

From Aspiration Detection to Prevention: A Proposed Risk Stratification Framework and Radiographer-Led Aspiration Risk Management in Barium-Based Fluoroscopic Swallowing Examinations

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Abstract

Background: Aspiration during barium-based fluoroscopic swallowing examinations is an uncommon but potentially serious patient-safety event, particularly in patients with chronic or progressive dysphagia and previously documented aspiration. Current clinical practice does not provide a widely adopted imaging-specific framework for systematically stratifying the risk of aspiration before contrast administration.

Case Presentation: The framework was informed by a longitudinal case of a 74-year-old man with progressive chronic dysphagia who underwent three fluoroscopic swallowing examinations between 2021 and 2026, with aspiration documented during each episode. During the third examination in 2026, extensive barium aspiration into the right tracheobronchial tree occurred immediately after swallowing. The event was promptly recognized by the radiographer/radiologic technologist*, further contrast administration was discontinued, and the patient was closely monitored. Despite the extensive radiographic appearance of aspiration, no clinical respiratory deterioration was observed during 72 hours of follow-up.

Risk Stratification Framework: The longitudinal clinical course was used to identify potentially relevant pre-examination risk factors and to develop a provisional aspiration risk stratification framework. The proposed framework incorporates previous documented aspiration, chronic dysphagia, neurological disease, previous aspiration pneumonia, suspected structural abnormalities, advanced age, cognitive impairment, impaired cough reflex, and recurrent fluoroscopic examinations. A provisional weighted scoring system categorizes patients into low-, moderate-, and high-risk groups and is intended to support individualized examination planning rather than replace clinical judgment.

Discussion: This case highlights the potential value of reviewing previous swallowing examinations and identifying aspiration-related risk factors before repeat fluoroscopic assessment. The radiographer may serve as an important frontline safety professional through continuous patient observation, early recognition of aspiration, and immediate communication with the multidisciplinary team. Artificial intelligence may further support future risk assessment and real-time aspiration detection, although its clinical utility requires prospective validation.

Conclusion: Progressive aspiration risk may be identifiable before repeat fluoroscopic swallowing examinations in selected patients. The proposed framework provides a preliminary, hypothesis-generating approach to pre-examination risk stratification and proactive patient-safety management. Prospective multicenter studies are required to validate the proposed risk factors, determine appropriate weighting, and evaluate whether structured risk stratification improves clinical safety.

Introduction

Aspiration is a major complication of dysphagia and may lead to serious respiratory consequences, including aspiration pneumonia. Barium-based fluoroscopic swallowing examinations, particularly videofluoroscopic swallowing studies (VFSS), play an essential role in assessing swallowing function and detecting aspiration (3). However, identifying aspiration during the examination represents only one component of patient safety (4). A structured assessment of aspiration risk before and during the examination may help anticipate potential complications, guide appropriate precautions, and support individualized examination protocols.

As frontline healthcare professionals, radiographers/radiologic technologists play a critical role in patient risk assessment, continuous monitoring, radiation protection, and the safe implementation of fluoroscopic examinations(8). During swallowing studies, radiographers are often among the first healthcare professionals to recognize subtle changes in a patient's clinical condition, and their responsibilities extend beyond image acquisition to include patient observation and safety management (1, 2). At the same time, the rapid integration of artificial intelligence, automated workflow systems, advanced image reconstruction algorithms, and clinical decision-support tools is transforming radiography practice(5, 6). This evolution requires radiographers to develop advanced digital competencies and actively participate in AI-assisted clinical practice (7, 9, 23).

A key clinical question addressed in this case-based review is whether patients with previously documented aspiration can be systematically identified as being at increased risk before undergoing a repeat fluoroscopic swallowing examination (10). Early identification of such patients could allow examination protocols, monitoring strategies, and safety precautions to be appropriately individualized. Previous aspiration should be treated as a major pre-examination warning signal, and this information can be incorporated into a structured, imaging-specific aspiration risk assessment before repeat fluoroscopic swallowing examination.

This case report, supported by a narrative review, therefore proposes an aspiration risk stratification framework for barium-based fluoroscopic swallowing examinations. It also examines the expanding role of radiographers in pre-examination risk assessment, intra-examination monitoring, and aspiration prevention, with the broader aim of shifting the focus from aspiration detection alone toward proactive risk management. The clinical case underlying the development of the framework has previously been reported as a preprint (24). The present manuscript does not seek to republish the case; rather, it uses the previously reported clinical observations as the clinical rationale for developing and structuring a provisional risk-stratification framework.

Case Presentation

A 74-year-old man with a six-year history of progressive dysphagia, mainly affecting solid food intake, was referred for fluoroscopic swallowing assessment. Previous imaging examinations had demonstrated a progressive tendency toward aspiration, prompting repeated radiological evaluation and further investigation of the underlying mechanism (24).

The initial fluoroscopic study performed in March 2021 showed preserved pharyngeal anatomy without epiglottic abnormalities. A small suspected right-sided upper esophageal diverticular lesion was noted, and an aspiration event was observed during swallowing in association with a subglottic air-containing structure causing mild superior esophageal displacement. Further anatomical evaluation with cervicopharyngeal Computed tomography (CT) was recommended.

A subsequent contrast study in October 2023 demonstrated preserved passage of contrast through the upper gastrointestinal tract, with no evidence of obstructive or reflux-related abnormalities. Nevertheless, a new episode of limited barium aspiration involving the trachea and right main bronchus was identified. Post-procedural chest radiography confirmed minimal contrast deposition within the right tracheobronchial tree, without acute pulmonary complications, and the patient remained clinically stable.

