JOURNAL OF Surgical Simulation

*Journal of Surgical Simulation* (2018) **5**, 99–104
DOI: https://doi.org/10.1102/2051-7726.2018.0012

ORIGINAL ARTICLE

# Will SCOBY do? An alternative for teaching basic surgical skills of suturing and skin excision

**Amber van Dreven,[a,*] Sue J. Garner,[a] Sean T. MacDermott,[b] Mark W. Yates[a] and Steve G. Costa[c]**

[a]*Faculty of Health, School of Medicine, Deakin University, Geelong, Australia;* [b]*La Trobe Rural Health School, Mildura, Australia;* [c]*Ballarat Health Services, Ballarat, Victoria, Australia*

[*]*Corresponding author at: Faculty of Health, School of Medicine, Deakin University, Geelong, Victoria, Australia.*
*Email: amber.vandreven@deakin.edu.au*

Date accepted for publication: 9 November 2018

## Abstract

**Background:** Using pork or ethylene-vinyl acetate (EVA) pads to teach suturing and excision skills to medical students can be expensive and lack a degree of realism. This project aimed to ascertain if a symbiotic culture of bacteria and yeast (SCOBY) represented a viable alternative. **Methods:** Part 1 of this study was designed to identify the descriptors against which SCOBY, pork and EVA pads could be evaluated. Participants in part 1 were asked to identify elements of fidelity that best represented skin when comparing the three models. Part 2 of the study required a second cohort of participants to rank the three models against the descriptors identified. **Results:** The overall results indicate that, with the exception of odour, respondents rated SCOBY superior to EVA pads and equivalent to pork. There were no significant differences between pork and SCOBY for skin likeness, cutting likeness, and suturing likeness, although both were deemed superior to EVA pads. Qualitative feedback indicated that SCOBY was not as robust as pork and lacked the layers of skin that pork better represents. Cultural and religious impediments to using pork models were also highlighted. **Conclusion:** SCOBY offers a viable, low-cost alternative to pork to teach suturing and excision with comparable fidelity to pork and a superior fidelity to EVA pads. The smell of SCOBY is mildly vinegary due to the secondary fermentation of alcohol to acetic acid. Ten percent of the participants in part 2 of the study identified cultural or religious barriers to using pork.

**Keywords:** *medical education; suturing; cultural sensitivity; cost effectiveness; simulation; skin model*

## Background

In teaching the skills of suturing and excision to postgraduate medical students, materials used to represent human skin have included vegetables, pads and foam products, chicken legs, pig feet, and other post-mortem animal parts.[1–6] The fidelity of these materials to living human tissue can vary significantly and, as shown in the literature, evaluations of model fidelity are often based on authors' opinions rather than research.[7–9] The criteria for selection of suture models appear to be based on cost, convenience of use, and degree of skin fidelity.[1–3,7,8] Staff at the Grampians Clinical School – Deakin University (GCS) have used ethylene-vinyl acetate pads (EVA) and pork belly as materials to simulate human skin.

The use of porcine material has potential religious and cultural implications for both students and staff. Compliance with food safety, handling and storage regulations requires onerous monitoring of procedures. These issues, coupled with the financial outlay of pork belly purchase (upwards from $25 AUD/kg), has led GCS to explore an alternative material.

Using EVA pads as an alternative to pork has the advantage of reducing infection risks, eliminating cultural issues, and requiring little set up by clinical skill staff. However, their use and replacement can be costly (approximately $85 AUD for a pack of four), and the fidelity of EVA pads differs markedly to human skin in that they are dry and inelastic.

Suture model fidelity is an important determining factor when selecting a specific material for teaching clinical skills.[10] A review of the literature indicated that few studies have reported on differences in skill acquisition using high- and low-fidelity models. Those that did concluded that the fidelity of the model did not affect the acquisition of skills.[11,12] However, the superiority of either high- or low-

fidelity models is often dependent on a number of factors, such as student skill level and the intended use of the material.[10] The limitations presented by both porcine and EVA materials have resulted in a need to explore a low-cost, low-risk and culturally appropriate alternative.

