

# Providing microbiology education to rural nurses: A case study

## AUTHORS

**KATHRYN CASTELLETTO** BSocSci (Psych), MSW (PQ)<sup>1</sup>

**ELYCE GREEN** RN, PhD<sup>1</sup>

**CLAIRE ELLEN SEAMAN** PhD<sup>1</sup>

**NATALIE ELLIS** RN, GradCert (CritCare)<sup>1</sup>

**MARY-CLARE SMITH** RN, GradCert (InfectPrevControl)<sup>2</sup>

**THIRU VANNIASINKAM** BSc, Hons (ApplSci), GradDip (MedLabSc), PhD<sup>3</sup>

## CORRESPONDING AUTHOR

**KATHRYN CASTELLETTO**, Three Rivers Department of Rural Health Boorooma Street, Wagga Wagga, NSW 2678, Wiradjuri Country. E: [kcastelletto@csu.edu.au](mailto:kcastelletto@csu.edu.au)

1 Three Rivers University Department of Rural Health, Charles Sturt University, Wagga Wagga, NSW, Australia

2 Clinical Governance Unit, Murrumbidgee Local Health District, Wagga Wagga, NSW, Australia

3 School of Dentistry and Medical Sciences, Charles Sturt University, Wagga Wagga, NSW, Australia

## ABSTRACT

**Objective:** This case study assesses a microbiology and infection control education workshop delivered to rural nurses. The study assesses workshop value through changes in respondents' self-assessed confidence using measures of microbiology knowledge, teaching, and best practice. Respondents also identified the aspects of the education perceived as most useful to their practice and barriers to implementing microbiology education in practice.

**Study design and methods:** Pre- and post-workshop surveys were administered to the participants. The surveys used a 7-point ordinal scale to measure respondents' confidence in explaining key concepts and their perception of the influence of such education opportunities on positive patient outcomes. Change in ratings was analysed using Wilcoxon signed-ranks tests; whilst the open-ended survey responses were analysed using a manifest content analysis.

**Results:** All thirteen nurses who participated in the education workshop responded to both surveys. The results demonstrated a significant increase post-workshop in confidence measures and belief that microbiology and infection control education influence positive patient outcomes. The perceived

barriers to implementation of microbiology education in practice included poor organisational culture, lack of access to training, and lack of resources.

**Discussion:** This case study describes a method of providing microbiology education to rural nurses and highlights the benefit of this access, particularly in the mode of face-to-face learning. A suggestion for future iterations of the program is to include content that would support nurses' implementation of theory to practice.

**Conclusion:** A face-to-face microbiology and infection prevention workshop, which enables participants to discuss content and undertake a tour of the pathology laboratory for practical insights, enhances nurses' self-rated confidence on this topic.

**Implications for research, policy, and practice:** This study demonstrates the significance of microbiology education for rural nurses and describes how this can be undertaken in practice, with insight provided on the most valued aspects. It also shows the importance of supporting in-person education. Future research could address the medium to long terms effects of this education for nurses and their practice.

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**Keywords:** case study; education; infection control; microbiology; nurse; rural health.

**What is already known about the topic?**

- Access to continuing professional development is difficult for rural nurses, particularly in comparison to their urban counterparts.
- Nurses hold a vital role in infection prevention and infection control.
- Increased knowledge leads to positive patient care and positive patient outcomes.

**What this paper adds**

- It demonstrates that providing microbiology education to rural nurses increases their confidence in the topical area.
- It provides an example program for delivering microbiology education to rural nurses.
- It highlights the benefits of the face-to-face aspect of education and practical component of the laboratory tour.

