

Improving Sputum Specimen Quality Through a Hospital-Based Educational Intervention on Proper Sputum Collection for Cytological and Bacteriological Examination

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Abstract- The quality of sputum specimens is a critical determinant of the accuracy of cytological and bacteriological examinations. Inadequate collection practices, including saliva contamination, insufficient volume, and improper handling, may compromise diagnostic interpretation. This hospital-based health education program aimed to increase awareness of proper sputum collection techniques among healthcare professionals and hospital visitors at Martha Friska General Hospital, Medan, Indonesia. Two educational sessions were conducted on March 9 and March 16, 2026, involving healthcare professionals and hospital visitors, respectively.

Educational materials were delivered through oral presentations, visual illustrations, demonstrations, interactive discussions, and educational leaflets. The program addressed the clinical importance of sputum examination, differentiation between sputum and saliva, appropriate collection timing, deep-cough techniques, recommended specimen volume, suitable containers, storage, transportation, and common preanalytical errors. A total of 20 healthcare professionals participated in the first session, while the second session involved hospital visitors and patients attending outpatient services. Both sessions demonstrated active participation and generated practical discussions regarding specimen collection and quality. This program demonstrates that hospital-based education is a feasible strategy for strengthening awareness of proper sputum collection and supporting the preanalytical quality of respiratory laboratory examinations. Continued education involving healthcare providers and the public may contribute to improved specimen adequacy and diagnostic reliability.

Index Terms:- sputum collection, health education, preanalytical phase, respiratory diagnosis

I. INTRODUCTION

Respiratory diseases remain a major public health concern worldwide, with pulmonary tuberculosis and lung cancer continuing to contribute substantially to morbidity and mortality. Early and accurate diagnosis is essential for timely treatment and improved patient outcomes. Sputum examination remains one of the most accessible, inexpensive, and non-invasive diagnostic methods for evaluating respiratory diseases. It is routinely used for bacteriological examination, particularly in the diagnosis of pulmonary tuberculosis, as well as for cytological evaluation in patients with suspected lung malignancy. However, the diagnostic performance of both examinations is highly dependent on the quality of the sputum specimen submitted to the laboratory rather than the analytical process alone.^{1,2}

The quality of sputum specimens is largely determined during the preanalytical phase, particularly at the time of specimen collection. Inappropriate collection techniques may result in saliva contamination, insufficient specimen volume, poor cellularity, or delayed submission, thereby reducing the diagnostic value of both bacteriological and cytological examinations. Previous reports have emphasized that proper sputum collection is one of the most important factors influencing specimen adequacy and overall diagnostic accuracy.³⁻⁶

Despite the availability of standard recommendations for sputum collection, inadequate collection practices remain common in daily healthcare services. Many patients experience difficulty distinguishing sputum from saliva, while healthcare personnel may have limited opportunities to provide standardized instructions regarding appropriate collection techniques. Consequently, educational activities that involve both healthcare workers and hospital visitors are expected to improve awareness of appropriate sputum collection procedures and encourage the submission of higher-quality respiratory specimens for laboratory examination.^{7,8}

To address this issue, a hospital-based health education programme on proper sputum collection techniques for cytological and bacteriological examination was conducted at Martha Friska General Hospital. The programme targeted healthcare personnel and hospital visitors with the aim of increasing awareness of appropriate sputum collection practices and promoting the submission of high-quality sputum specimens to support accurate laboratory diagnosis.

II. METHODOLOGY

This health education programme was conducted at Martha Friska General Hospital, Medan, Indonesia, with the objective of increasing awareness of proper sputum collection techniques for cytological and bacteriological examination. The programme was organized in two separate educational sessions targeting healthcare personnel and hospital visitors.

The first educational session was conducted on March 9, 2026 and was attended by 20 healthcare professionals, including nurses from the infectious disease ward, nurses from the pulmonary outpatient clinic, and medical laboratory technologists. The session focused on strengthening participants' understanding of the preanalytical phase of sputum examination and emphasizing the importance of proper specimen collection in achieving accurate laboratory diagnosis.

The second educational session was held on March 16, 2026 for hospital visitors and patients attending outpatient services. This session aimed to improve public awareness regarding the correct sputum collection technique and to encourage active participation in producing high-quality sputum specimens for laboratory examination.

