Indonesian Journal of Global Health Research
Volume 8 Number 5, October 2026
e-ISSN 2715-1972; p-ISSN 2714-9749
http://jurnal.globalhealthsciencegroup.com/index.php/IJGHR

PERCEPTIONS OF NURSING EXPERTS ON CLINICAL NEED–BASED SUTURE TRAINING PAD : A MIXED-METHODS APPROACH

Sulistia Nur[1]*, Hartanto Prawibowo[2], Etanaulia Marsim[3], Riki Ukhtul Fitri[4]
[1]Department of Nursing, Faculty of Health Sciences, Universitas Aisyah Pringsewu, Jl. Ahmad Yani No. 1 A, Tambak Rejo, Wonodadi, Pringsewu, Lampung 35372, Indonesia
[2]Mechanical Engineering Department, Politeknik Negeri Semarang, Jl. Prof. Soedarto, Tembalang, Semarang, Jawa Tengah 50275, Indonesia
[3]Department of Medical Records and Health Information Study Program, Faculty of Health Sciences, Universitas Aisyah Pringsewu, Jl. Ahmad Yani No. 1 A, Tambak Rejo, Wonodadi, Pringsewu, Lampung 35372, Indonesia
[4]Faculty of Health Sciences, Universitas Bina Bangsa, Jl. Raya Serang - Jakarta Km. 03 No. 1B (Pakupatan), Panancangan, Cipocok Jaya, Serang, Banten 42124, Indonesia
*sulistianur@aisyahuniversity.ac.id

ABSTRACT
Suturing skills in nursing education are commonly taught using conventional media, such as gauze and sponges, which provide limited realism and may affect students' confidence and clinical preparedness. Developing realistic wound suturing training tools is essential to enhance competence, confidence, and readiness for clinical practice. This study explored nurses' perceptions of suture pad use, evaluated its potential as a clinical training tool, and identified areas for further refinement. A mixed-methods study was conducted involving 30 nurses who participated in both quantitative and qualitative phases. Quantitative data were collected using a structured questionnaire assessing perceptions of suture pad utilization and analyzed using frequency distributions. Instrument testing demonstrated validity ($r > 0.361$) and reliability (Cronbach's alpha = 0.745). . Qualitative data were obtained through in-depth interviews and analyzed using Colaizzi's phenomenological method. Quantitative findings showed that 29 respondents (96.7%) recommended revising and improving the suture pad, while one respondent (3.3%) strongly supported its continued use. Qualitative analysis generated three themes: (1) realism of material and construction, characterized by rigidity, limited elasticity, and high needle drag; (2) usability and application context, emphasizing practicality, ease of use, and hygiene despite limited anatomical realism; and (3) product development needs, including softer materials, multilayered skin structures, diverse wound models, and instructor feedback integration.

Keywords: anatomical detail; however; improvements in material realism; the suture pad shows potential for supporting suturing skills training; tissue elasticity; wound model

How to cite (in APA style)
Nur, S., Prawibowo, H., Marsim, E., & Fitri, R. U. (2026). Perceptions of Nursing Experts on Clinical Need–Based Suture Training Pad: A Mixed-Methods Approach. Indonesian Journal of Global Health Research, 8(5), 1499–1508. Retrieved from https://jurnal2.globalhealthsciencegroup.com/index.php/IJGHR/article/view/2876.

INTRODUCTION

Wound suturing (hecting) is a fundamental clinical skill that nursing students must acquire before entering professional practice. Competence in this skill directly supports patient safety and serves as a critical indicator of nursing students' clinical competence in accordance with national and international educational standards (Antonopoulos et al., 2023; Chao et al., 2022; Kuzu, 2022b; Szarmach et al., 2017). Suturing skills in nursing education is still dominated by conventional methods, such as gauze, sponges, or other simple materials. Although these methods are cost-effective and easy to implement, they provide limited realism in terms of tissue texture, elasticity, anatomical structure, and needle resistance, resulting in poor simulation of actual clinical conditions. These limitations reduce students' confidence, hinder the development of psychomotor competence, and increase the risk of technical errors when performing suturing procedures on patients for the first time (Byrne & Aly, 2019; Dennis et al., 2016; Gusman, 2012; Regula & Yag-Howard, 2015).