## INTRODUCTION

Living and working in rural Australia has significant implications for clinicians' professional development and work experiences. Rural practice offers several benefits, including increased autonomy, the development of broad clinical skills, and community immersion.<sup>1</sup> However, rural nurses face challenges related to accessing continuing professional development (CPD) opportunities.<sup>2</sup> While online CPD programs can enhance rural nurses' access to education, not all education can be effectively delivered online and many learners still prefer face-to-face options.<sup>3,4</sup> Education modalities are highly dependent on learning content, and, in nursing, there are specific considerations for teaching practical skills such as those related to infection control. Literature points to the importance of rural nurses' knowledge of infection control practices and microbiology and there is a need to understand the efficacy of different learning methods related to this content.<sup>5</sup> This is further reflected in the work of Alhumaid et al which revealed gaps in healthcare workers' understanding of certain areas of infection prevention and control and emphasized the need for targeted education on these topics.<sup>6</sup>

This case study aims to address this gap in the literature by contributing to knowledge of effective ways to deliver microbiology education to nurses. The case study focuses on learnings from delivering education focused on microbiology for a group of rural nurses in NSW, Australia. In this context, rural is defined using the Modified Monash Model which considers remoteness and population size to classify locations across a scale of Modified Monash (MM) categories where rural encompasses MM2-7.<sup>7</sup> The impetus for the training was multifactorial and included consideration of the role of nurses in infection control – particularly after the COVID-19 pandemic, the significant risk of healthcare-associated infections (HAIs) for patients,<sup>9-11</sup> limitations to accessing CPD in rural Australia,<sup>2</sup> preference for face-to-face training.<sup>12</sup>

In 2021, an initial microbiology education workshop was hosted for 10 rural nurses. A pre-post survey focused on the nurses' learning was conducted to examine their learning,

the results of which are published elsewhere.<sup>5</sup> Following this education offering, the format and content of the workshop were modified based on participants' feedback. This case study focuses on evaluating the outcomes of the modified education offering. An outline of the education program is shown in Appendix A. The purpose of this case study is to explore the effect of the training on elements of nurses learning and confidence, to identify the most valuable parts of the training from the perspective of the respondents, outline the self-reported barriers to implementation, and provide an example of a learning program that can be used by others.

## OBJECTIVE

This case study aims to:

- 1) Determine the effect of a microbiology education workshop on rural nurses' confidence in elements of infection control practice.
- 2) Describe the elements of infection control education that rural nurses perceived as the most useful.
- 3) Outline the barriers rural nurses perceive to the implementation of microbiology education in practice.

## METHODS

### STUDY DESIGN

This case study used pre-post cross-sectional surveys to address the research questions. The surveys are shown in Appendix B.

### DATA COLLECTION

The CPD workshop was advertised as a flyer that was sent to contacts in the local health district for distribution. Nurses registered themselves using a link on the flyer. The training was provided free of charge. The principal investigator coordinated the registrations, program, and evaluation, but did not have a role in the teaching component of the CPD workshop. At the time of registration for the workshop, the nurses were provided with the participant information,

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consent form, and workshop program. Participation in the research component of the training was not mandatory due to ethical considerations related to withholding education opportunities from rural nurses in response to non-participation. When the nurses arrived at the training, they were given an envelope with the pre- and post-survey and consent forms. There were instructions on when to fill out the surveys and all surveys (whether filled out or not) were returned to the principal investigator in the original envelope at the end of the day so that researchers were blind to participation. No identifiable information was collected. The pre- and post-surveys were coupled with an identification number to pair the results.

To assess nurse learning, the surveys contained a 7-point ordinal scale to measure the respondents' confidence in explaining five key concepts to a colleague at a similar level, as well as their perception on the extent that nurses' participation in microbiology can influence positive patient outcomes. The scale ranged from 1 to 7, with the endpoints and midpoints labelled. For the confidence items, these were labelled 'not at all confident' (1), 'somewhat confident' (4), and 'very confident' (7). The influence scale was labelled 'no influence' (1), 'moderate influence' (4), and 'substantial influence' (7). In addition to the confidence and influence items, the pre-survey asked about professional background, previous training opportunities, and perception of the accessibility of best practice training. The post-survey had an additional 5-item Likert scale with a neutral midpoint about experiences in the workshop.

### DATA ANALYSIS

Data were analysed using SPSS (ver. 25, IBM/SPSS Inc.). Wilcoxon signed-ranks tests were conducted due to the ordinal nature of the pre- and post-survey questions. Manifest content analysis was used to analyse the results of the open-ended survey responses. The open-ended responses were generally presented as dot points or one-two sentence summaries and thus the researchers did not attempt to discern deep meaning from the data but counted the times certain concepts were mentioned. Some responses were coded across multiple categories. The survey responses were analysed by two researchers using the stages suggested by Bengtsson including decontextualization, recontextualization, categorisation, and compilation.<sup>13</sup>

### ETHICAL APPROVAL

This research was granted human research ethics approval by the Greater Western Human Research Ethics Committee, approval number 2023/ETH00455.