Educational materials were delivered through oral presentations supported by PowerPoint slides, visual illustrations, demonstrations, and educational leaflets. The programme covered the clinical importance of sputum examination for cytological and bacteriological diagnosis, characteristics of an adequate sputum specimen, differentiation between sputum and saliva, appropriate timing of specimen collection, recommended sputum volume, deep-cough collection techniques, proper specimen containers, specimen storage and transportation, and common preanalytical errors that may compromise specimen quality and diagnostic accuracy. The educational sessions also emphasized the influence of specimen quality on laboratory interpretation, highlighting the importance of adequate cellularity for sputum cytology and representative lower respiratory tract secretions for bacteriological examination.

At the end of each educational session, participants received educational leaflets summarizing the essential steps of proper sputum collection to reinforce the information delivered during the programme and to facilitate the application of recommended sputum collection practices in routine clinical settings.

III. RESULT

The hospital-based health education program on proper sputum collection techniques for cytological and bacteriological examination was successfully conducted in two educational sessions at Martha Friska General Hospital. The first session was held on March 9, 2026, for healthcare professionals directly

involved in patient care and sputum specimen handling. The second session was conducted on March 16, 2026, for hospital visitors and patients attending outpatient services. Both educational sessions were completed according to schedule and were characterized by active participation throughout the program.

A total of 20 healthcare professionals attended the first educational session, including nurses from the infectious disease ward, nurses from the pulmonary outpatient clinic, and medical laboratory technologists. The multidisciplinary composition of participants reflected the collaborative role of healthcare personnel in ensuring proper sputum collection and maintaining specimen quality before laboratory examination.

Table 1. Healthcare professionals participating in the first educational session

Professional category	Number of participants (n)
Nurses from the infectious disease ward	10
Nurses from the pulmonary outpatient clinic	5
Medical laboratory technologists	5
Total	20

The educational sessions were delivered through lectures, visual presentations, demonstrations, and interactive discussions. Participants actively engaged throughout the program and raised numerous practical questions regarding sputum collection procedures. Among healthcare professionals, the most frequently discussed topics included distinguishing sputum from saliva, the recommended sputum volume for laboratory examination, the optimal timing for specimen collection, appropriate specimen storage and transportation, and the influence of specimen quality on cytological and bacteriological diagnostic accuracy. Hospital visitors predominantly asked about techniques for producing sputum through deep coughing, the appropriate specimen container, whether sputum could be collected after eating or brushing their teeth, and the importance of avoiding saliva contamination during specimen collection.

Table 2. Frequently discussed topics during the educational sessions

Discussion topic	Healthcare professionals	Hospital visitors
Differentiating sputum from saliva	✓	✓
Appropriate sputum volume	✓	✓
Optimal timing of sputum collection	✓	✓
Deep-cough sputum collection technique	✓	✓
Specimen storage and transportation	✓	✓
Appropriate specimen container	✓	✓

Influence of specimen quality on cytological diagnosis	✓	
Influence of specimen quality on bacteriological examination	✓	✓
Collection after eating or tooth brushing	✓	✓



Figure 1. Hospital-based health education program on proper sputum collection techniques for healthcare professionals at Martha Friska General Hospital, March 9, 2026.

IV. DISCUSSION

Obtaining a high-quality sputum specimen is a fundamental prerequisite for accurate laboratory diagnosis of respiratory diseases. Unlike many other laboratory investigations in which analytical performance predominantly determines diagnostic reliability, sputum examination is particularly dependent on the quality of the specimen collected during the preanalytical phase. In both cytological and bacteriological examinations, inadequate specimens frequently lead to reduced diagnostic sensitivity despite appropriate laboratory processing and interpretation. Saliva contamination, insufficient specimen volume, delayed submission, and poor collection techniques remain common causes of specimen inadequacy that may ultimately compromise diagnostic accuracy. Previous studies have consistently demonstrated that sputum adequacy is closely associated with the diagnostic performance of sputum cytology, emphasizing that improvements in specimen collection are capable of increasing the clinical value of laboratory examination without requiring additional technological resources.^{1,3,7,9} These observations highlight that optimization of the preanalytical phase should be considered an essential strategy for improving respiratory diagnostic services.

The present health education program was developed based on the recognition that specimen quality is influenced not only by laboratory personnel but also by healthcare professionals responsible for patient instruction and by patients themselves during specimen collection. Consequently, the educational intervention intentionally involved both healthcare professionals and hospital visitors, representing two groups with complementary

roles in the diagnostic pathway. The multidisciplinary participation of nurses, medical laboratory technologists, and members of the public created opportunities for interactive discussions addressing practical challenges encountered during routine sputum collection. Rather than focusing exclusively on theoretical concepts, the educational sessions emphasized practical demonstrations and standardized collection procedures that could be directly implemented in daily clinical practice. Educational interventions that actively engage participants have been widely recognized as effective approaches for improving health literacy, promoting appropriate healthcare behavior, and strengthening communication between healthcare providers and patients. Such initiatives may contribute to sustainable improvements in service quality because they encourage participants to translate newly acquired knowledge into routine practice.^{7,8}

