2017, the NGO sent formal surveys via e-mail to officials representing the following international ATLS programs (N = 64) regarding their use of animals or simulators as part of the course's surgical skills laboratory: Argentina, Australia, Bangladesh, Bolivia, Brazil, Chile, China, Colombia, Costa Rica, Curacao, Cyprus, Czech Republic, Denmark, Ecuador, Egypt, Estonia, France, Germany, Ghana, Greece, Hong Kong, Hungary, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Jamaica, Jordan, Kenya, Lebanon, Lithuania, Malaysia, Mexico, Mongolia, Nigeria, Norway, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Portugal, Qatar, Saudi Arabia, Singapore, Slovenia, South Africa, Spain, Sudan, Sweden, Switzerland, Syria, Taiwan, Thailand, The Netherlands, Trinidad and Tobago, United Arab Emirates, Uruguay, Venezuela, and the United Kingdom.

The NGO's survey consisted of the following questions for each respective international ATLS program:

"1. How many ATLS courses do you conduct in [name of country] each year?"

"2. How many students participate in ATLS courses in [name of country] each year?"

"3. How many ATLS training facilities are in [name of country]?"

"4. How many animals are used in ATLS training in [name of country] each year?"

ATLS officials from certain countries (N = 8) including Brazil, Ireland, Paraguay, Singapore, Spain, Taiwan, Uruguay and Venezuela, did not reply to the NGO's survey. The survey response rate was 87.5%, and included pre- and postcomparison surveys relative to the industry-NGO simulation collaboration.

## RESULTS

Numerous international ATLS officials from countries that use animals for this course expressed a desire to switch to nonanimal simulation models, yet cited financial constraints as the primary transition barrier.

## ATLS Program Financial Hardship

Cyprus' ATLS official wrote, "As you may know Cyprus face[s] a big financial crisis and your help will be very appreciated [in obtaining TraumaMan models] ..."<sup>23</sup> Greece's ATLS official referenced that their country is in a "financially tight era."<sup>24</sup> Pakistan's ATLS official stated, "After spending [a] huge budget on infrastructure, [the College of Physicians and Surgeons Pakistan's] resources are restrained to buy [T]rama[M]an."<sup>25</sup> An ATLS official in the United Arab Emirates also wrote, "Our main concern is steep cost of [T]rauma [M]an and cost of replacement parts."<sup>26</sup>

## Industry-NGO Collaborative Solution

To solve this issue, the NGO established a collaborative program with simulation industry and ATLS leaders in twenty-two countries to cost-effectively replace their use of animals with TraumaMan models.<sup>27-29</sup> Specifically, as per the collaborative program, the NGO would purchase and donate TraumaMan models to countries whose ATLS officials agreed in writing to end their use of animals for ATLS courses. As part of this effort, the simulation industry partner also allowed a discount on replacement "skins" – artificial tissue covering the TraumaMan model's throat and abdominal area – as well as a five-year extended maintenance and support program for repair or replacement of heavily used system components vulnerable to damage during normal training use. Through the NGO's TraumaMan donation program, ATLS officials can spend less per student than they would spend using animals. The NGO estimated the costs of animal versus simulation training, and used anecdotal data from ATLS programs surveyed, to determine cost-savings for ATLS programs that participated in the industry-NGO collaboration.

From 2012 to 2017, the NGO worked directly with international ATLS officials who expressed a desire to replace animal use in their ATLS programs. **Table 1** shows ATLS officials' answers to the NGO's questions regarding their respective ATLS programs.

Based on the data reported by these 22 countries, more than 2063 dogs, pigs, goats, and sheep were used each year in at least 124 ATLS facilities outside of the United States and Canada in at least 373 ATLS courses to teach more than 8350 surgical trainees. As a result of participating in the industry-NGO collaborative program, these 22 countries represent more than one-third of all 64 national ATLS programs surveyed outside of the United States and Canada that have now fully replaced their use of animals for ATLS training due to the NGO's donation of 119 TraumaMan models valued at nearly \$3 million (USD).

**TABLE 1.** Responses from Countries Participating in the Industry-NGO Collaborative Program to Replace Animal Use in ATLS Training with TraumaMan Models