Data from the Ministry of Health of the Republic of Indonesia show a significant annual increase in the number of nursing graduates. Between 2019 and 2023, a total of 113,045 students completed a bachelor's degree in nursing. Data from the Central Statistics Agency of the Republic of Indonesia indicate a consistent increase in accident cases with minor to serious injuries each year (Kemenkes RI, 2019). Between 2018 and 2022, 13,364 patients sustained serious injuries and 160,449 patients sustained minor injuries (Badan Pusat Statistik, 2022). According to these data, wound suturing is an essential competency for nursing graduates to meet increasing clinical demands (Agusdinata, 2022; Allen et al., 2018).

Nursing educational institutions abroad have adopted the Hecting Medical Suture Training Set as an advanced tool for wound suturing training. The tool is designed to provide a training experience that closely simulates real clinical conditions, including texture, wound visualization, elasticity, and materials that mimic human skin. Its availability and accessibility remain limited, highlighting the need for research and development to create a model suited to the context of nursing education in Indonesia (Alves de Oliveira et al., 2024; Halim et al., 2024; Sumardi & Must, 2025; Szabelski & Karpiński, 2024).

The urgency of this research lies in the need for effective and realistic training methods in nursing education. Developing innovative wound suturing training tools will better prepare students, strengthen their confidence in addressing clinical challenges, and enhance the quality of patient care. This research contributes to improving the quality of nursing education and supports government efforts to produce competent healthcare professionals who are ready to meet demands in the field. This study explored nurses' perceptions of suture pad use, evaluated its potential as a clinical training tool, and identified areas for further refinement.

METHOD

Research Design

This study employs a mixed-methods design that integrates both qualitative and quantitative approaches to comprehensively address the research problem. A concurrent triangulation strategy was applied, in which data from each component were collected and analyzed independently, followed by comparison and integration to generate robust findings in Fig. A1. This approach enhances the rigor of the study by ensuring that the results are cross-validated, thereby improving the validity and reliability of the overall conclusions.

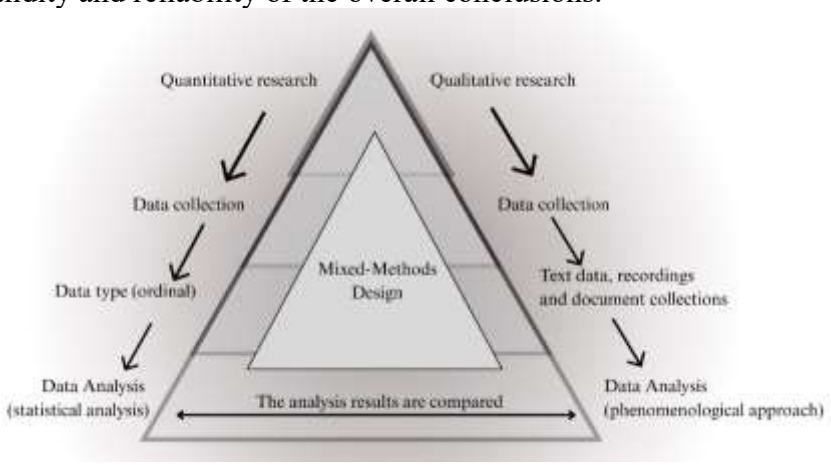


Figure A1. Mixed-methods design illustrating the integration of qualitative and quantitative components in the research process

Sample

The study involved 30 nurses working at Mutiara Hati Hospital in Pringsewu, who were recruited using purposive sampling based on specific inclusion criteria, namely experience in suturing human

skin, work in emergency room and operating room, age above 25 years, and a minimum of one year of clinical work experience. These criteria were applied to ensure that all participants had adequate clinical exposure and competence to evaluate the wound suturing training tools, thereby enabling the questionnaire data to accurately reflect their professional perceptions. Ethical approval for this study was obtained from the Ethics Committee of the Faculty of Health, Aisyah University, Pringsewu, Indonesia (Reference No. 600/UAP.OT/KEP/EC/2025), and all participants provided written informed consent prior to their involvement in the study.

