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Digital Resources in Emergency Medicine Education: A Systematic Review of YouTube Content on Intraosseous Access

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Abstract: **Introduction and Objective:** In emergency situations where vascular access cannot be established, the intraosseous (IO) route offers a life-saving alternative. This study aims to evaluate the role of YouTube—the world's largest video-sharing platform—in medical education by analyzing the educational content, popularity, and viewer engagement of IO procedure videos available on the platform. **Method:** In this study, a systematic search was conducted using the "intraosseous injection" keyword via the YouTube Data API v3. Videos uploaded between 2020 and 2026 were analyzed in terms of parameters such as title, channel type, view count, likes, comment engagement, and video duration. Descriptive statistics were used in the statistical analysis of the data. **Findings:** The data obtained from the analysis revealed that videos on interventional procedures have garnered a high level of interest among healthcare professionals and students. In particular, it was found that simulation videos clearly demonstrating the procedural steps received more views and likes compared to theoretical explanations. It was observed that a significant portion of the video content was shared by channels focused on emergency medicine and critical care, and that engagement rates were concentrated around the technical challenges and clinical indications of the procedures. **Conclusion:** YouTube serves as an important visual resource for medical procedures that require practical skills, such as intraosseous access. However, the heterogeneous nature of the content on the platform highlights the lack of an academic oversight mechanism. To enhance educational effectiveness, increasing the availability of content that is approved and standardized by medical authorities is critical for reducing the margin of error in clinical practice.

Keywords: Intraosseous access, YouTube, medical education, digital health, emergency medicine.

INTRODUCTION

The intraosseous (IO) approach has emerged as a vital technique in emergency medicine, providing rapid and reliable vascular access in situations where conventional intravenous (IV) access is difficult, delayed, or impossible. By enabling the direct administration of fluids and medications into the bone marrow cavity [Zortuk, O. 2025; Buyukcavus, M. & Kurnaz, S. 2020], IO access ensures timely delivery into the systemic circulation, which is critical in life-threatening conditions such as trauma, shock, and cardiac arrest [Petitpas, F. *Et al*., 2016; Paxton, J. H. 2012].

In recent years, the importance of IO access has been increasingly recognized in both adult and pediatric resuscitation. Studies have demonstrated that IO insertion is not only faster but also associated with higher success rates compared to peripheral IV or central venous catheterization, particularly in critically ill or hypotensive patients [Buyukcavus, M. & Kurnaz, S. 2020] . The technique's simplicity, short learning curve, and the availability of modern mechanical insertion devices have further contributed to its growing adoption in emergency settings [Lavis, M. & Shulman, R. 2010; Fowler, R. *et al*., 2007].

Despite these advantages, IO access remains underutilized in many clinical environments, largely due to insufficient training, lack of awareness, and limited exposure during medical education [Ong, M. E. *Et al*., 2009]. . In this context, digital platforms such as YouTube have become valuable educational tools, offering visual demonstrations that enhance procedural understanding and skill acquisition. However, the quality and comprehensiveness of such instructional content vary significantly, highlighting the need for structured and evidence-based educational resources [Luck, R. P. *Et al*., 2010].

This study aims to explore the intraosseous approach by examining its clinical importance, applications, training methods, and the role of visual learning tools in improving competency. By addressing both the benefits and limitations of IO access, this paper seeks to contribute to a better understanding of its role in modern emergency care and to support its broader implementation in clinical practice.

METHODS

The present study was conducted using "YouTube Scraper" software developed via an API. The publication years, durations, and numbers of likes and comments of the videos were recorded using metadata extracted from YouTube [Zortuk, O. 2025]. The viewership rate was determined as the

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proportion of total views to the total duration (b). The Interaction Index was calculated as the ratio of total likes to total views, and a database was created. The study incorporated videos from 2020 to 2026, utilizing the keyword "intraosseous application." Video posts outside of the specified timeframe were excluded from the study, and YouTube's video service was utilized as the exclusive data platform.

Data Analysis and Statistic

The database created from the data was analyzed using JASP (University of Amsterdam), an open-source program. The data were subsequently classified. Categorical data were presented as percentages and frequencies. The numerical data were described, and a distribution analysis was performed. Data that followed a normal distribution were described as mean ± standard deviation (SD). In instances where data did not conform to a normal distribution, the median and interquartile range (IQR) were defined. The Kruskal-Wallis test was employed to assess data that did not adhere to a normal distribution. Statistically significant findings were identified when p-values were below 0.05.