A contrast-enhanced cervicofacial CT was obtained to investigate persistent dysphagia and recurrent aspiration. The examination excluded major structural abnormalities of the pharyngolaryngeal region but revealed a small right paraesophageal air-containing pouch near the esophageal inlet, suggestive of a small Zenker's diverticulum. An incidental finding of significant right internal carotid artery stenosis was also reported. Overall, imaging findings suggested a progressive functional swallowing disorder with recurrent aspiration in the absence of a major anatomical cause.

Third fluoroscopic examination (2026): Critical role of the radiologic technologist in aspiration

recognition and patient safety-The patient subsequently underwent a third fluoroscopic swallowing examination because of persistent chronic dysphagia and previous documented aspiration events. The examination was performed using 150 mL of Micropaque® (barium sulfate suspension) according to the standard departmental protocol. Contrast administration was performed orally under fluoroscopic guidance with continuous monitoring by the radiologic technologist and radiologist.

Before swallowing, the patient showed no signs of respiratory distress or ineffective airway protection, and no coughing was observed during preparation. Immediately following swallowing, however, the patient developed vigorous coughing. The radiologic technologist rapidly recognized the abnormal swallowing pattern and the fluoroscopic evidence of contrast entering the airway. Continuous real-time observation allowed immediate identification of extensive barium aspiration into the tracheobronchial tree, predominantly involving the right main bronchus and extending into multiple segmental branches.

Recognizing the severity of the aspiration event, the radiologic technologist immediately alerted the supervising radiologist and stopped further contrast administration. This rapid intervention resulted in immediate cessation of further contrast administration and may have limited additional contrast aspiration. The fluoroscopic appearance demonstrated a bronchographic distribution of barium throughout the right lower bronchial tree, mimicking a deliberate bronchographic examination (Figures 1). Compared with previous examinations performed in 2021 and 2023, this episode represented a significant progression in both the volume and extent of aspirated contrast material despite the absence of major structural abnormalities on CT imaging. The immediate interruption of the examination following aspiration recognition represented a critical patient safety intervention (24).

Clinical outcome

Following the aspiration event, the patient was placed under close clinical observation according to departmental safety procedures. Despite the extensive radiographic appearance of barium aspiration, the patient remained clinically stable throughout follow-up. Continuous monitoring at 24, 48, and 72 hours demonstrated no respiratory deterioration. No persistent cough, fever, dyspnea, oxygen desaturation, or clinical signs of aspiration pneumonia developed.

No hospitalization, invasive intervention, or respiratory support was required, and the patient recovered without immediate complications.

This case illustrates the important role of the radiographer as a frontline healthcare professional in fluoroscopic swallowing examinations, particularly in high-risk dysphagic patients. Beyond technical image acquisition, continuous patient observation, early recognition of aspiration, effective communication with the medical team, and immediate implementation of safety measures may significantly influence clinical outcomes. The case also demonstrates the potential discrepancy between dramatic radiographic findings and clinical evolution, while emphasizing the importance of serial imaging, multidisciplinary follow-up, aspiration risk assessment, and standardized safety protocols during fluoroscopic examinations.

Discussion

The Role of Radiographer in Fluoroscopic Swallowing Examinations

During fluoroscopic swallowing examinations, the Radiographer plays a critical role as a healthcare professional responsible for continuous patient observation, real-time image monitoring, and early recognition of potential complications (Figure 2).

Before the examination, the radiographer should review the patient's clinical history, previous fluoroscopic studies, CT findings, neurological disorders, previous aspiration episodes, and current swallowing status. In our patient, aspiration had already been documented in both 2021 and 2023. These findings alone should have identified the patient as being at high risk before the 2026 examination. During fluoroscopy, the radiographer continuously observes swallowing mechanics, monitors patient behaviour, recognizes coughing or voice changes, and immediately alerts the radiologist when aspiration occurs. Early interruption of contrast administration may substantially reduce the volume of aspirated material. In the present case, the radiologic technologist was the first member of the imaging team to identify the abnormal airway entry of barium during swallowing, based on the combination of fluoroscopic findings and the patient's sudden coughing response. Rapid recognition of aspiration allowed immediate communication with the radiologist and prompt interruption of contrast administration, thereby limiting the volume of aspirated material and potentially reducing the risk of severe respiratory complications. After the examination, the radiographer contributes to post-procedural

monitoring, chest imaging, documentation of complications, and communication with the multidisciplinary team.

This event highlights that the role of the radiographer extends beyond technical image acquisition and includes active participation in clinical decision-making, aspiration risk management, and patient safety. Continuous vigilance, knowledge of swallowing physiology, understanding of aspiration patterns, and effective collaboration with radiologists and other healthcare professionals are essential components of modern radiography practice. In high-risk dysphagic patients, the radiologic technologist represents a key safety barrier by identifying early signs of aspiration, ensuring appropriate procedural responses, and contributing directly to improved patient outcomes.

Proposal for Aspiration Risk Stratification- Preventive Aspiration Risk Management Framework

The present case, together with the available literature, demonstrates that barium aspiration is not merely an isolated procedural complication but a predictable event in selected high-risk patient populations. Elderly individuals, patients with neurological disorders, head and neck malignancies, impaired consciousness, previous aspiration events, or severe dysphagia are particularly vulnerable to aspiration during videofluoroscopic swallowing study (VFSS) with barium contrast. Although most aspiration episodes are clinically insignificant, severe complications—including aspiration pneumonitis, respiratory failure, and, in rare cases, death—have been reported. These findings emphasize that identifying patients at increased risk before the examination is a fundamental component of patient safety rather than a reactive response to complications.