Data Analysis

This study employed both quantitative and qualitative analysis. The quantitative analysis applied descriptive analytic methods using a questionnaire designed to assess nurses' perceptions of suturing training equipment. The questionnaire comprised four domains: physical and sensory aspects, ease and comfort of use, effectiveness and benefits of suture pads, and overall perception and satisfaction. Instrument testing demonstrated validity ($r > 0.361$) and reliability (Cronbach's alpha = 0.745). (Nur et al., 2025). The qualitative analysis followed a phenomenological approach using Colaizzi's method. The analysis steps included: (1) reading the entire transcript, (2) extracting meaningful statements, (3) formulating meaning, (4) grouping into themes and subthemes, (5) developing a comprehensive description, (6) identifying the essence, and (7) verifying findings with participants. The qualitative instrument was a semi-structured interview guide that underwent expert validation. Interviews lasted 20–40 minutes and were guided by trigger questions such as: "How was your experience using the suture pad?", "What was the most helpful or challenging?", and "What are your hopes for improvement?".

Material

The suture pad used in this study was constructed from synthetic rubber material, composed of three layers with a total thickness of approximately 7–8 mm. The first layer (epidermis) measured about 2 mm, was white color with high density, and simulated the texture of human skin by providing initial resistance to needle penetration.

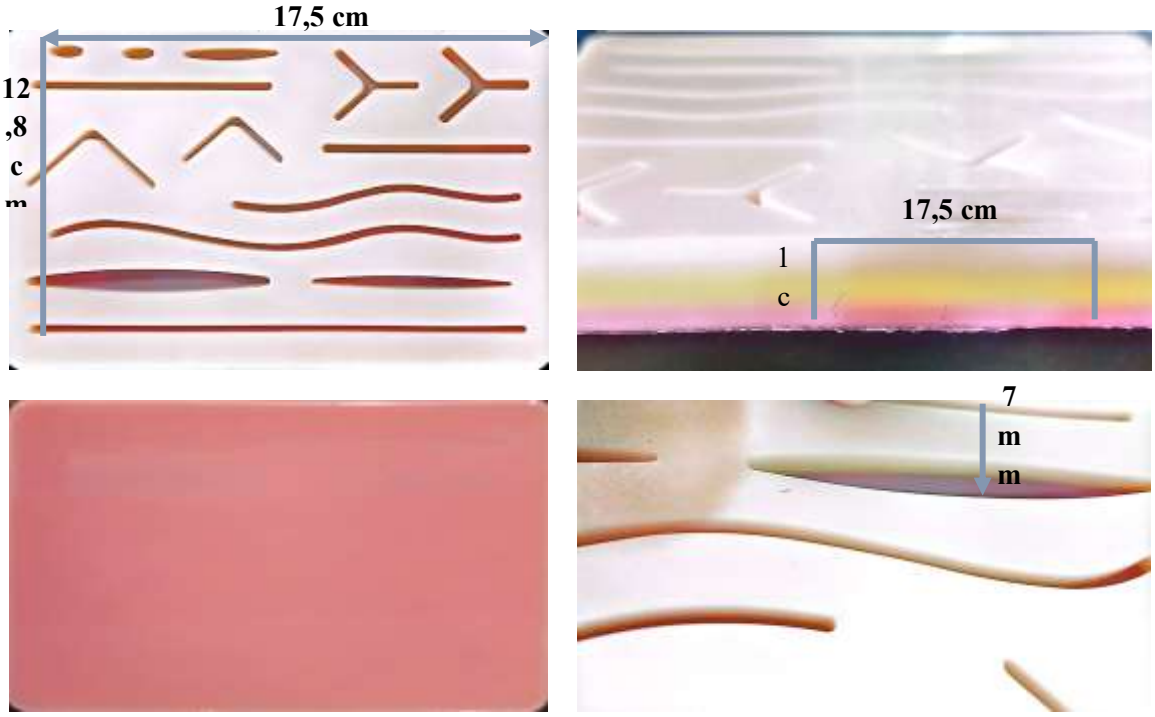


Figure A2. Structure of the suture pad designed from synthetic rubber with three layers: epidermis (2 mm, white, dense), subcutaneous tissue (±3 mm, yellow, soft and elastic), and muscle (2–3 mm, pink, dense and elastic). The pad surface features multiple incision patterns (straight, curved, zig-zag, branched, and Y-shaped) for varied suturing practice.

The second layer (subcutaneous tissue) measured approximately 3 mm, was yellow color, and was softer and more elastic to resemble adipose tissue. The third layer (muscle) measured 2–3 mm, was pink color, and exhibited denser and more elastic properties to mimic muscle tissue capable of withstanding suture tension. The pad surface included various incision patterns (straight, curved, zig-zag, branched, and Y-shaped) to allow training variations reflective of real wound conditions. Synthetic rubber was selected as the primary material for its durability, elasticity, and reusability, making it an effective medium for wound suturing skill training specification in Fig.A2.

RESULT

This section presents the overall findings of the study, incorporating both quantitative and qualitative analyses to provide a comprehensive overview of respondents' perceptions of the suture pad as a wound suturing training tool. The quantitative analysis describes the distribution of responses regarding the level of recommendation for revision, refinement, and continued utilization of the tool. The qualitative analysis offers deeper insights into respondents' experiences and perspectives, organized into key themes concerning the realism of material and construction, usability in the training context, and identified needs for product improvement. Collectively, these findings highlight the strengths and limitations of the suture pad as an educational medium and indicate its potential for further development to meet clinical training needs more effectively.