## RESULTS

There were thirteen nurses (100% response rate) who responded to the pre-post survey. Table 1 shows a summary of the survey respondents, including their current work location, access to similar education in the past five years, and perception of access to education.

**TABLE 1. DESCRIPTIVE SUMMARY OF SURVEY RESPONDENTS**

Item	Categories	N	%
What type(s) of service do you currently work in?	Multipurpose service	6	46%
	Small rural	2	15%
	Regional	5	39%
In the past 5 years, have you received any training relevant to the field of microbiology?	No	11	85%
	Yes: partially relevant	1	8%
	Yes: directly relevant	1	8%
In the past 5 years, have you received any training relevant to the field of infection control?	No	1	8%
	Yes: partially relevant	4	31%
	Yes: directly relevant	8	62%
To what extent do you think access to education is different as a rural nurse compared to nurses in metro areas?	Less than equal	11	84%
	Equal	1	8%
	Better than equal	0	0%
	Missing	1	

### Pre-post survey results

The pre-post survey results are shown in Table 2 and demonstrate a significant increase in the respondents' confidence across all five survey items related to the education content. There was no significant difference in the extent nurses thought microbiology education or infection control education influenced positive patient outcomes, but this can be attributed to the high pre-survey ratings (i.e. ceiling effect).

### SUMMARY OF OPEN-ENDED RESPONSE

In the feedback, three open-ended questions were asked, out of these, two were analysed. The first open-ended question asked respondents "What was the best part(s) of this workshop?". Twelve out of thirteen participants gave valid responses to this question, and these were allocated to five codes. The second question analysed was "What (if any) barriers do you foresee in the implementation of best practice in microbiology/infection control?". There were 10 valid responses analysed and allocated to three codes. Codes, counts, and examples for each question are shown in Table 1. The third open question was "Are there any other education topics you believe are required for your nursing practice?", this was not analysed but instead used as suggestions for future workshops.

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TABLE 2. PRE-POST SURVEY ITEMS

Item	Pre Med. (Mean)	Post Med. (Mean)	Test statistic <sup>a</sup>	p
Confidence: Explaining the process of how microorganisms are identified from clinical samples <sup>b</sup>	2 (2.77)	4 (4.62)	-2.96	0.003
Confidence: Explaining the importance of accuracy when collecting samples from patients to send to the pathology lab for testing <sup>b</sup>	3 (3.62)	5.5 (5.33)	-2.69	0.007
Confidence: Explaining the importance of antimicrobial resistance in relation to infections <sup>b</sup>	4 (3.77)	4 (4.77)	-2.23	0.026
Confidence: Explaining the technology used in diagnostic labs to diagnose infectious diseases <sup>b</sup>	2 (2.31)	4 (4.38)	-2.97	0.003
Confidence: Explaining which antibiotics are relevant for different types of bacteria <sup>b</sup>	2 (2.77)	4 (4.38)	-3.02	0.003
To what extent do you think nurses' participation in microbiology education can influence positive patient outcomes <sup>c</sup>	6 (5.54)	6 (6.15)	-1.35	0.176
To what extent do you think nurses' participation in infection control education can influence positive patient outcomes <sup>c</sup>	6 (6.08)	7 (6.38)	-0.92	0.357
The delivery of content was clear and engaging <sup>d</sup>		4 (4.08)		
The workshop activities helped to improve my understanding of the content <sup>d</sup>		5 (4.46)		
This workshop has encouraged me to understand best practice behaviours <sup>d</sup>		5 (4.39)		
I found the laboratory tour a worthwhile use of time <sup>d</sup>		5 (4.39)		
I will use the knowledge I have gained today in my nursing practice <sup>d</sup>		5 (4.31)		
I would recommend this workshop to other nurses <sup>d</sup>		5 (4.33)		

a Test statistic (Z) from Wilcoxon signed rank test

b Seven-point scale: 1 (Not at all confident)..., 4 (Somewhat confident)..., 7 (Very confident)

c Seven-point scale: 1 (No influence)..., 4 (Moderate influence)..., 7 (Substantial influence)

d Five-point scale: 1 (Strongly disagree)..., 3 (Neither disagree or agree)..., 5 (Strongly agree)