Current clinical practice relies largely on the experience and clinical judgment of the multidisciplinary team when determining whether a patient can safely undergo fluoroscopic swallowing study with barium contrast. While professional guidelines describe examination techniques, radiation protection principles, and dysphagia assessment, they provide limited practical guidance for systematically stratifying patients according to their risk of barium aspiration before the examination. To date, no universally accepted, standardized risk stratification tool specifically designed for VFSS-associated barium aspiration has been widely implemented in routine clinical practice. Consequently, decisions regarding contrast selection, bolus volume, patient positioning, monitoring, and post-procedural management often vary among institutions and individual practitioners. This lack of a standardized pre-procedural assessment may contribute to inconsistencies in clinical decision-making and potentially avoidable adverse events. A structured risk stratification approach could facilitate early identification of vulnerable patients, support individualized examination planning, improve communication among radiographers, radiologists, speech-language pathologists, and referring physicians, and promote a proactive rather than reactive approach to patient management. From a patient safety perspective, such an approach aligns with the principles of preventive medicine by reducing the likelihood of severe aspiration events while maintaining the diagnostic value of fluoroscopic swallowing study with barium contrast.

Based on the findings of the present case and the evidence identified in the literature, we therefore propose a practical risk stratification tool and clinical management algorithm for patients undergoing

fluoroscopic swallowing study with barium contrast. Rather than replacing clinical judgment, this framework is intended to support multidisciplinary decision-making, standardize risk assessment, optimize examination protocols, and strengthen patient safety in routine clinical practice (Table 1 and Table 1a).

The framework is hypothesis-generating and requires prospective validation before clinical implementation .

Pre-examination Risk Factor	Score	Rationale / Evidence Basis
Previous documented aspiration	3	Direct evidence of impaired airway protection
Neurological disease	2	Associated with impaired swallowing and airway protection (26)
Chronic dysphagia (>6 months)	2	Persistent swallowing dysfunction (27)
Previous aspiration pneumonia	2	Evidence of clinically significant aspiration (28)
Suspected Zenker diverticulum or structural abnormality	1	Potential alteration of swallowing mechanics (29)
Age ≥ 75 years	1	Increased prevalence of dysphagia/aspiration in older adults (Park et al., 2013) (25).
Cognitive impairment	1	May impair cooperation, swallowing safety, and the ability to follow procedural instructions (30).
Poor cough reflex	2	Reduces the ability to clear aspirated material from the airway (31).
Recurrent fluoroscopic examinations	1	Repeated examinations may indicate persistent or progressive swallowing dysfunction requiring enhanced pre-examination risk assessment (32)

Table 1: Proposed preliminary aspiration risk stratification framework for barium-based fluoroscopic swallowing examinations**.

****Scoring note:** The individual risk factors were selected based on the clinical characteristics of the presented case and the risk factors discussed in the literature. The weighting system (1–3 points) and proposed score thresholds are author-proposed and provisional. This framework is intended as a hypothesis-generating clinical decision-support tool and should not be considered a validated clinical prediction model.

Total Score Interpretation

0–2 points: Low risk-Standard fluoroscopic examination.

3–5 points: Moderate risk- Small initial bolus (1–3 mL), Continuous monitoring, Frequent reassessment.

≥6 points: High risk-Radiologist and experienced radiographer present throughout the examination, Consider modified examination protocol and multidisciplinary review before contrast administration, Minimal contrast volumes, Immediate interruption if aspiration occurs, Post-procedure observation and chest radiography when indicated.

Worked example of the provisional aspiration risk stratification framework applied to the presented patient

Factor	Yes/Non	Score
Previous aspiration	Yes	3
Neurological disease	No	0
Chronic dysphagia	Yes	2
Previous aspiration pneumonia	No	0
Structural abnormality	Yes	1
Age ≥75	No	0
Cognitive impairment	No	0
Poor cough Reflex	No	0
Recurrent examinations	Yes	1

Table 1a: Worked example of the provisional aspiration risk stratification framework applied to the presented patient.

Using the proposed provisional scoring framework, the patient would have received 7 points, corresponding to the proposed high-risk category before the 2026 examination. The highest-weighted factor was the history of previous aspiration during fluoroscopic examinations, which provided direct evidence of impaired airway protection and represented an important warning signal for subsequent aspiration. This was further supported by the presence of chronic dysphagia persisting for more than six months, a structural abnormality consistent with a suspected small Zenker’s diverticulum, and recurrent fluoroscopic examinations. Although the patient had no documented neurological disease, previous aspiration pneumonia, cognitive impairment, impaired cough reflex, or post-swallow voice change, the cumulative presence of these established risk factors was sufficient to classify him as high risk. Importantly, this classification could have been established before the 2026 examination and therefore supports the potential value of a structured pre-examination assessment. In such a patient, identification of high risk may prompt individualized procedural planning, including the use of small initial contrast

volumes, close real-time monitoring, readiness to interrupt contrast administration, and multidisciplinary communication. The score should, however, be interpreted as a provisional, hypothesis-generating framework rather than a validated clinical prediction tool, and prospective studies are required to determine its predictive accuracy and clinical utility.

Comparison with Existing Aspiration Risk Stratification Tools and Novelty of the Proposed Framework

Several clinical risk assessment tools have been developed to identify patients at increased risk of dysphagia-related complications; however, most existing stratification systems were designed for screening swallowing impairment, predicting aspiration pneumonia, or evaluating the severity of aspiration during swallowing assessment, rather than predicting the risk of barium aspiration during fluoroscopic examinations.