An important observation during the educational sessions was the diversity of questions raised by participants, reflecting differences in professional responsibilities and prior experience. Healthcare professionals were primarily interested in technical issues related to specimen handling, transportation, laboratory acceptance criteria, and the influence of specimen quality on diagnostic interpretation. In contrast, hospital visitors focused on practical aspects of sputum production, including techniques for deep coughing, appropriate collection containers, the distinction between sputum and saliva, and factors that could affect specimen quality before submission to the laboratory. These differences demonstrate that educational activities should be adapted to the characteristics of the target audience while maintaining consistent scientific messages. Tailoring educational content according to participants' backgrounds allows complex laboratory concepts to be communicated more effectively and increases the likelihood that recommended collection practices will be adopted in routine clinical settings.^{1,7,8}

Among the educational topics presented, differentiating sputum from saliva emerged as one of the most clinically relevant issues. Many patients assume that any oral secretion produced during coughing is suitable for laboratory examination, whereas, in reality, saliva contains predominantly squamous epithelial cells originating from the oral cavity and provides limited diagnostic information for either cytological or bacteriological evaluation. In contrast, sputum produced through effective deep coughing contains secretions from the lower respiratory tract and is more likely to include bronchial epithelial cells, inflammatory cells, infectious organisms, or exfoliated malignant cells when present. For sputum cytology, adequate cellularity and preservation of cellular morphology are essential for identifying atypical or malignant cells. Similarly, bacteriological examination requires representative lower respiratory tract secretions while minimizing contamination from normal oral flora to improve microbiological accuracy. Previous publications have emphasized that standardized patient instruction before specimen collection can substantially improve specimen adequacy and increase the diagnostic yield of sputum examination.^{1,3,9} Therefore, patient education should be regarded as an integral component of laboratory quality management rather than an optional supplementary activity.

Another important aspect highlighted by this program is the broader contribution of health education to hospital quality

improvement. Educational programs implemented within healthcare institutions extend beyond knowledge transfer by fostering collaboration among healthcare professionals, strengthening adherence to standardized procedures, and encouraging patients to participate actively in their own diagnostic process. When healthcare providers deliver consistent instructions regarding sputum collection, patients are more likely to submit representative specimens that meet laboratory requirements. Improved specimen quality may subsequently reduce the frequency of inadequate samples, minimize unnecessary repeat collections, shorten diagnostic delays, and optimize the utilization of laboratory resources.⁸ Although the present program did not quantitatively evaluate changes in specimen adequacy after the intervention, the active engagement observed throughout the educational sessions indicates that participants recognized the importance of proper sputum collection as a critical determinant of diagnostic quality. Similar educational initiatives have been reported to enhance awareness, reinforce good clinical practice, and support continuous quality improvement within healthcare services by strengthening the preanalytical phase of laboratory testing.

This health education program demonstrates that promoting appropriate sputum collection techniques is a feasible and practical strategy that can be integrated into routine hospital activities without requiring substantial additional resources. The combination of lectures, visual demonstrations, interactive discussions, and educational leaflets provided participants with practical guidance that could be readily applied in clinical settings. Future programs may further strengthen this initiative by incorporating structured evaluations of participant knowledge, follow-up assessments of behavioral changes, and laboratory indicators of sputum specimen adequacy before and after educational interventions. Such evaluations would provide objective evidence regarding the effectiveness of educational programs in improving specimen quality and diagnostic performance. Nevertheless, the present program underscores the importance of continuous educational efforts involving both healthcare professionals and the public as an effective approach to strengthening the preanalytical phase and supporting accurate cytological and bacteriological diagnosis through the submission of high-quality sputum specimens.

V. CONCLUSION

Proper sputum collection is a fundamental component of the preanalytical phase that directly influences the diagnostic quality of both cytological and bacteriological examinations. This hospital-based health education program demonstrated the feasibility of delivering standardized educational messages to healthcare professionals and hospital visitors through lectures,

demonstrations, interactive discussions, and educational leaflets. The active engagement of participants highlighted the continuing need for practical education on appropriate sputum collection techniques in routine clinical practice. Integrating similar educational initiatives into regular hospital health promotion activities may strengthen awareness of proper specimen collection, support the submission of higher-quality sputum specimens, reinforce collaboration between healthcare providers and patients, and ultimately contribute to improving the quality and reliability of respiratory laboratory diagnosis.

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