TABLE 3. CODES, COUNTS AND EXAMPLE RESPONSES TO THE OPEN-ENDED QUESTIONS

Code	Count	Example/s
<b>Q: What was the best part(s) of this workshop?</b>		
Nurses role in specimen collection and antimicrobial stewardship	8	".. as well as specimen collection best practices"
Access to expert teaching & information	5	"Hearing from actual employees that perform the path testing"
Laboratory tour	5	"Tour of Pathology Lab"
Group and panel discussions	4	"Open discussion of all the participants as well as the microbiology associate professor"
Case study examples	4	"Case study discussion"
<b>Q: What (if any) barriers do you foresee in the implementation of best practice in microbiology/infection control?</b>		
Poor organisational culture and practices	5	"Change of practice in experienced nurses set in their ways"
Lack of access to training	5	"Lack of knowledge and confusion around evidence based best practice procedures"
Lack of resources; physical, staffing and time	4	"availability of ABHR in the clinical space"

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### DISCUSSION

This case study demonstrates one method for providing microbiology education to rural nurses, including the topical areas that nurses found important, and the training inclusions they found beneficial. The results demonstrated no significant pre-post differences in the extent nurses thought microbiology education or infection control education influenced positive patient outcomes. This was attributed to a ceiling effect whereby the nurses had high pre-survey ratings. This reflects that although the respondents had limited previous opportunity to undertake microbiology education, they believed it could influence positive patient outcomes. Approximately 15% of respondents reported having access to microbiology education in the past 5 years, which is notable considering most of the participants worked as infection prevention specialists within their rural facility. This shows that providing this type of training was locally relevant to the area and was meeting a need for these health professionals. Access to continuing professional development has previously been noted as difficult for rural nurses,<sup>2</sup> despite the importance of providing relevant and locally based education for enhancing rural health practice.<sup>14</sup> Although the findings of this case are only relevant to one locality, it is likely that other rural areas may similarly benefit from access to this type of education.

This case study highlights considerations for the mode of education made accessible to rural nurses. Geographical distance and technological growth have fostered a widespread adoption of online learning in recent years. It has been recognised, however, that this mode of learning is not as desirable for some people, nor is it conducive to learning certain types of content. The open-ended survey responses in this case study demonstrated elements of the workshop that were directly related to, or facilitated by, the face-to-face nature of the workshop. Activities such as a tour of the pathology laboratory and the roundtable discussions were facilitated by the nurses being onsite at the hospital that services the rural catchment area. This finding may also reflect an incidental outcome of the education as facilitating a networking opportunity to a group of geographically isolated health professionals, as was found by Kelly et al in a study of rural palliative care nurses.<sup>15</sup> Kutoane et al also pointed to the importance of education sessions to reduce professional isolation for rural nurses.<sup>16</sup> This may be an area for further exploration in future research.

In relation to the education outcomes of this case study, surveys respondents had increased confidence across all five survey items, including explaining microbiology processes, accuracy collecting samples, importance of antimicrobial resistance, and the use of technology in labs. This demonstrates that, for this group of respondents, the education content met its target of increasing their confidence in this topical area.

Finally, it should be noted there were several barriers identified by the nurses that they believed would affect their ability to implement their learning in practice. Several similar barriers to implementing best practice in infection prevention and control have been discussed in the literature, including organisational structure and culture, resources, and time.<sup>6,16</sup> This reflects that education as a standalone intervention is not enough to embed best practice and should be scaffolded into a wider organisational approach. Future iterations of this education could include content on translating evidence into practice to facilitate the nurses' ability to implement their learnings into the workplace.

### LIMITATIONS

Limitations of this study included a small, convenience sample of participants that may not be representative of the demographics and training level of the general nursing population and may have introduced a selection bias. This affects the generalisability of the study and should be considered by those seeking to design similar programs. Although the survey demonstrates an immediate effect on participating nurses', this research was not designed to test any medium to long term effects of the training.