The Penetration–Aspiration Scale (PAS), originally described by Rosenbek et al.(12), is one of the most widely used instruments for evaluating airway invasion during videofluoroscopic swallowing studies. The PAS classifies the severity of penetration and aspiration based on the depth of contrast entry into the airway and the patient’s response to aspiration. Although highly valuable for describing the severity of an observed aspiration event, PAS is an outcome measurement tool rather than a pre-examination predictive model. It cannot identify high-risk patients before contrast administration and therefore cannot directly guide preventive strategies (13, 14).

Several dysphagia screening tools have also been developed, including the Eating Assessment Tool-10 (EAT-10) (16), the Gugging Swallowing Screen (GUSS) (17), and the 3-ounce water swallow test (18). These instruments primarily aim to detect swallowing impairment, particularly in populations such as patients with stroke, neurological disease, or elderly individuals. Although they may identify patients who require further assessment, they were not specifically developed for patients undergoing fluoroscopic contrast examinations and do not incorporate imaging-related factors such as previous aspiration during fluoroscopy, contrast administration strategy, or the need for radiographer-led safety interventions.

Similarly, clinical prediction models for aspiration pneumonia have focused mainly on factors such as age, neurological impairment, reduced consciousness, dependence for feeding, and previous pulmonary complications. These models evaluate the probability of developing aspiration-related respiratory complications rather than the immediate procedural risk of aspirating barium contrast during a fluoroscopic examination (15).

In contrast, the majority of published reports on barium aspiration consist of isolated case reports or small case series describing acute complications after aspiration has already occurred. Studies by Yan et al., Kumar et al., Sacco et al. (19, 20, 21), and other authors identified important predisposing factors, including chronic dysphagia, neurological disease, advanced age, structural abnormalities, and impaired airway protection. However, these studies did not propose a practical scoring system to classify aspiration risk before fluoroscopic examination (22).

The proposed Preliminary Aspiration Risk Stratification Model for videofluoroscopic swallowing study with barium contrast differs from previous approaches in several important aspects. **First**, it is specifically designed for patients undergoing fluoroscopic swallowing examinations involving contrast administration, where aspiration represents a procedure-related safety event rather than only a manifestation of underlying swallowing dysfunction. **Second**, the model incorporates previous documented aspiration during fluoroscopy as the highest-weighted risk factor, recognizing that prior aspiration represents direct evidence of impaired airway protection and may predict future aspiration events. **Third**, the model integrates both patient-related factors (age, neurological disease, cognitive impairment, dysphagia severity) and procedure-specific factors (previous aspiration during imaging, repeated fluoroscopic examinations, need for individualized contrast administration).

Furthermore, unlike existing dysphagia screening tools that primarily determine whether swallowing impairment is present, the proposed framework aims to support clinical decision-making before and during the imaging procedure. It provides a practical approach for radiographers and radiologists to identify high-risk patients, modify examination protocols, minimize contrast exposure, and implement appropriate monitoring strategies.

The innovation of this proposed model lies not in replacing validated swallowing assessment tools, but in addressing an unmet clinical need: the absence of a simple, imaging-focused risk stratification framework for predicting barium aspiration during fluoroscopic examinations. By integrating previously reported risk factors with radiographer-centered safety considerations, this approach represents a preliminary step toward standardized aspiration prevention protocols in fluoroscopy.

Future research should focus on prospective multicenter validation of this model, determination of optimal weighting of individual risk factors, and integration with artificial intelligence-based clinical decision-support systems. AI-assisted models may further enhance individualized risk prediction by combining clinical history, previous imaging findings, and real-time fluoroscopic analysis to improve patient safety during swallowing examinations.

The proposed framework is not intended to replace PAS, EAT-10, GUSS, or other validated swallowing assessment instruments. Rather, it addresses a different clinical question: what is the patient's risk of aspiration during the planned fluoroscopic examination before contrast administration?

Role of Aspiration Risk Stratification as a Preventive Patient Safety Strategy

The proposed aspiration risk stratification framework should not be considered merely as a predictive scoring system, but rather as a preventive patient safety tool designed to reduce the occurrence of barium aspiration during fluoroscopic swallowing examinations. Unlike traditional approaches that primarily focus on the management of aspiration after it has occurred, this framework aims to identify vulnerable patients before contrast administration and enable the implementation of individualized safety measures.

Barium aspiration is an uncommon but potentially serious adverse event associated with fluoroscopic swallowing examinations. Although the clinical outcome may vary from asymptomatic radiographic findings to severe respiratory complications, prevention remains the most effective strategy to minimize patient harm. In this context, early identification of patients at increased risk provides an opportunity to modify the examination pathway, optimize contrast administration, and enhance multidisciplinary preparedness.

The proposed stratification model supports a shift from a reactive approach toward a proactive risk management strategy (Figure 3). Instead of waiting for aspiration to occur, radiographers and radiologists can use pre-examination risk assessment to anticipate potential complications and implement preventive interventions. Patients classified as moderate or high risk may benefit from modified examination protocols, including reduced initial contrast volumes, careful patient positioning, slower administration techniques, continuous fluoroscopic observation, and immediate reassessment after the first swallow. A key element of this framework is the recognition that previous aspiration is not simply a historical finding but an important warning indicator of future risk. Patients with documented aspiration during previous fluoroscopic examinations may have persistent or progressive impairment of airway protection mechanisms. Therefore, previous imaging findings should be systematically reviewed before repeat examinations and incorporated into individualized safety planning. From a patient safety perspective, aspiration risk stratification may contribute to several important improvements:

- Prevention of avoidable adverse events through early identification of high-risk patients.
- Reduction of aspirated contrast volume by enabling earlier interruption of contrast administration.
- Improved examination planning through individualized protocols rather than a standardized approach for all patients.
- Enhanced communication among healthcare professionals, including radiographers/radiologic technologist , radiologists, speech-language pathologists, gastroenterologists, and referring clinicians.
- Optimization of clinical resources by ensuring that appropriate expertise and emergency preparedness are available when required.