Country	Type of Animals Used in ATLS	Number of Animals Used in ATLS Per Year	Number of ATLS Training Facilities	Number of ATLS Courses Per Year	Number of ATLS Trainees Per Year
Bangladesh*	—	0 (95-180 animals projected without simulator donation)	1 currently (3 in near future)	4-6	80-120
Bolivia†	Dogs, pigs, goats	64	8	16	241
China*	—	0	1	—	—
Costa Rica	Pigs	44-48 currently (82-96 when all 4 sites open)	1 currently (4 in near future)	11-12 currently (20-24 when all 4 sites open)	180 (372 when all 4 sites open)
Cyprus	Pigs	12-18	1	2-3	15-20
Egypt†	Goats	25	6	11	200
Ghana*	—	(Nonspecified amount of animals projected without simulator donation)	1	2	40
Greece	Pigs	64-200	8 currently (10 in near future)	16-40	256-800
Indonesia	Sheep	1152	30	144	4608
Iran†	Dogs, Goats	24	3	6	96
Iraq*	—	0	3 (9 more in future)	36	250
Jamaica	Pigs	24 (Ended animal use previously, but in need of new simulators to continue abstaining from animal use)	1	6	96
Jordan*, †	—	0	1	1	15
Kenya	—	6	1 (more facilities planned in future)	3	72
Mexico†	Dogs, pigs	560	40	49	784
Mongolia*, †	—	4	2	1	16
Pakistan	Dogs, goats	16-30	6 currently (4 more planned)	24-36 currently (56 when all sites open)	700-1000
Panama†	Dogs	24	1	6	96
Philippines	Pigs	16	1	4	64
Sudan*	—	0 (60-70 animals projected without simulator donation)	3 (6-8 more planned)	12	240-280
Trinidad and Tobago†	Pigs	8	1	3	61
United Arab Emirates	Goats	20-28	4	16-20	240-280

\*At the time of the NGO's TraumaMan donation, 6 countries — Bangladesh, China, Ghana, Iraq, Jordan, Mongolia and Sudan — were in the process of forming their ATLS programs and were keen to use nonanimal training methods from inception if possible.

†Eight countries that received TraumaMan models from the NGO's first round of donations submitted annual reports to the organization in 2015 with updated ATLS program data, which is incorporated in this table. The data from Mexico is only for 7 months and not a full year.

Based on correspondence between the NGO and ATLS officials from 56 countries outside of the United States and Canada (with the understanding that ATLS officials from 8 other countries did not respond), prior to the NGO's TraumaMan donation 38 of these countries (67.8%) used animals for ATLS training and 18 countries (32.1%) used exclusively nonanimal training methods. As [Table 2](#) shows, after the NGO's TraumaMan donations, 14 of the countries (25.0%) surveyed continue to use animals for ATLS training and 39 countries (75.0%) surveyed now use exclusively TraumaMan, SynMan or other ACS-approved nonanimal training methods.

### **ATLS Cost Savings and Improved Training After Participation in Industry-NGO Collaboration**

Facilities that use animals in the ATLS surgical skills laboratory incur assorted expenses associated with caring for animals, including the costs of a vivarium or veterinary facility, veterinary staff, veterinary supplies, anesthesia medicine, food, and repeated animal acquisition and disposal. On the contrary, ATLS courses that replace animal use with TraumaMan simulators avoid these animal-related expenses. One U.S. study found that, "Institutional cost for purchase of 16 [TraumaMan replacement] 'skins' was [US] \$2000 and previous cost of the animal facility was approximately [US]\$2400," representing a cost savings of US\$25 per student for replacing animal use with TraumaMan models.<sup>32</sup>

Several international ATLS facilities that participated in the industry-NGO collaborative program realized similar cost savings per anecdotal evidence.<sup>33</sup> In annual reports sent to the NGO following the organization's TraumaMan donations, various ATLS directors cited cost savings compared to previous animal laboratories, the ability to expand ATLS training to remote areas, anatomical accuracy of the TraumaMan, and easing of ethical concerns regarding the use of animals.

For instance, Bolivia's ATLS official wrote, "The introduction of TraumaMan has allowed us to save between US\$55-60 per student per course. This represents a cost saving of roughly US\$14,000 per year . . . TraumaMan has expedited setup of the course and allows us to teach the course outside of a Veterinary Hospital . . . This would have been impossible with the previous animal model. The students and instructors have responded very positively to TraumaMan. . . [It] allows us to teach and learn the surgical skills in a clean, humane and appropriate setting."<sup>34</sup> Similarly, Egypt's ATLS official cited an animal laboratory cost per student of US\$440 compared to a TraumaMan cost per student of US\$380, representing a cost savings of US\$60 per student or US\$12,000 per year when Egypt ATLS replaced its animal-based surgical skills laboratory with TraumaMan models.<sup>35</sup>

Kenya's ATLS official noted, "ATLS Kenya is proud to be able to train physicians to treat traumatic injuries using effective human simulation technology instead of live animals while also reducing the cost of this critical training, thanks to a generous donation of advanced TraumaMan models from [the NGO]."<sup>36</sup>

Iraq's ATLS official noted, "Thanks to a generous donation by [the NGO] of advanced and realistic TraumaMan human simulators, surgeons in Iraq can avoid using expensive and crude animals in trauma training and will be better prepared treat people suffering from traumatic injuries."<sup>37</sup>

