



ASSESSING THE COMPETENCY OF BIOMEDICAL SCIENTISTS IN MANAGING COMPLICATIONS ARISING FROM AESTHETIC PROCEDURES: A SCOPING REVIEW

Janislene Santos Ferreira^A

^ADiscente Biomedicina- Universidade Estácio de Sa.- Rio de Janeiro- Brasil.

ABSTRACT

The increasing demand for minimally invasive aesthetic procedures has led to a rise in the number of qualified professionals, including biomedical scientists (BMP), performing these treatments. While generally safe, these procedures carry potential risks and complications, necessitating a high level of expertise and proper management skills from practitioners. This scoping review aims to map the existing literature regarding the specific competencies required for biomedical scientists to effectively manage complications in aesthetic procedures. A search of scientific databases (e.g., PubMed, LILACS, VHL) was conducted using keywords related to “biomedical scientists,” “aesthetic procedures,” “complications,” and “competency.” Initial findings indicate an emphasis on general knowledge and technical skills, but a potential gap exists in the systematic identification of core competencies for complication management. The literature highlights the importance of specialized knowledge and continuous education to minimize adverse events such as local edema, ecchymosis, ptosis, and, in severe cases, vascular occlusion. This review presents an outline of a standardized procedural protocol for managing complications and suggests that while current education enables practitioners to perform procedures, a structured framework for managing unexpected outcomes is crucial to ensure patient safety. Upholding ethical principles and ensuring robust training are paramount to safeguarding patient well-being and maintaining the integrity of aesthetic medicine.

Keywords: Biomedical Scientists; Aesthetic Procedures; Complications Management; Competency Assessment; Scoping Review.

INTRODUCTION

The biomedical professional's role has expanded from traditional areas of clinical analysis (1) and disease research (2) to include the emerging field of aesthetics.

The field of aesthetic medicine has experienced significant growth, driven by an increasing societal emphasis on appearance and well-being. (3)

Minimally invasive procedures, such as botulinum toxin and dermal filler injections, have become widely popular due to their rapid results and minimal downtime. (4)

In Brazil, the field of Aesthetic Biomedicine was officially recognized by the Federal Council of Biomedicine (CFBM) in 2010, allowing qualified biomedical scientists to perform a variety of non-surgical aesthetic treatments. (5)

Despite the high safety profile of most procedures when performed correctly, complications are inevitable in aesthetic practice. These can range from common, mild side effects (e.g., bruising, temporary edema) to rare but severe adverse events (e.g., vascular occlusion, necrosis, visual loss). Effective management of these complications is paramount to ensuring patient safety and maintaining professional integrity. (6)

^ACorresponding Author: Janislene Santos Ferreira – E-mail: janislenesf@hotmail.com - ORCID: <https://orcid.org/0009-0005-3008-6380>

While existing literature often focuses on the techniques themselves, there is a lack of consolidated information regarding the specific competencies, training requirements, and protocols for managing complications among biomedical scientists in this field. (7)

This scoping review aims to address this gap by systematically mapping the available evidence on the core competencies required for biomedical scientists in managing complications arising from aesthetic procedures.

METHODS

A scoping review methodology, guided by the framework proposed by Arksey and O'Malley (2005), will be utilized to systematically map the available literature on the competencies of biomedical scientists in managing aesthetic procedure complications. The key stages involve:

Identifying the research question: What are the documented competencies and educational requirements for biomedical scientists to manage complications from aesthetic procedures?

Identifying relevant studies: A systematic search will be conducted across electronic databases including PubMed, LILACS, Scopus, and the Virtual Health Library (VHL). The search strategy will combine terms related to "biomedical scientists," "biomedicine aesthetics," "complications," "adverse events," "management," "competency," and "training."

Study selection: Articles in English and Portuguese, published between 2011 (year of CFBM Resolution 197) and 2025, will be included. Inclusion criteria will focus on studies directly discussing the role, training, or competency of biomedical scientists in managing aesthetic complications. Exclusions will incorporate general aesthetic surgery reviews or articles not mentioning biomedical professionals.

Charting the data: Data from selected studies will be extracted and charted to identify key themes, including types of complications, required knowledge/skills, training methods, regulatory guidelines, and identified competency gaps.