Importantly, this framework places the radiographer at the center of preventive safety management. During fluoroscopic swallowing examinations, the radiographer is uniquely positioned to continuously observe patient behavior, swallowing performance, respiratory response, and early radiographic signs of aspiration. Therefore, a structured risk assessment tool may support radiographers/radiologic technologist in making timely safety decisions and communicating concerns effectively with the medical team (Figure 4).

The implementation of aspiration risk stratification also aligns with the broader principles of modern healthcare safety, where prevention, early recognition, and risk mitigation are prioritized over intervention after complications occur. Similar to risk assessment models used in other areas of medicine, such as

falls prevention, contrast reaction assessment, and infection control, a structured aspiration risk framework may provide a standardized approach for reducing variability in clinical practice.

However, this proposed model should be regarded as a preliminary preventive framework rather than a validated clinical prediction score. Prospective multicenter studies are required to evaluate its predictive performance, refine individual risk weights, and determine its effectiveness in reducing aspiration-related complications. Future integration with artificial intelligence-based decision-support systems may further enhance prevention by combining clinical risk factors with previous imaging data and real-time fluoroscopic analysis.

Ultimately, the primary goal of aspiration risk stratification is not simply to predict which patients may aspirate, but to protect patients by preventing aspiration whenever possible and ensuring that fluoroscopic swallowing examinations are performed according to individualized safety principles.

Can Artificial Intelligence Replace the Radiographer?

The rapid development of artificial intelligence has transformed many areas of medical imaging, including image reconstruction, noise reduction, radiation dose optimization, and workflow automation. However, fluoroscopic swallowing examinations represent one of the most complex dynamic imaging procedures because patient safety depends not only on image interpretation but also on continuous observation of the patient's clinical condition (11). Current AI systems may eventually assist radiographers by:

- Automatically detecting penetration and aspiration;
- Measuring hyoid bone excursion;
- Analysing laryngeal elevation;
- Tracking contrast bolus movement;
- Quantifying swallowing timing;
- Predicting aspiration probability;
- Generating real-time visual alerts;
- Comparing current fluoroscopy with previous examinations (23, 24).

Despite these capabilities, AI cannot independently assess patient discomfort, anxiety, cooperation, coughing strength, respiratory distress, or clinical deterioration. Likewise, AI cannot reassure the patient, modify examination strategy in response to unexpected events, or coordinate emergency management.

Radiographers possess essential competencies that cannot be replicated by AI alone, including patient communication, clinical judgment, ethical decision-making, adaptation to unexpected clinical situations, radiation protection, and compassionate patient care. These human-centered responsibilities remain fundamental to safe and effective fluoroscopic swallowing examinations.

The future of fluoroscopic swallowing examinations is therefore likely to be radiographer + AI, rather than radiographer versus AI (Figure 5). This collaborative model combines the computational capabilities of artificial intelligence with the clinical expertise, critical thinking, and patient-centered approach of radiographers. Such synergy has the potential to improve diagnostic accuracy, enhance workflow efficiency, reduce human error, support personalized examination protocols, and strengthen multidisciplinary communication. Most importantly, the integration of AI into radiographic practice should ultimately serve a single objective: to maximize patient safety while ensuring the highest possible diagnostic quality and radiation protection. As AI technologies continue to evolve, the role of the radiographer is expected to expand rather than diminish, with professionals assuming greater responsibilities in AI supervision, quality assurance, data validation, patient advocacy, and the ethical implementation of intelligent imaging systems. Rather than replacing radiographers, AI is expected to support faster decision-making, improve standardization, and enhance patient safety.

Limitations

This study has several limitations. The proposed risk stratification framework is based on a single longitudinal case and has not been statistically validated. The weighting of individual risk factors is therefore provisional and should not be considered predictive. The retrospective nature of the case may also introduce selection and interpretation bias, while the absence of a control group limits generalizability. In addition, the 72-hour follow-up does not exclude delayed complications, and the proposed role of artificial intelligence remains conceptual. Prospective multicenter studies are needed to validate the framework and determine its clinical utility.

Conclusion

The proposed Aspiration Risk Stratification Framework is intended as a preliminary, hypothesis-generating clinical decision-support approach rather than a validated prediction model. By integrating patient-related and procedure-related risk factors, the framework may provide a practical structure for identifying patients who require enhanced monitoring, modified contrast administration, and multidisciplinary preparedness before and during fluoroscopic swallowing examinations.

Radiographers may play an important frontline role in this process through review of previous examinations, continuous patient observation, early recognition of aspiration, and immediate communication with the multidisciplinary team. Future artificial intelligence systems may complement these activities through automated aspiration detection, quantitative swallowing analysis, integration of previous imaging data, and clinical decision support.

Prospective multicenter studies are required to determine the predictive performance, optimal weighting, reproducibility, and clinical utility of the proposed framework and to establish whether structured pre-examination risk stratification can improve patient safety during fluoroscopic swallowing examinations.

Declarations

Additional Declarations

The authors declare that they have no competing interests or conflicts of interest related to this work.

The patient provided informed consent for participation in the case report and for the publication of the clinical case, including relevant clinical information and accompanying data.