Sudan's ATLS official stated, "[The NGO]'s donation of life-like human TraumaMan simulators . . . will greatly improve skills training for surgeons that benefits patients, save our program money, and allow us to avoid the outdated and unethical use of animals in surgical training."<sup>38</sup>

Mexico's ATLS official noted, "All who have used the [TraumaMan] model instead of animals are very pleased with the change. It is easier to perform the [ATLS] skill[s], [and we] will not have to use a special [training] area. The model is very similar to the human body. People who have pets at home report that the skill[s] [training on TraumaMan] does not generate unpleasant emotions."<sup>39</sup>

An ATLS official from Trinidad and Tobago stated, "TraumaMan is much more acceptable and superior [than using animals] in teaching technical procedures. In general the ATLS program is more acceptable for those that had reservations about animal usage."<sup>40</sup>

## **CONCLUSION**

Through participation in the industry-NGO collaboration to modernize medical training, 22 ATLS programs around the world have successfully been able to replace their use of animals in the surgical skills laboratory portion of the ATLS course with more realistic TraumaMan simulation models that – unlike animals – provide superior human anatomy, significantly lower costs for ATLS programs, and improve training by allowing ATLS participants to repeat procedures until proficient. This novel industry-NGO collaboration has been pivotal in transforming the global ATLS training paradigm from one that previously used animals in surgical skills training by 67.8% of ATLS international country programs surveyed to one that now uses exclusively nonanimal simulation-based training methods by 75% of these ATLS programs.

There is a mutual interest in maintaining the success of this industry-NGO collaborative program following the expiration of the five-year term for discounted TraumaMan replacement "skins" and extended TraumaMan

**TABLE 2.** Comparison of Animal Use in ATLS Training Outside of the United States and Canada Before and After the NGO's TraumaMan Donation

Before NGO's TraumaMan Donation		After NGO's TraumaMan Donation	
Use Animals (N = 38)	Do Not Use Animals (N = 18)	Use Animals (N = 14)	Do Not Use Animals (N = 42)
Argentina	Czech Republic	Argentina	Australia
Australia <sup>#</sup>	Denmark	Chile	Bangladesh
Bangladesh <sup>*, ‡</sup>	Estonia <sup>¶</sup>	Colombia	Bolivia
Bolivia <sup>‡</sup>	France	Curacao	China
Chile	Germany	Ecuador	Costa Rica
China <sup>*, ‡</sup>	Israel	Hong Kong	Cyprus
Colombia	Italy	Hungary	Czech Republic
Costa Rica <sup>‡</sup>	Lebanon	Malaysia	Denmark
Curacao	Lithuania	Peru	Egypt
Cyprus <sup>‡</sup>	Nigeria	Qatar	Estonia
Ecuador	Norway	Saudi Arabia	France
Egypt <sup>‡</sup>	Oman	Syria	Germany
Ghana <sup>§, ‡</sup>	Portugal	Thailand	Ghana
Greece <sup>‡</sup>	Slovenia	United Kingdom	Greece
Hong Kong	South Africa		India
Hungary <sup>  </sup>	Sweden		Indonesia
India <sup>†</sup>	Switzerland		Iran
Indonesia <sup>‡</sup>	The Netherlands		Iraq
Iran <sup>‡</sup>			Israel
Iraq <sup>*, ‡</sup>			Italy
Jamaica <sup>*, ‡</sup>			Jamaica
Jordan <sup>*, ‡</sup>			Jordan
Kenya <sup>§, ‡</sup>			Kenya
Malaysia			Lebanon
Mexico <sup>‡</sup>			Lithuania
Mongolia <sup>‡</sup>			Mexico
Pakistan <sup>‡</sup>			Mongolia
Panama <sup>‡</sup>			The Netherlands
Peru			Nigeria
Philippines <sup>‡</sup>			Norway
Qatar			Oman
Saudi Arabia			Pakistan
Sudan <sup>*, ‡</sup>			Panama
Syria			Philippines
Thailand			Portugal
Trinidad and Tobago <sup>‡</sup>			Slovenia
United Arab Emirates <sup>‡</sup>			South Africa
United Kingdom			Sudan
			Sweden
			Switzerland
			Trinidad and Tobago
			United Arab Emirates

\* ATLS officials in Bangladesh, China, Iraq, Jamaica, Jordan, and Sudan left open the possibility of animal use and did not rule out animal use prior to the NGO's donation, so that is why they are in the "Use Animals" column.

† India's ATLS representative initially stated no animals are used for ATLS, but later another representative confirmed that animals are indeed used. This is why India appears in the "Use Animals" column.

‡ Twenty-two ATLS countries received TraumaMan models from the NGO.

§ Ghana and Kenya are promulgating new ATLS programs but have used animals for ATLS-type courses before, which is why they appear in the "Use Animals" column.

|| ATLS officials in Hungary did not reply to the NGO's survey questions about its ATLS program. But a study published in 2016 about Hungary's ATLS program references an animal laboratory component,<sup>30</sup> which is why Hungary appears in the "Use Animals" column.