Collating, summarizing, and reporting the results: The findings will be qualitatively synthesized and presented thematically to provide a comprehensive overview of the current state of knowledge.

RESULTS AND DISCUSSION

Common Complications in Aesthetic Procedures

Complications vary depending on the procedure and product used. (8)

Dermal Fillers: While minor side effects like erythema, edema, pain, and ecchymosis are common, severe complications include nodule formation (granulomas), infections, and vascular occlusion, which can lead to skin necrosis or blindness. The nose, glabella, and forehead are considered high-risk areas due to complex vascular anatomy.

Botulinum Toxin: Adverse effects are generally transient and

dose-dependent, including pain at the injection site, headache, brow ptosis, and asymmetry (e.g., droopy eyelids or a crooked smile).

Thread Lifts: Common adverse events include swelling, dimpling, paresthesia (numbness), thread visibility, infection, and thread extrusion. Non-absorbable threads are associated with higher complication risks than absorbable ones.

The Danger of Not Being Prepared

Inadequate training and a lack of preparedness for complications are significant risk factors in the aesthetic field. Insufficient anatomical knowledge and technical skills often lead to preventable adverse events. Practitioners without the necessary training may fail to recognize early warning signs of complications, leading to delayed or incorrect treatment, which can result in permanent disfigurement or even death. The underreporting of complications in the literature further exacerbates this issue by limiting the collective knowledge base and preventing the development of robust, evidence-based guidelines. (9)

Ethical Obligations and Professional Conduct Biomedical professionals operate under core ethical principles: respect for autonomy, beneficence (acting in the patient's best interest), nonmaleficence (doing no harm), and justice. (10)

Informed Consent: Ethically, BMPs must ensure comprehensive informed consent, clearly communicating all potential risks, benefits, and alternative therapies in language the patient understands. Patients must have realistic expectations, and practitioners should be prepared to decline procedures if patient goals are unachievable or pose undue risk.

Competence and Training: There is a moral and professional obligation to maintain competence through ongoing, evidence-based training and certification. BMPs should only perform procedures for which they are adequately trained and have a clear understanding of complication management.

Patient Safety First: The primary commitment must be to patient safety, which supersedes financial gain or commercial interests. This includes having emergency equipment readily available and a clear referral pathway to specialists if a complication exceeds one's expertise.

Transparency and Reporting: Ethical practice demands transparency when complications occur. Open communication with the patient about the incident and the steps being taken to manage it is crucial for building trust. Furthermore, contributing to formal reporting systems helps the wider medical community learn from adverse events.

The literature search revealed a growing body of work on aesthetic procedures and related complications; however, very few studies specifically focus on the *competency* of biomedical scientists in managing these events. The existing literature, primarily from Brazil, confirms that qualified biomedical scientists are legally authorized to perform various aesthetic procedures and act as technical managers in clinics. (10,11,12)

Key competencies identified for managing complications fall

into several categories: (13,14,15)

Underlying Knowledge: A deep understanding of relevant anatomy, physiology, pharmacology (especially of injectables like botulinum toxin and hyaluronic acid), and risk assessment is crucial.

Technical Skills: Meticulous technique during the procedure is the first step in prevention. The ability to perform emergency interventions (e.g., using hyaluronidase for vascular occlusion) requires specific practical training.

Decision-Making & Judgment: The ability to identify when a situation exceeds one's level of expertise and to refer the patient to appropriate medical specialists is a critical competency.

Patient Communication: Effective risk assessment includes clearly informing patients about potential complications and

managing expectations.

Procedural Protocol for Complication Management

All BMPs in aesthetic practice must have a clear, documented emergency protocol and the necessary equipment and medications on hand. (16,17,18)

The protocol on Table 1 is a summary of standard emergency management principles for complications arising from dermal filler procedures, widely recognized and utilized in aesthetic medicine guidelines provided by professional bodies such as the British Association of Cosmetic Nurses (BACN), the American Society for Dermatologic Surgery (ASDS), and various national health organizations. (19)

Table 1 - Protocol of standard emergency management for complications on aesthetic procedures