The purpose of this study was to evaluate a symbiotic culture of bacteria and yeast (SCOBY) as a low-cost, low-risk and culturally appropriate alternative to both pork and EVA (Fig. 1). SCOBY is a by-product of kombucha manufacture. Kombucha is a tea produced via a yeast fermentation of sugar to alcohol followed by a bacterial fermentation of alcohol to acetic acid.[13]

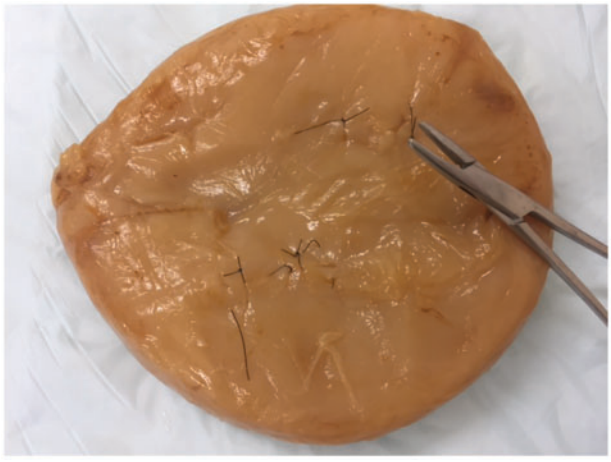

**Fig. 1.** A sample of SCOBY.

During the fermentation process, a biofilm (SCOBY) is formed on the surface of the tea. SCOBY is formed to a food-grade level, and as such, issues of infective risks are minimized. The major bacterial genera present in SCOBY are *Gluconacetobacter*, *Acetobacter* and *Lactobacillus*.[14,15] An infectious diseases consultant confirmed SCOBY to be safe for clinical education (R. Cowan, personal communication, May 5, 2016). Currently, there have been no reported studies in the literature examining the use of SCOBY in medical education. To the author's knowledge, this is the first study to examine SCOBY as a feasible alternative to both EVA and porcine material.

## Methods

SCOBY was grown specifically for this study in our clinical school. We grew the SCOBY until we had a uniform depth of approximately 15 mm, which was then cut into 10-cm square pieces. This appeared deep enough to suture and excise, although greater depth can be achieved by prolonging the brew cycle in smaller containers. For further information on how we produced the SCOBY, see Fig. 2.

### Part 1: identification of descriptors defining the fidelity profile requirements for skin suturing and excision

#### Participants

Purposeful sampling was utilized to recruit 10 consultant-level clinicians for participation in part 1 of this study.

| STEPS | INSTRUCTIONS |
|---|---|
| 1 | Clean utensils and containers to a food grade quality (we used a fish tank to brew in) |
| 2 | Make a tea using -<br>a. 15 litres of hot water<br>b. 20 tea bags<br>c. 4 cups of sugar, dissolved in the hot water |
| 3 | Once this has cooled and tea bags removed, add -<br>a. 6 cups starter Kombucha tea<br>b. 3 large (at least 1cm thick x 10 cm diameter) SCOBYs (often referred to as 'mothers') |
| 4 | Cover with breathable thin cotton sheet to keep out insects but allows for some airflow. |
| 5 | Brew for 4-5 weeks. Thickness will vary according to length of brew cycle, as well as ambient temperature. |
| 6 | Cut to desired size, keeping enough SCOBY and tea to start next cycle. |
| Adapted from Crum, LaGory and Katz (2016)[17]. | |

**Fig. 2.** Ballarat Clinical School SCOBY manufacture.

### Eligibility

Before participation in this study, all participants were initially screened for eligibility. The inclusion criteria were as follows: (1) current registered professionals who suture/excise routinely as a part of their clinical practice; (2) current registered professionals who have previous teaching associations with the GCS.

### Data collection

Participants were invited to suture three materials (pork belly, an EVA material, and SCOBY) and to perform an elliptical excision on two of the materials (pork belly and SCOBY). The clinicians independently sutured the three materials, with the order of presentation alternating between participants to minimize any order effects.

Participants were then invited to independently complete a semi-structured questionnaire recording their opinions, attitudes and ideas pertaining to the fidelity of pork, SCOBY, and EVA (Table 1). Participants were initially asked to nominate their preferred material to facilitate reflection on which aspects of fidelity had informed their choice. Questions relating to recent practice were included to explore any relationship that might have existed between perceptions of fidelity and the clinical reality of skin suturing/excision. Confidentiality was ensured by de-identifying participant responses and assigning a case number to each of the questionnaires.

### Questionnaire analysis

Members of the research team and two assistants conducted thematic coding independently, coding each questionnaire to generate initial themes. Common themes were discussed in collaboration with the entire research team and a thematic framework was developed. The themes of look, feel and smell were not chosen, but rather emerged during the thematic analysis conducted during part 1 of the study. The themes and sub-themes that emerged during this process were endorsed by clinicians who had completed questionnaires during part 1 of the study. These themes and sub-themes are provided in Table 2.