Quantitative analysis results

The quantitative findings describe respondents' perceptions regarding the use of the suture pad as a training tool, including the level of recommendation for its refinement and continuous application.

Demographic Characteristics of Respondents

The majority of respondents in this study were within the age range of 26–31 years, totaling 16 individuals (53.3%), followed by the age group of 32–39 years with 7 individuals (23.3%), the 40–50 years group with 4 individuals (13.3%), and the smallest proportion in the 18–25 years group with 3 individuals (10.0%). In terms of gender, respondents were predominantly female, with 17 individuals (56.7%), while males accounted for 13 individuals (43.3%). Regarding length of service, most respondents had 1–3 years of work experience (19 individuals, 63.3%), followed by 10 individuals (33.3%) with 4–6 years of experience, and only 1 individual (3.3%) with 7–10 years of work experience in Table 1.

Table 1.
Characteristics of Respondents (n=30)

Variable	f	%
Age (years)		
18-25	3	10.0
26-31	16	53.3
32-39	7	23.3
40-50	4	13.3
Gender		
Male	13	43.3
Female	17	56.7
Length of Service		
1-3 Years	19	63.3
4-6 Years	10	33.3
7-10 Years	1	3.3

These findings suggest that the majority of respondents were in their productive age, which may positively influence their adaptability and motivation to engage in practical training using simulation tools such as suture pads. The predominance of female respondents is consistent with the gender distribution commonly found in the nursing profession, indicating that the results reflect the demographic characteristics of the workforce in this field. Regarding length of service, most respondents had 1–3 years of work experience (19 individuals, 63.3%), followed by 10 individuals (33.3%) with 4–6 years of experience, and only 1 individual (3.3%) with 7–10 years of work experience. This distribution indicates that the majority of participants, despite being in the early to

middle stages of their careers, had already acquired direct clinical exposure, including performing wound suturing procedures in real practice settings. Such hands-on experience provides them with sufficient insight to critically evaluate the suture training pad. Therefore, the feedback and suggestions expressed by respondents such as the need for more realistic elasticity, layered structures, and varied wound models are highly relevant and valuable for guiding future product improvements. Their perspectives reflect not only theoretical understanding but also practical challenges encountered during clinical practice, making their input essential in ensuring that training tools better align with actual patient care needs.