Complication Type	Immediate Recognition and Action	Management Protocol	Emergency Kit Essentials
Vascular Occlusion (VO)	Immediate blanching, severe pain, dusky/mottled skin, slow capillary refill (>2 seconds), coolness of skin. Can lead to necrosis or blindness.	STOP INJECTION. Massage area. Apply warm compress. Administer high-dose hyaluronidase (if HA filler used) to dissolve filler. Administer aspirin (300mg) and potentially topical nitroglycerin. Refer immediately to vascular specialist/ED.	Hyaluronidase, sterile needles/syringes, aspirin tablets, topical nitroglycerin paste, oxygen, anaphylaxis kit.
Anaphylaxis	Rapid onset of hives/rash, itching, swelling of face/throat/tongue, difficulty breathing, dizziness/syncope, abdominal pain, shock.	STOP PROCEDURE. Call emergency services immediately. Position patient appropriately (supine with legs raised). Administer intramuscular adrenaline (epinephrine) 0.5mg (1:1000 concentration). Administer oxygen. Monitor vitals.	Adrenaline (epinephrine) ampoules/auto-injector, oxygen tank/mask, antihistamines, corticosteroids, IV fluids.
Infection	Delayed onset (days to weeks) of increasing redness, swelling, pain, warmth, pus formation, fever, systemic symptoms.	Obtain swab for culture and sensitivity. Initiate appropriate oral antibiotics (often broad-spectrum initially). Consider incision and drainage if abscess forms. May require surgical debridement for severe cases.	Sterile dressings, antiseptic solutions, prescription pad for antibiotics, referral network to an infectious disease specialist.
Nerve Damage	Sensory loss, motor function impairment (e.g., facial drooping, inability to move certain muscles).	Stop procedure. Assess the extent of the damage. Provide reassurance and clear explanation to the patient. Refer to a neurologist for further evaluation and management (e.g., physical therapy, medication).	N/A (management is often non-procedural/referral-based)

Font: BACN, ASDS

The current educational landscape, often involving short postgraduate courses, which is not very popular either, may not provide the systematic, hands-on training required for complex complication management. The literature suggests a significant underreporting of complications, making it difficult to assess the true scope of the problem and the necessary training needs. The lack of a standardized competency framework specific to complication management for biomedical scientists remains a key gap. (19)

Delphi exercise to be used to achieve a consensus of best practices

Future research should aim to conduct a Delphi exercise. **A Delphi exercise** (or Delphi study) regarding aesthetic complications is a structured, multi-round survey technique used to achieve a reliable **consensus among a panel of experts** on the best practices for preventing, managing, and treating complications

in aesthetic medicine. (20)

In aesthetic medicine, Delphi exercises have been used to: (20)

Develop standardized protocols for the prevention and management of specific complications from procedures like botulinum toxin or dermal filler injections.

Identify essential anatomical knowledge required to minimize risks during non-surgical aesthetic procedures.

Formulate recommendations for patient selection, pre- and post-procedure care, and product reconstitution to enhance safety and reduce adverse events.

By using this method, the aesthetic medicine community can establish evidence-informed “best practices” and clinical guidelines where formal randomized controlled trials are difficult to conduct, ultimately improving patient safety and outcomes. (20)

In-depth reflection on how to ensure patient safety and satisfaction without compromising their integrity and authenticity, the true beauty lies in accepting and valuing the uniqueness of each person. Instead of following a merely technical approach, this new paradigm requires professionals to act as agents of holistic health, encouraging critical reflection on imposed beauty standards and prioritizing the self-esteem, mental well-being and safety of patients. (21)

Thorough training, adherence to ethical principles like informed consent and patient safety, and having emergency protocols in place are essential for minimizing risks and ensuring positive outcomes. Maintaining competence through continuous professional development and contributing to the reporting of complications are vital for advancing safe aesthetic practice.

CONCLUSION

Biomedical scientists play a significant role in the growing field of aesthetic procedures. While their competency in performing these procedures is regulated, this scoping review highlights a potential gap in the systematic assessment and standardized training for managing associated complications. The ability to manage adverse events requires specific knowledge, practical skills, sound judgment, and continuous education. There is a need for the development of a core competency framework and mandatory training modules focused on complication management to ensure the highest standard of patient safety in aesthetic practice. Future research should aim to conduct a Delphi exercise or consensus meeting among experts to establish minimum competency requirements.

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