¶ ATLS officials in Estonia did not fully answer the NGO's survey questions about its ATLS program. However, Estonian ATLS officials did state it was using the Synman simulator, which is why Estonia appears in the "Do Not Use Animals" column.

# Officials for Australia's ATLS-equivalent program announced it would end animal use for this training by 2018.<sup>31</sup> At the time of the NGO's initial survey, Australia was using animals for this program, which is why Australia initially appears in the "Use Animals" column.

Note: Eight countries — ATLS officials in Brazil, Ireland, Paraguay, Singapore, Spain, Taiwan, Uruguay and Venezuela — did not reply to the NGO's questions, therefore their status regarding animal use in ATLS training is unknown.



**PHOTO 1.** ATLS trainees in United Arab Emirates practicing surgical skills on a goat.

maintenance and support. The NGO desires permanent replacement of animal use for ATLS training, the industry partner seeks continued business with respect to purchase of “skins” for the TraumaMan models, and the ATLS programs want reduced training costs and advanced training simulators. As such, the NGO is proactively contacting officials for each participating ATLS country prior to the agreements’ expiration to renew these terms for another five-year period – as it will do again in the future – with the latest TraumaMan model upgrade costs covered by industry and the discounted industry-NGO program renewal cost covered by each ATLS program. In the case of ATLS programs’ financial hardship preventing them from covering the discounted industry-NGO program renewal cost, the NGO is working out individual financial arrangements or grants on a case-by-case basis to ensure ATLS programs can renew their participation in this collaborative program.

## DISCUSSION

Training surgeons in trauma management requires teaching models that convey realistic human anatomy, allow for repetitive use to develop skill proficiency, and facilitate team training – all of which, unlike using animals,

can be achieved using TraumaMan and other ACS-approved nonanimal training methods.

In addition to the problematic ethical issues associated with using animals in surgical training, the choice to use live animals or nonanimal methods during an ATLS course should be based on which model is pedagogically superior, which in this case the evidence clearly points to TraumaMan being the best-practice model of choice. Additional benefits of TraumaMan include being more economically sustainable and logistically expandable to remote regions.

Given that the same ATLS surgical skills laboratory procedures are taught at facilities around the world and each facility has its own animal ethics committee that evaluates ATLS animal use protocols, it is difficult to reconcile one committee’s decision to use animals and another’s decision to use human simulation models. However, once an animal ethics committee, training facility, or government agency has decided to replace animal use in a training protocol with simulation models, pressure grows on other facilities teaching the same procedures and courses to follow suit. This is the case with ATLS in the United States and around the world, as justifications for continued animal use for this purpose are weakened as more ATLS programs make the transition to human simulation methods.

Continuing to use animals during ATLS courses bases the choice of training modality not on evidence-based best



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**PHOTO 2.** ATLS trainees from Trinidad and Tobago practice surgical skills on a TraumaMan model donated by the NGO.

practices, but rather on the unproven perceived benefit of working with live tissue that has not been shown to be superior in peer reviewed studies. There is no scientific, ethical or financial justification for continuing to use animals for ATLS training, and we encourage ATLS programs that still use animals to transition their ATLS programs to modern and humane nonanimal training methods.

A similar case for a global transition to simulation-based training methods can be made for other areas of

medical education. For example, in addition to banning animal use for ATLS training, the DOD has banned animal use in favor of human simulation methods for the following: neonatal resuscitation training of family medicine residents and pediatric residents, pediatric nurses and staff; obstetrics and gynecology residency training; training of registered nurse anesthetist residents and staff; and the development and maintenance of surgical and critical care skills for field operational surgery and

field assessment and skills tests.<sup>41</sup> Facilities or other governments that continue to use animals for these disciplines may face difficulty in providing adequate justification for this practice given that the Pentagon has taken a lead in mandating human simulation training methods for these learning areas.

Interestingly, while the DOD has led efforts to replace animal use in certain medical training areas, the agency still conducts “live tissue training” (LTT) drills that involve inflicting traumatic injuries in thousands of animals each year,<sup>42</sup> despite the U.S. Coast Guard having ended this practice in 2017 in favor of human simulation models.<sup>43</sup> The Coast Guard’s proactive decision to halt animal use for LTT drills may in turn pressure the Pentagon to reevaluate its justification for continued animal use in LTT, similar to how animal use for ATLS training is gradually being replaced around the world as increasing numbers of ATLS facilities adopt superior and more cost-effective human simulation technology (Photo 1 and Photo 2).

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## SUPPLEMENTARY INFORMATION

Supplementary material associated with this article can be found in the online version at <https://doi:10.1016/j.jsurg.2018.08.011>.