Nurses' Perceptions Toward the Suturing Training Pad

The majority of respondents (29 nurses, 96.7%) recommended that the suturing training tool should be reviewed and improved. This finding highlights that, although the tool has potential as a practical medium for suturing practice, most participants perceived that its material, design, or usability requires further refinement to better simulate clinical conditions. Only one respondent (3.3%) strongly recommended the tool for continued use without modification, indicating that the current version may not fully meet the expectations and training needs of the broader nursing cohort in Table 2.

Table 2.
Frequency Distribution of Nurses' Perceptions Toward the Suturing Training Pad (n=30)

Variable	f	%
Recommended for review and improvement	29	96.7
Strongly recommended for continued use	1	3.3

The high percentage of recommendations for improvement suggests that while the suture pad provides a valuable foundation for skill development, enhancements in terms of realism, anatomical accuracy, and durability are still necessary. These perceptions align with qualitative feedback in which respondents emphasized issues such as pad hardness, insufficient elasticity, and limited wound variation. Therefore, the quantitative results complement the qualitative findings, reinforcing the urgency of product refinement before widespread implementation in nursing education.

Qualitative Analysis Results

The qualitative findings are presented in the form of emerging themes that reflect respondents' experiences and perceptions regarding material realism, usability, and the need for product improvement. A summary of these themes can be seen in Fig.A3.

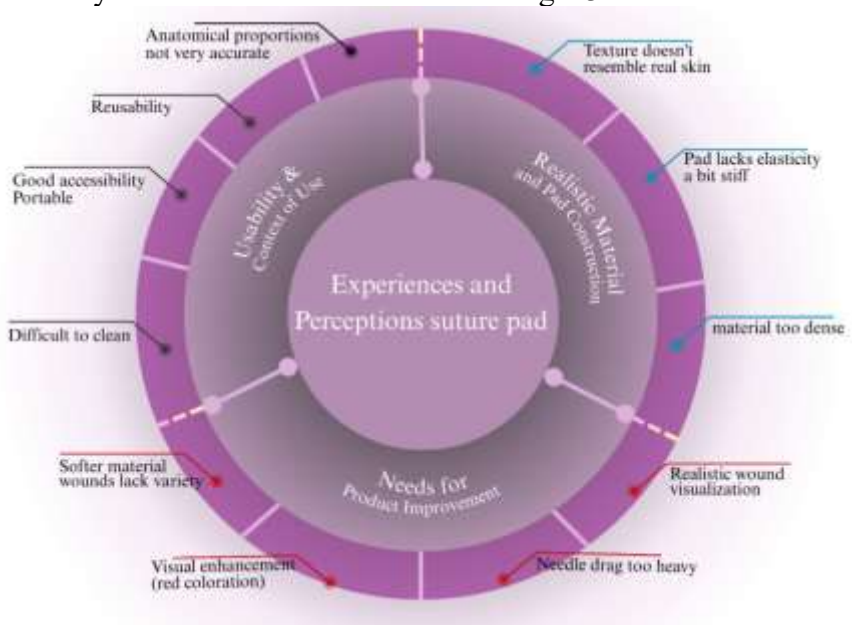


Figure A3. Thematic map of nursing experiences and perceptions of the suture training pad, showing three main themes: Realistic Material and Pad Construction, Usability and Context of Use, and Needs for Product Improvement.

Theme 1. Realistic Material and Pad Construction

Most respondents considered the suture pad to be quite realistic in resembling human skin, although some complained that it felt hard and the needle drag was too heavy. Elasticity and thickness also played a role in their experience**.**

R01: "In my opinion, the pad's texture doesn't resemble real skin. However, for learning purposes, I think it's quite good, but it needs improvement to more realistically mimic the elasticity of human skin."

R03: "When the needle is inserted, the pad lacks elasticity, is a bit stiff, and requires more force when suturing."

R05: "The surface is a bit hard, so the initial puncture is difficult."