All information presented in this report has been carefully anonymized to ensure the confidentiality and protection of the patient's privacy.

Transparency Statement -Relationship to Previous Publication

The clinical case underlying the development of the proposed framework was previously reported as a preprint by the authors «**Recurrent Barium Aspiration During Fluoroscopic Swallowing Examination in Chronic Dysphagia: A Case Report with a Risk Management, Clinical Recommendations and Future Perspectives on Artificial Intelligence for Enhancing Patient Safety**» (Research Square, DOI: **10.21203/rs.3.rs-10895060/v1**)». The present manuscript builds upon those previously reported clinical observations but has a distinct scientific objective. Specifically, the current work focuses on the development and structuring of a provisional and potentially generalizable aspiration risk-stratification framework for patients undergoing fluoroscopic swallowing examinations, together with a proposed approach to radiographer-led aspiration risk management.

The previously reported case is therefore used as the clinical basis for the development of the proposed framework and is not presented as a new or independent case report. Relevant overlap in clinical background and patient characteristics is explicitly acknowledged, and the previously published source is cited throughout the manuscript where appropriate.

** In this article, the terms radiographer and radiologic technologist are used interchangeably to refer to healthcare professionals responsible for performing and supporting medical imaging examinations. The term radiographer is predominantly used in European and many international contexts, whereas radiologic technologist is more commonly used in North America.*

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Figures

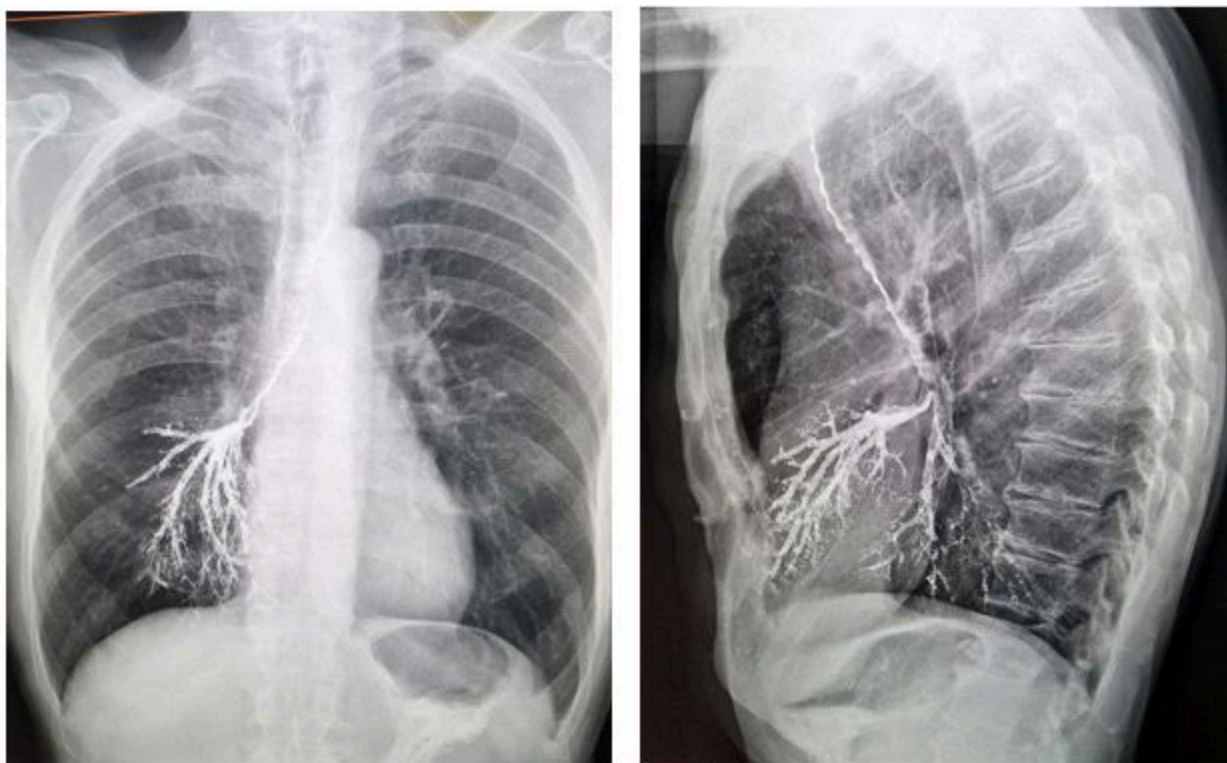


Figure 1

Post-examination chest radiograph demonstrating extensive aspiration of barium sulfate into the right bronchial tree following a fluoroscopic swallowing examination (2026).