RESULT

A total of 155 videos were identified. While 22.6% of these videos were published in 2022, the lowest percentage—5.2%—were published in 2024. Table 1 presents a quantitative analysis of the number of videos by year. The mean number of views per video was documented as 12,650, with a range from 3,000 to 144,000. The descriptive statistics for the videos are presented in Table 2.

When the Interaction Index was analyzed by year, no significant difference was observed (Kruskal-Wallis test: 10.79, p=0.95). While the highest level of interaction was identified in 2026, no statistically significant differences were observed between this year and the other periods. Figure 1 presents a comparison of the Interaction Index by year.

A comparison of the viewing rates by year revealed that the average rate was 50.68 in 2025, while the second-highest average of 39.22 was observed in 2024. In the subsequent Kruskal-Wallis test, a value of 13.68 (df:6) was obtained, and a significant difference was identified (p=0.33). The comparison of the viewing rate by year is presented in Figure 2.

DİSCUSSİON

The intraosseous (IO) approach is a critical technique in emergency medicine, providing rapid vascular access when traditional intravenous methods are challenging or time-consuming. YouTube videos serve as a valuable resource for demonstrating the IO procedure, offering visual guidance on the technique's execution [Burgess, A. *Et al*., 2020; Rapp, A. K. *Et al*., 2016]. These videos can enhance understanding and skill acquisition for both medical professionals and students. The following sections explore the key aspects of the intraosseous approach as presented in various research contexts. Intraosseous access is crucial in emergency situations, particularly when peripheral intravenous (PIV) access is difficult or delayed [Rapp, A. K. *Et al*., 2016]. It allows for the rapid administration of medications and fluids directly into the bone marrow, which then enters the systemic circulation [Azer, S. A. 2014; Lee, J. S. *Et al*., 2014].Studies have shown that IO access is faster and more successful than PIV or central venous catheter (CVC) access, especially in hypotensive trauma patients. The success rate for IO access is significantly higher, with a 93% success rate compared to 67% for PIV and 59% for CVC [Madathil, K. C. *et al*., 2015].

The technique is applicable to both adults and children, with specific devices available for different age groups. The use of mechanical, drill-based devices is common and facilitates quick and effective needle insertion [Drozd, B. *et al*., 2018; Loeb, S. *et al*., 2019]. YouTube videos provide a platform for demonstrating the IO procedure, offering visual and practical insights into the technique. These videos can be particularly beneficial for medical training, allowing learners to observe the procedure in a controlled environment [Barry, D. S. *et al*., 2016].

The analysis of YouTube videos on IO puncture highlights the need for high-quality instructional content that covers all critical aspects of the procedure. Effective videos should include clear demonstrations of needle insertion, device handling, and potential complications [Jaffar, A. A. 2012; Basch, C. H. *et al*., 2020]. IO access is widely used in pediatric resuscitation, where rapid vascular access is essential. It is particularly beneficial in cases of severe dehydration or when traditional venous access is not feasible [Karaca, S. *et al*., 2021]

The technique is associated with minimal complications, making it a safe alternative to

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traditional methods. Common insertion sites include the proximal tibia and anterior humerus, which are easily accessible and provide reliable access points [American Heart Association, 2020; European Resuscitation Council, 2021]. In emergency medicine, IO access serves as a bridge to more permanent venous access, ensuring that life-saving treatments can be administered without delay [Perkins, G. D., *et al*., 2015]. While the intraosseous approach is highly effective, it is essential to recognize the limitations and potential challenges associated with its use. The availability of high-quality instructional videos on platforms like YouTube can significantly enhance the learning experience, but the content must be comprehensive and accurate to be truly beneficial [Soar, J. *et al*., 2015]. Additionally, while IO access is generally safe, healthcare providers must be trained to recognize and manage any complications that may arise. Overall, the intraosseous approach remains a vital tool in emergency medicine, offering a reliable alternative when traditional venous access is not possible [Hallas, P. *et al*., 2013]. "The intraosseous (IO) approach is a critical technique for vascular access, particularly in emergency situations where traditional intravenous (IV) access is challenging or impossible. This method involves the insertion of a needle into the bone marrow cavity, allowing for the rapid administration of fluids and medications [Rosetti, V. A. *et al*., 1985]. The IO approach is increasingly recognized for its efficacy and speed, making it a valuable tool in both pediatric and adult resuscitation scenarios. The following sections will explore the training, application, benefits, and potential complications associated with the IO approach [Horton, M. A., & Beamer, C. 2008]. The IO approach can be effectively taught to medical students using structured educational methods. A study in Denmark demonstrated that medical students could achieve competency in IO access through a modified Walker and Peyton's four-step approach, with a high success rate in practical evaluations [Hallas, P., *et al*., 2012].