R06: "It feels less natural because the material is too dense."

Theme 2. Usability & Context of Use

Respondents found the pad to be practical and easy to use during the practical sessions. The equipment was considered hygienic and relatively affordable, although some comments were made regarding anatomical accuracy.

R09: "It's very easy to prepare, so it's quick to use during practical sessions."

R10: "After training, it's difficult to clean because the material is rubber-like and makes the suture thread sticky if any thread fragments remain."

R11: "I feel the anatomical proportions aren't very accurate."

R12: "This tool is practical and hassle-free to use in the lab."

R14: "It has good accessibility; it's available in the lab whenever needed."

Theme 3. Needs for Product Improvement

Several respondents provided suggestions for product development, including the use of softer materials, multiple layers of skin, variations in wound care, and instructor involvement in providing feedback.

R01: "For future production, we could differentiate the elasticity levels of the suture pads, as human skin has different elasticity levels. For example, the palms and soles are slightly harder, while the back is softer. So, a future suggestion would be to have different areas of elasticity within each suture pad."

R21: "If possible, make it softer to make it more skin-like."

R22: "There needs to be a dermis and subcutaneous layer for more realistic results."

R23: "The wound model is monotonous; it would be better to have irregular lacerations."

R26: "It would be better if there were modifications with layers."

R27: "The available wounds lack variety; there should be irregular lacerations."

R28: "The needle drag is sometimes too heavy, making it difficult to puncture."

R29: "The wound visualization could be improved, for example, by adding red to create a more realistic visualization of the wound, similar to a wound on the human body."

R30: "Generally, it's good, but the material and shape of the wound still need improvement."

DISCUSSION

The results of this study show that 96.7% of nurses recommended revision and improvement of the suture pad, while 3.3% considered it very suitable for continued use. These findings indicate that although the suture pad supports learning, deficiencies in its materials and construction remain, influencing user perceptions. The results align with previous research demonstrating that the quality of simulation materials is a critical determinant of acceptance and effectiveness in clinical skills training (Hilton & Monaghan, 2018; Szabelski & Karpiński, 2024).

The first theme of the qualitative analysis emphasized the realism of the pad’s material and construction. Respondents noted that the pad felt hard and stiff, requiring additional force during

needle insertion. They also considered its elasticity and thickness inadequate to simulate human skin. Prior studies have shown that simulations with unrealistic textures reduce the quality of students' learning experiences by limiting the authenticity of practice. These findings underscore the need to improve material realism as a critical aspect of product refinement (Faris et al., 2022; Nur et al., 2025).

The second theme, related to usability, indicated that respondents perceived the suture pad as practical, easy to use, hygienic, and affordable. Nevertheless, they reported challenges in cleaning and noted inaccuracies in anatomical proportions. These findings suggest that although the suture pad provides accessible training in the laboratory, refinement in anatomical detail remains necessary. An effective simulation should combine ease of use with realistic anatomical representation to optimize the development of students' clinical skills (Kuzu, 2022a; Randhawa et al., 2024).

The third theme emphasized the need for product improvement. Respondents recommended that the pads incorporate varying elasticity according to body regions, the addition of a dermis–subcutaneous layer, and irregular laceration patterns. Such input is significant, as variation in simulation design enables students to practice skills across diverse clinical scenarios. Providing diversity in simulation media enhances students' adaptability in managing different patient conditions in real clinical settings (Gusman, 2012; Szarmach et al., 2017).

The quantitative results, which showed a high rate of revision recommendations (96.7%), reinforce the qualitative findings that respondents perceived significant deficiencies in the suture pad. These findings indicate a gap between the recognized benefits of practicality and hygiene and user expectations regarding material realism and wound variation. Prior research affirms that continuous revision and innovation in simulation media are essential to maintain relevance and effectiveness in supporting clinical skills curricula (Allen et al., 2018; Halim et al., 2024).