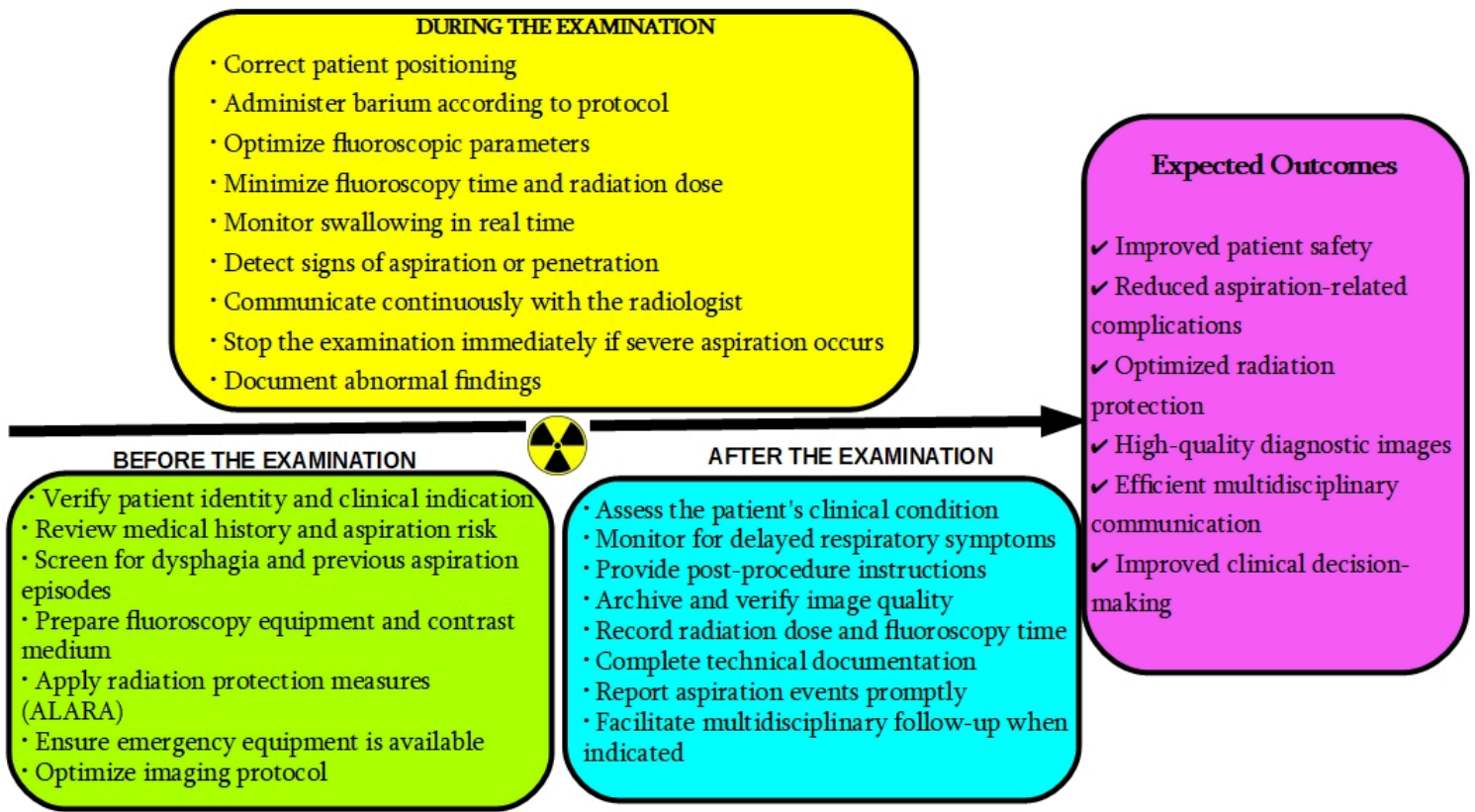


Figure 2

The Role of radiographer in Fluoroscopic Swallowing Examinations

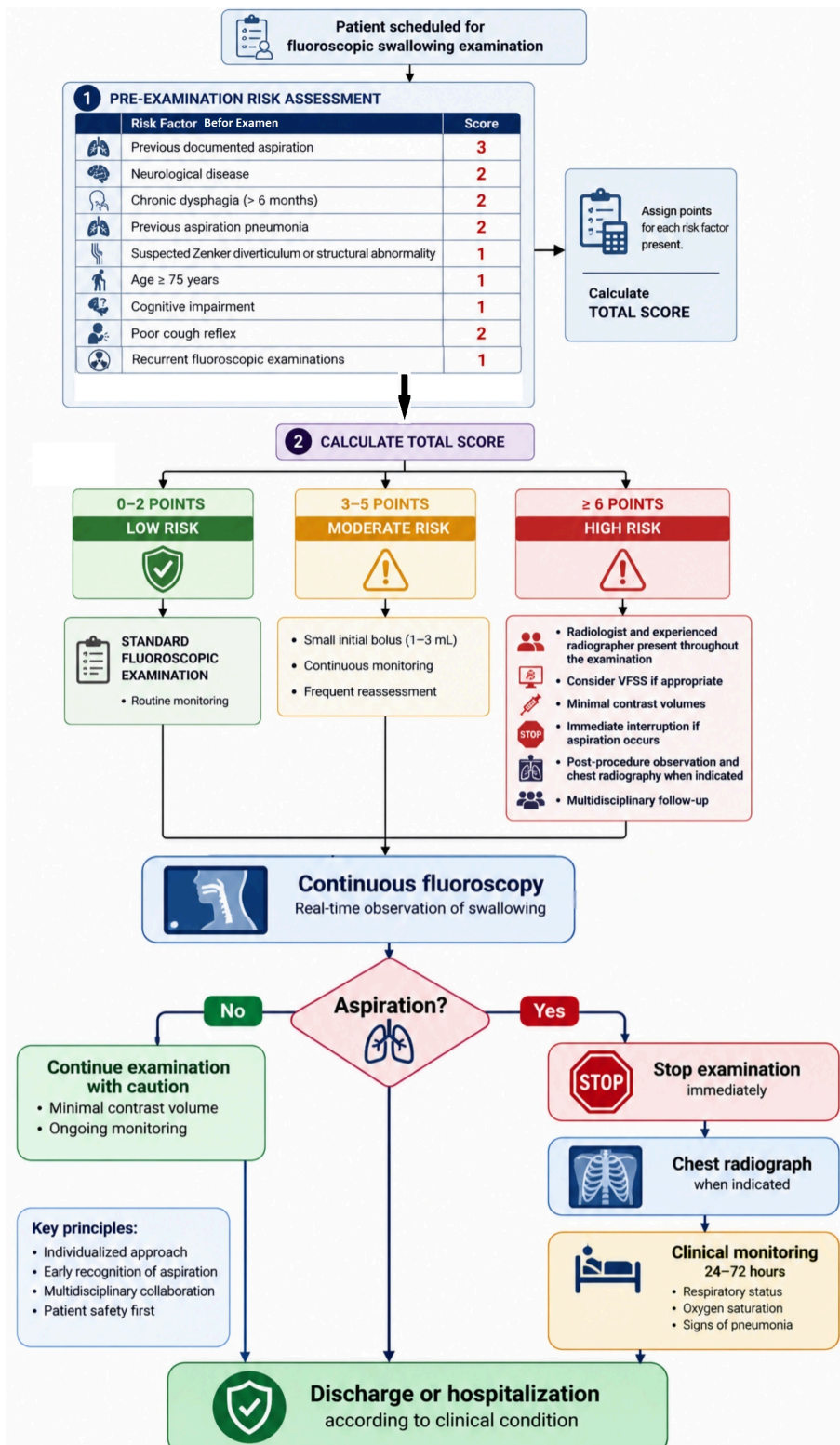


Figure 3

Proposed Aspiration Risk Stratification and Proactive Risk Management Algorithm for