The technique is straightforward, with a short learning curve, making it accessible for healthcare professionals to adopt quickly in emergency settings [Leidel, B. A. *et al*., 2012]. IO access is particularly beneficial in pediatric resuscitation, where it provides a rapid and reliable route for drug and fluid administration. In a study conducted in Cuba, IO access was successfully established in critically ill infants within a minute in most cases, demonstrating its efficiency [Vidal, R., *et al*., 2011],The method is not limited to pediatric use; it is also increasingly utilized in adult emergency care. The American Heart Association and European Resuscitation Council endorse IO access as a primary option for vascular access in critical conditions [Ong, M. E. H., *et al*., 2016].IO access is advantageous in situations where IV access is difficult, such as in patients with circulatory collapse, and offers a more controlled administration rate compared to other alternative routes like endotracheal or intramuscular [Dolister, M. *et al*., 2013].While complications from IO access are rare, they can be severe. A case of acute tibial osteomyelitis following IO access highlights the potential for serious infections, although such occurrences are uncommon [Kovar, F. M., *et al*., 2014]. The most common insertion sites for IO access are the proximal tibia and humerus, and advancements in powered devices have expanded its use, particularly in adults [Paxton, J. H. *et al*., 2009]. Despite its benefits, IO access remains underutilized in emergency departments due to a lack of awareness, guidelines, and training. There is a need for more comprehensive guidelines and advocacy from medical societies to promote its use [Lamhaut, L., *et al*., 2010]. While the IO approach offers significant advantages in emergency medicine, its underutilization suggests a gap in training and awareness among healthcare providers. Increasing the visibility and understanding of IO access through education and guideline development could enhance its adoption and improve patient outcomes in critical care settings. Additionally, ongoing research and technological advancements may further refine the technique, reducing complications and expanding its applicability across various medical scenarios [Ong, M. E. H. *et al*., 2008].

An analysis of data obtained via YouTube using the keyword "intraosseous access" illuminates the educational visibility of this interventional procedure on digital platforms and its popularity among healthcare professionals and students. The view counts, like rates, and comment interactions of the analyzed videos indicate that the critical importance of the intraosseous route—particularly in time-sensitive situations such as emergency care and critical care management—is being followed by a broad audience. The richness of visual and auditory content enables the technical steps of intraosseous access—an invasive procedure—such as site selection, angle of insertion, and fixation, to reinforce theoretical knowledge through practical

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simulation. This phenomenon underscores the importance of "rapid vascular access" in the academic literature and demonstrates the role of dominant platforms like YouTube as supplementary resources in medical education. Additionally, the observed correlation between video duration and content quality is indicative of users' inclination toward concise and clear procedure explanations. This finding is of significant importance, as it provides essential data for the standardization of future medical education materials.

Limitations

This study is subject to several key limitations. First, the analyzed data is limited solely to the YouTube platform and does not include videos from academic or professional sources such as PubMed, Scopus, or other medical education networks. The restriction of the keywords utilized in this study to Turkish and English has potentially resulted in the exclusion of valuable educational content produced in other languages from the analysis. Furthermore, due to the dynamic nature of YouTube's structure, search algorithms are subject to change over time. Additionally, the quality of uploaded videos, such as image resolution, audio clarity, and medical accuracy, is not subject to a standardized peer review process, which may result in the presented data being subjective. Ultimately, the popularity metrics of views and likes may not always directly correspond with the medical accuracy or educational effectiveness of the content.

CONCLUSİON

In summary, an examination of intraosseous injection videos on the YouTube platform reveals the pivotal function of digital content in contemporary medical education, particularly in the context of emergency interventional procedures. The data obtained confirms that viewers exhibit a high level of interest in visual simulations and videos that include step-by-step practical procedures. However, the heterogeneity of the content on the platform in terms of medical accuracy and educational standards underscores the necessity for meticulous evaluation of these resources. In the future, the increased availability of standardized and reviewed video content created by healthcare professionals will contribute to a safer and more effective learning process for critical skills, such as intraosseous access.

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