**Table 1.** Questions used in part 1

| | |
|---|---|
| 1. | Have you sutured human skin within the last 3 months? |
| 2. | Have you excised human skin within the last 3 months? |
| 3. | Which model most closely resembles the clinical reality of suturing human skin? |
| 4. | Which model most closely resembles the clinical reality of excising human skin? |
| 5. | What has led you to these decisions? List and explain as many possible comparable properties that best describes the fidelity of suturing or excising human skin |
| 6. | Any other comments |

## Part 2: identifying which material best represents the fidelity of skin when suturing and excising

### Participants

Purposeful sampling was used to recruit an additional 33 clinicians for participation in part 2 of this study. These clinicians were recruited based on their breadth of experience and expertise but differed from clinicians in part 1 of this study who were deemed to be consultant experts in the field of suturing and excision. Participants in part 2 were asked if they had sutured and excised human skin within the last 3 months. All participants reported that they had. Participants were invited to take part in this study during dedicated education time. Participants were informed that there were no adverse consequences to not participating, and that participation was completely voluntary.

### Eligibility

All interested participants were screened for eligibility before participation in this study according to the following inclusion criteria: (1) current registered medical officers in a regional hospital (second year post-graduation or above), who routinely suture and excise human skin as a part of their clinical practice; (2) available to attend the Clinical School at scheduled times to participate.

**Table 2.** Themes and sub-domains identified that define the fidelity profile requirements for skin suturing and excision

| Theme | Sub-domain |
|---|---|
| Skin likeness | Elasticity |
| | Tissue layers |
| | Tissue thickness |
| | Tissue firmness |
| | Fluid content |
| Cutting likeness | Knife feel |
| | Response to forceps |
| Suturing likeness | Cut through of sutures |
| | Response to tension of sutures |
| Smell | |
| Feel | |
| Look | |

Participants were asked to rate each of the above themes and sub-themes on a Likert-type scale (1 = little similarity to human skin to 5 = very similar to human skin).

### Data collection

Participants were invited to place three 3-0 nylon interrupted sutures in the three materials (pork belly, an EVA material, and SCOBY) and to perform one elliptical excision on two of the materials (pork belly and SCOBY). The clinicians independently sutured the three materials, with the order of presentation alternating between participants to minimize any order effects. No time limits were placed on completion of the tasks.

Participants were then asked to complete a semi-structured questionnaire, with each of the suturing materials listed against the themes identified in part 1 of this study. A 5-point Likert-type scale was also used to rank the materials, with 1 indicating little similarity to human skin and 5 indicating that the material was very similar to human skin. In addition, participants were asked:

(1) Given your responses above, which of these three models do you think is most suitable for teaching suturing?

(2) Which of these three models do you think is most suitable for teaching excision?

### Statistical analysis

Likert scale survey responses were examined using SPSS, and differences were examined using a one-way repeated measures ANOVA. Comparison of agreement among raters was also assessed using a post-hoc Bonferroni test.

### Ethics approval

The study was granted ethics approval from the associated University Human Research and Ethics Committee at each participating site. Consent to access the contact information for potential participants was obtained from the health service with which the Clinical School is affiliated.

## Results

### Semi-structured questionnaires

Six themes were highlighted from the qualitative feedback received by the participants. These were identified as skin likeness, cutting likeness, suturing likeness, smell, feel, and look.

Most of the feedback from the participants revealed that SCOBY was not as robust as pork. One respondent noted that "it will (sic) be easier to get a suture through than pork, but isn't anything like skin". Similarly, other comments indicated that SCOBY "needs to be firmer", is "too floppy", is "inelastic", is "slippery" and "lacks defined layers". Conversely, comments regarding the pork material included that it was much tougher than skin and could "reinforce a degree of roughness that is not desirable". From the written comments, it appeared that both pork and SCOBY had shortcomings in their accuracy of skin representation.

The descriptor in which the pork-based model was overwhelmingly superior was that of smell. Qualitative feedback described the smell of SCOBY as "unpleasant", "pretty funky, but not as bad as stale meat", "very stinky" and "(SCOBY had a) mildly unpleasant smell".

Although this study did not set out to explore the cultural impact of using porcine models specifically, two participants in part 2 of this study highlighted this issue in their qualitative feedback, and one participant neglected to rank the pork belly without explanation. Feedback included "I felt uncomfortable suturing it (pork) due to religious beliefs" and "model b (pork) was not tried due to cultural reason". Another participant wrote "Pig still no. 1, but Scobie (sic) is a good enough likeness to skin minus the hassles of storage and Halal".