In terms of learning impact, respondents acknowledged that the use of suture pads enhances wound suturing skills, time efficiency, and student confidence. The lack of material realism, however, remains a barrier to delivering an immersive clinical experience. Prior studies suggest that simulation media must support technical proficiency while also providing authenticity to real-world practice to ensure optimal skill transfer (Antonopoulos et al., 2023; Baillie et al., 2020).

Overall, the combination of qualitative and quantitative results confirms that the suture pad has potential as a learning material for nurs education but requires significant refinement. Future studies should focus on improving material quality, incorporating wound variations, and refining anatomical detail to align with the needs of clinical nursing education. Prior research demonstrates that the effectiveness of medical simulation is determined by the level of realism, diversity of scenarios, and integration of instructor feedback in supporting the learning process (Dennis et al., 2016; Khan et al., 2003).

CONCLUSION

This study demonstrates that the suture pad has good potential as a training medium for nursing students to practice wound suturing skills. However, further development is still required to make it more closely resemble real clinical conditions. Most respondents perceived the tool as beneficial in improving technical skills, time efficiency, and confidence in performing suturing procedures, although several limitations were identified in terms of material realism, elasticity, and variation of wound models. Overall, both quantitative and qualitative findings emphasize the need for significant improvements in the design and materials of the suture pad, including enhanced softness, the addition of more realistic skin layers, and greater diversity of wound types to improve clinical training effectiveness.

REFERENCES

Agusdinata, D. B. (2022). The role of universities in SDGs solution co-creation and implementation: a human-centered design and shared-action learning process. *Sustainability Science*, *17*(4), 1589–1604. https://doi.org/10.1007/s11625-022-01128-9

Allen, C., Metternicht, G., & Wiedmann, T. (2018). Initial progress in implementing the Sustainable Development Goals (SDGs): A review of evidence from countries. *Sustainability Science*, *13*, 1453–1467. https://doi.org/10.1007/s11625-018-0572-3

Alves de Oliveira, M., Arcanjo, A., Castro, F., Fernandes, J. C. H., & Fernandes, G. V. O. (2024). Evaluating and Comparing the Tensile Strength and Clinical Behavior of Monofilament Polyamide and Multifilament Silk Sutures: A Systematic Review. *Surgeries*, *5*(2), 350–366. https://doi.org/10.3390/surgeries5020029

Antonopoulos, I., Tzortzis, A.-S., Pechlivanidou, E., & Troupis, T. (2023). A Simplified Three-Layered Suturing Training Pad for Undergraduate Medical Students: A Technical Note. *Cureus*, *15*(10), 1–5. https://doi.org/10.7759/cureus.47330

Badan Pusat Statistik. (2022). *Jumlah Kecelakaan, Korban Mati, Luka Berat, Luka Ringan, dan Kerugian Materi*. Badan Pusat Statistik.

Baillie, S., Christopher, R., Catterall, A. J., Kruydenberg, A., Lawrenson, K., Wonham, K., Kilfeather, P., & Warman, S. (2020). Comparison of a silicon skin pad and a tea towel as models for learning a simple interrupted suture. *Journal of Veterinary Medical Education*, *47*(4), 516–522. https://doi.org/10.3138/JVME.2018-0001

Byrne, M., & Aly, A. (2019). The surgical suture. *Aesthetic Surgery Journal*, *39*, S67–S72. https://doi.org/10.1093/asj/sjz036

Chao, K., Elsensohn, A. N., Singh, G., & Jiang, S. I. B. (2022). Suture materials and techniques for optimal cutaneous wound cosmesis: A systematic review. *Journal of the American Academy of Dermatology*, *86*(5), 1136–1137. https://doi.org/10.1016/j.jaad.2021.04.035

Dennis, C., Sethu, S., Nayak, S., Mohan, L., Morsi, Y., & Manivasagam, G. (2016). Suture materials - Current and emerging trends. *Journal of Biomedical Materials Research - Part A*, *104*(6), 1544–1559. https://doi.org/10.1002/jbm.a.35683