### CONCLUSION

This case study demonstrates that providing CPD focused on microbiology, including topics related to the accuracy of sample collection, the importance of antimicrobial resistance, and diagnostic technology increases nurse confidence. Providing the education onsite at the local referral hospital enabled the participants to discuss the content, and to undertake a tour of the pathology laboratory, both of which were seen as beneficial. Future research should consider opportunities for an increased sample size to achieve better generalisability and examining the long-term retention of microbiology knowledge after education sessions.

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## RESEARCH ARTICLES

## REFERENCES

1. Ryan E, de Klerk, E, Green, E. What are the benefits and opportunities of rural health practice? A call to capitalise on strengths-based approaches to rural health discourse. *Aust Nurs Midwifery J*. In Press.
2. Berndt A, Murray CM, Kennedy K, Stanley MJ, Gilbert-Hunt S. Effectiveness of distance learning strategies for continuing professional development (CPD) for rural allied health practitioners: a systematic review. *BMC Med Educ*. 2017;17(1):1-13.
3. Wu Y, Wei X, Zhou L, Fenfen E, Zhu Y, Xu M, Chen Nan, Shang X, Guo K, Li Y, Yang K, Li X. The effectiveness of continuing education programmes for health workers in rural and remote areas: a systematic review and meta-analysis. *Rural Remote Health*. In Press.
4. Gottlieb M, Egan DJ, Krzyzaniak SM, Wagner J, Weizberg M, Chan T. Rethinking the approach to continuing professional development conferences in the era of COVID-19. *J Contin Educ Health Prof*. 2020;40(3):187-91.
5. Green E, Seaman C, Vanniasinkam T. Microbiology education for rural nurses: continuing professional development strategies. *Microb Aust*. 2023;44(3):162-5.
6. Alhumaid S, Al Mutair A, Al Alawi Z, Alsuliman M, Ahmed GY, Rabaan AA, et al. Knowledge of infection prevention and control among healthcare workers and factors influencing compliance: a systematic review. *Antimicrob Resist Infect Control*. 2021;10(1):1-32.
7. Commonwealth of Australia. Modified Monash Model [Internet]. Department of Health and Aged Care Commonwealth of Australia; 2021. Available from: <https://www.health.gov.au/topics/rural-health-workforce/classifications/mmm>.
8. Australian Commission on Safety and Quality in Health Care. National Safety and Quality Health Service Standards. Sydney(AU); Australian Commission on Safety and Quality in Health Care; 2012.
9. Allegranzi B, Nejad SB, Combescore C, Graafmans W, Attar H, Donaldson L, et al. Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. *Lancet*. 2011;377(9761):228-41.
10. Haque M, Sartelli M, McKimm J, Bakar MA. Health care-associated infections—an overview. *Infect Drug Resist*. 2018;2321-33.
11. Umscheid CA, Mitchell MD, Doshi JA, Agarwal R, Williams K, Brennan PJ. Estimating the proportion of healthcare-associated infections that are reasonably preventable and the related mortality and costs. *Infect Control Hosp Epidemiol*. 2011;32(2):101-14.
12. Stagnitti K, Schoo A, Reid C, Dunbar J. Access and attitude of rural allied health professionals to CPD and training. *Int J Ther Rehabil*. 2005;12(8):355-62.
13. Bengtsson M. How to plan and perform a qualitative study using content analysis. *NursingPlus open*. 2016;2:8-14.
14. Muirhead S, Birks M. Roles of rural and remote registered nurses in Australia: an integrative review. *Aust J Adv Nurs*. 2019;37(1):21-33.
15. Kelley ML, Habjan S, Aegard J. Building Capacity to Provide Palliative Care in Rural and Remote Communities Does Education Make a Difference? *J Palliat Care*. 2004;20(4):308-15.
16. Kutoane M, Brysiewicz P, Scott T. Interventions for managing professional isolation among health professionals in low resource environments: a scoping review. *Health Sci Rep*. 2021;4(3):e361.
17. Barrera-Cancedda AE, Riman KA, Shinnick JE, Buttenheim AM. Implementation strategies for infection prevention and control promotion for nurses in Sub-Saharan Africa: a systematic review. *Implement Sci*. 2019;14(1):1-41.