### Quantitative analysis

Quantitative data comprised mean ratings of EVA, pork, and SCOBY. The sub-domain scores in the themes of skin

**Table 3.** Mean ratings for EVA, Pork and SCOBY against the themes identified in part 1

| | EVA (n = 33) | | Pork (n = 33) | | SCOBY (n = 33) | |
|---|---|---|---|---|---|---|
| | Min–max | Mean (SD) | Min–max | Mean (SD) | Min–max | Mean (SD) |
| Skin likeness | 5.00–21.00 | 10.42 (4.27) | 0.00–23.00 | 16.48 (5.77) | 6.00–23.00 | 15.33 (5.38) |
| Cutting likeness | 1.00–7.00 | 4.36 (1.85) | 0.00–10.00 | 6.45 (2.44) | 2.00–10.00 | 6.00 (2.52) |
| Suturing likeness | 2.00–9.00 | 5.45 (2.03) | 0.00–10.00 | 6.88 (2.29) | 2.00–10.00 | 6.52 (2.43) |
| Smell | 0.00–5.00 | 3.00 (1.77) | 0.00–5.00 | 2.76 (1.37) | 1.00–5.00 | 1.76 (1.00) |
| Feel | 1.00–5.00 | 2.09 (1.18) | 0.00–5.00 | 3.24 (1.25) | 1.00–5.00 | 3.18 (1.36) |
| Look | 0.00–5.00 | 2.18 (1.36) | 0.00–5.00 | 3.73 (1.28) | 1.00–5.00 | 2.58 (1.06) |

SD, standard deviation.

likeness, cutting likeness and suturing were collapsed to develop a single mean score (Table 3).

The mean ratings for EVA, pork, and SCOBY revealed that participants rated SCOBY at a similar level to pork. However, both pork and SCOBY were generally rated as superior to EVA. A one-way repeated measures ANOVA was conducted and no significant differences between SCOBY and pork were found for skin likeness, cutting likeness or feel. It was also revealed that both pork and SCOBY were rated as superior to EVA for each of these three themes ($P < 0.01$).

Although most of the qualitative feedback revealed that SCOBY was not as robust as pork, no significant difference in suturing likeness was found. A similar finding was reported between SCOBY and EVA, however, a slight preference for pork was noted over EVA ($P < 0.05$). Participants rated pork significantly better than both SCOBY and EVA with regard to look ($P < 0.1$). In addition, the one theme in which SCOBY was rated significantly worse than both pork and EVA was that of smell ($P < 0.05$).

There was no correlation between recency of practice and final model preferences by participants in either part 1 or part 2 of this study.

## Discussion

Results indicate that SCOBY offers a comparatively high-fidelity alternative to skin simulation in the context of suturing and excision. An addtional advantage of SCOBY is that it is not subject to issues of cultural sensitivity.

SCOBY was rated less favourably than the other models with regard to smell, which was identified as a valid descriptor. The vinegary smell of SCOBY is a result of the secondary fermentation of alcohol to acetic acid.[13] This may have been exacerbated in this study because the samples used were more than 1 month old. The perceptions of the smell of SCOBY may be improved if fresh SCOBYs are used. Future avenues to explore in order to reduce the vinegary smell include washing the SCOBY before use and dusting the SCOBY with bicarbonate.

Growing new SCOBYs is a relatively simple process and can easily be carried out in the clinical education setting. Equipment required includes a starter SCOBY (mother), some kombucha tea, ongoing tea and sugar, and a clean ceramic or glass container.[16] Although the resultant tea is not intended for consumption, it is still important to handle equipment to a food-grade level to avoid contamination and compromise the fermenting process.[13] Tea is brewed at room temperature covered with a cloth and the resultant SCOBYs can be stored indefinitely in a glass jar in a dark place and fed periodically with new tea.[16] The convenience that this affords contrasts with the level of care and planning required for the use of pork products. Similarly, the cost of pork belly and EVA pads over time is considerable. SCOBY production, by comparison, is low cost with ongoing costs for sugar and tea bags only.

### Limitations

This study used convenience sampling to recruit participants from one health service site. Assumptions were made as to clinicians' expertise based on the position they held within the organization, their previous contact with the Clinical School, and their years of experience. Although the themes were derived from the participants' subjective opinions, consensus was achieved despite small numbers.

Future work to enhance the transferability and generalizability of the study findings may include replication of part 2 with a broader range of participants. Similarly, avenues to reduce the smell of vinegar in SCOBY samples may also be incorporated into future studies, such as washing the SCOBY samples before use.

This study did not aim to uncover the impact that the use of porcine products has on our culturally diverse student population. However, the moral and ethical impact of porcine use is worthy of further investigation.