Faris, A., Khalid, L., Hashim, M., Yaghi, S., Magde, T., Bouresly, W., Hamdoon, Z., Uthman, A. T., Marei, H., & Al-Rawi, N. (2022). Characteristics of suture materials used in oral surgery: systematic review. *International Dental Journal*, *72*(3), 278–287. https://doi.org/10.1016/j.identj.2022.02.005

Gusman, D. N. (2012). Suture materials and techniques. In *Lower Extremity Soft Tissue & Cutaneous Plastic Surgery* (pp. 77–100). Elsevier Health Sciences. https://doi.org/10.1016/B978-0-7020-3136-6.00009-6

Halim, F., Widysanto, A., Wahjoepramono, P. O. P., Candrawinata, V. S., Budihardja, A. S., Irawan, A., Sudirman, T., Christina, N., Koerniawan, H. S., Tobing, J. F. L., Sungono, V., Marlina, M., & Wahjoepramono, E. J. (2024). Objective Comparison of the First-Person–View Live Streaming Method Versus Face-to-Face Teaching Method in Improving Wound Suturing Skills for Skin Closure in Surgical Clerkship Students: Randomized Controlled Trial. *JMIR Medical Education*, *10*. https://doi.org/10.2196/52631

Hilton, P., & Monaghan, J. M. (2018). Instruments, operative materials and basic surgical techniques. In *Bonney's Gynaecological Surgery* (pp. 15–30). John Wiley & Sons. https://doi.org/10.1002/9781444325225.ch3

Kemenkes RI. (2019). Hasil Riset Kesehatan Dasar Tahun 2018. *Kementrian Kesehatan RI*, *53*(9), 1689–1699.

Khan, M. S., Bann, S. D., Darzi, A., & Butler, P. E. M. (2003). Use of suturing as a measure of technical competence. *Annals of Plastic Surgery*, *50*(3), 304–308. https://doi.org/10.1097/01.SAP.0000037271.26659.F4

Kuzu, T. E. (2022a). Comparison Tensil Stength Of Different Sutur Materials. *Cumhuriyet Dental Journal*, *24*(4), 355–360. https://doi.org/10.7126/cumudj.978167

Kuzu, T. E. (2022b). Comparison tensile strength of different sutur materials. *Cumhuriyet Dental*

Journal, *24*(4), 355–360.

Nur, S., Hartanto Prawibowo, Marsim, E., & Fitri, R. U. (2025). Validity and Reliability of A Wound Suturing Training Tool Perception Questionnaire in Nursing Education. *Indonesian Journal of Global Health Research*, *7*(6), 701–708. https://doi.org/10.37287/ijghr.v7i6.286

Randhawa, R. K., Dubey, T., Pansuriya, I., Mishra, T., Tanwar, M., Kumar, A., & Singh, R. (2024). Assessment of the Mechanical Properties of Different Suture Materials for Oral Surgery: An In Vitro Tensile Strength Study. *Cureus*, *16*(8). https://doi.org/10.7759/cureus.65952

Regula, C. G., & Yag-Howard, C. (2015). Suture products and techniques: What to use, where, and why. *Dermatologic Surgery*, *41*(10), S187–S200. https://doi.org/10.1097/DSS.0000000000000492

Sumardi, S. N., & Must, A. (2025). The Implementation of Hand and Foot Massage Therapy for Hemodynamic Stability in Patients with Hemorrhagic Stroke: Case Study. In *Indonesian Contemporary Nursing Journal* (Vol. 10, Issue 1).

Szabelski, J., & Karpiński, R. (2024). Short-Term Hydrolytic Degradation of Mechanical Properties of Absorbable Surgical Sutures: A Comparative Study. *Journal of Functional Biomaterials*, *15*(9), 273. https://doi.org/10.3390/jfb15090273

Szarmach, R. R., Livingston, J., Rodeheaver, G. T., Thacker, J. G., & Edlich, R. (2017). A Review on the Innovative Surgical Suture and Needle Evaluation and Selection Program. *Journal of Long Term Effects of Medical Implants*, *27*(2–4). https://doi.org/10.1615/JLongTermEffMedImplants.v27.i2-4.140