## Conclusion

SCOBY offers a cost-effective, culturally sensitive and realistic alternative to pork and EVA on which to teach the skills of suturing and excision to medical postgraduate students. Future use of SCOBY may also see its successful application in wound moulage whereby wounds can be realistically portrayed with foreign bodies in situ, and blood and contaminates easily added. The convenience of storage, use, and supply may be a significant advantage in clinical schools that lack capacity for refrigeration and are looking for a more cost-effective model on which to teach suturing and excision. In the words of one participant "SCOBI (sic) material is definitely good enough without the need to buy actual meat".

## Conflict of interest

None declared.

## Acknowledgements

We would like to gratefully acknowledge the assistance of Meg Murray in her overview and preparation of the final manuscript.

## References

1. Denadai R, Oshiiwa M, Saad-Hossne R. Teaching elliptical excision skills to novice medical students: a randomized controlled study comparing low- and high-fidelity bench models. Indian J Dermatol 2014; 59: 169–175. https://doi.org/10.4103/0019-5154.127679.
2. Kumaresan R, Pendayala S, Srinivasan B, Kondreddy K. A simplified suturing model for preclinical training. Indian J Dent Res 2014; 25: 541–543. https://doi.org/10.4103/0970-9290.142577.
3. Denadai R, Saad-Hossne R, Souto L. Simulation-based cutaneous surgical-skill training on a chicken-skin bench model in a medical undergraduate program. Indian J Dermatol 2013; 58: 200–207. https://doi.org/10.4103/0019-5154.110829.
4. Weeks D, Kasdan M, Wilhelmi B. An inexpensive suture practice board. Eplasty 2015; 15: e53. PMID: 26693271.
5. Khalil P, Kanz K, Siebeck M, Mutschler W. Teaching advanced wound closure techniques using cattle digits. Dermatol Surg 2011; 37: 325–330. https://doi.org/10.1111/j.1524-4725.2011.01881.x.
6. Thomas I. Improving suturing workshops using modern educational theory. Clin Teach 2012; 9:137-142. https://doi.org/10.1111/j.1743-498X.2011.00526.x.
7. Wang X, Albahrani Y, Pan M, Levitt J. Skin simulators for dermatological procedures. Dermatol Online J 2015; 21(11). PMID: 26632926.
8. Hammoud MM, Nuthalapaty FS, Goepfert AR, Casey PM, Emmons S, Espey EL, et al. Association of Professors of Gynecology and Obstetrics Undergraduate Medical Education Committee. To the point: medical education review of the role of simulators in surgical training. Am J Obstet Gynecol 2008; 199: 338–343. https://doi.org/10.1016/j.ajog.2008.05.002.
9. Denadai R, Saad-Hossne R, Todelo AP, Kirylko L, Souto Luís RM. Low-fidelity bench models for basic surgical skills training during undergraduate medical education. Rev Col Bras Cir 2014; 41: 137–145. https://doi.org/10.1590/S0104-42302012000500019.
10. Munshi F, Lababidi H, Alyousef S. Low- versus high-fidelity simulations in teaching and assessing clinical skills. JTU Med Sci 2015; 10, 12–15. https://doi.org/10.1016/j.jtumed.2015.01.008.
11. Denadai R, Oshiiwa M, Saad-Hossne R. Does bench model fidelity interfere in the acquisition of suture skills by novice medical students? Rev Assoc Med Bras 2012; 58: 600–606. https://doi.org/10.1016/S0104-4230(12)70256-7.
12. Grober E, Hamstra S, Wanzel K, Reznick R, Matsumoto E, Sidu R, Jarvi K. The educational impact of bench model fidelity on the acquisition of technical skill: the use of clinically relevant outcome measures. Ann Surg 2004; 240: 374–381. https://doi.org/10.1097/01.sla.0000133346.07434.30.
13. Nummer B. Kombucha brewing under the Food and Drug Administration model food code: risk analysis and processing guidance. J Environ Health 2013; 76: 8-11. PMID: 24341155.
14. Marsh A, O'Sullivan O, Hill C, Ross R, Cotter P. Sequence-based analysis of the bacterial and fungal compositions of multiple kombucha (tea fungus) samples. Food Microbiol 2014; 38: 171–178. https://doi.org/10.1016/j.fm.2013.09.003.
15. Jayabalan R, Malbasa R, Loncar E, Vitas J, Sathishkumar M. A Review on kombucha tea – microbiology, composition, fermentation, beneficial effects, toxicity, and tea fungus. Compr Rev Food Sci Food Saf 2014; 13: 538–550. https://doi.org/10.1111/1541-4337.12073.
16. S Flynn. Ferment for good. Richmond, Victoria: Hardie Grant Books; 2017.
17. Crum H, LaGory A. The big book of kombucha: brewing, flavoring and enjoying the health benefits of fermented tea. North Adams, MA: Storey Publishing; 2016.