fluoroscopic swallowing study with barium contrast.

BENEFITS OF USING A RISK STRATIFICATION SCORING SYSTEM

in Videofluoroscopic Swallowing Studies (VFSS)

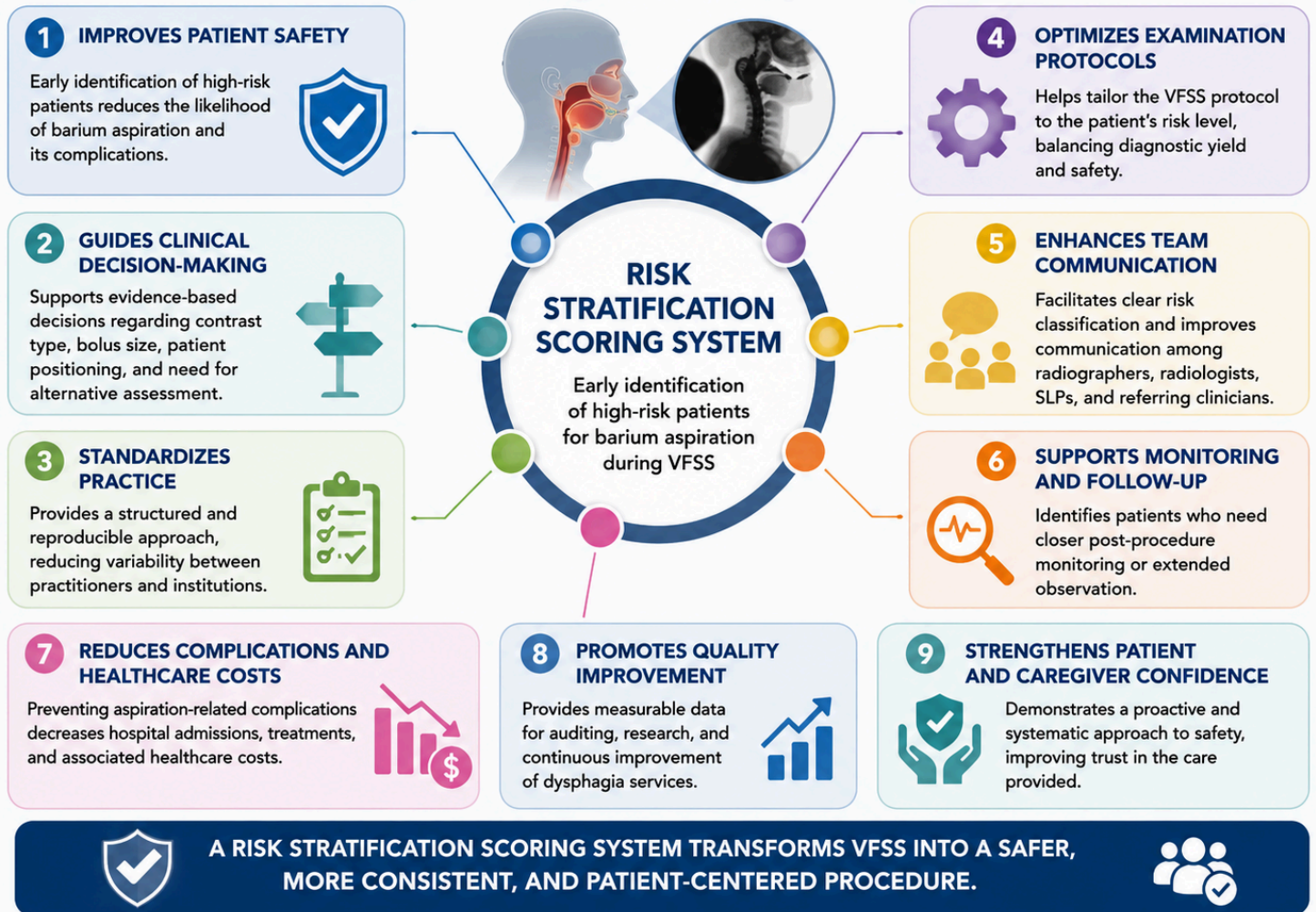


Figure 4

Benefits of using a Risk Stratification Scoring System

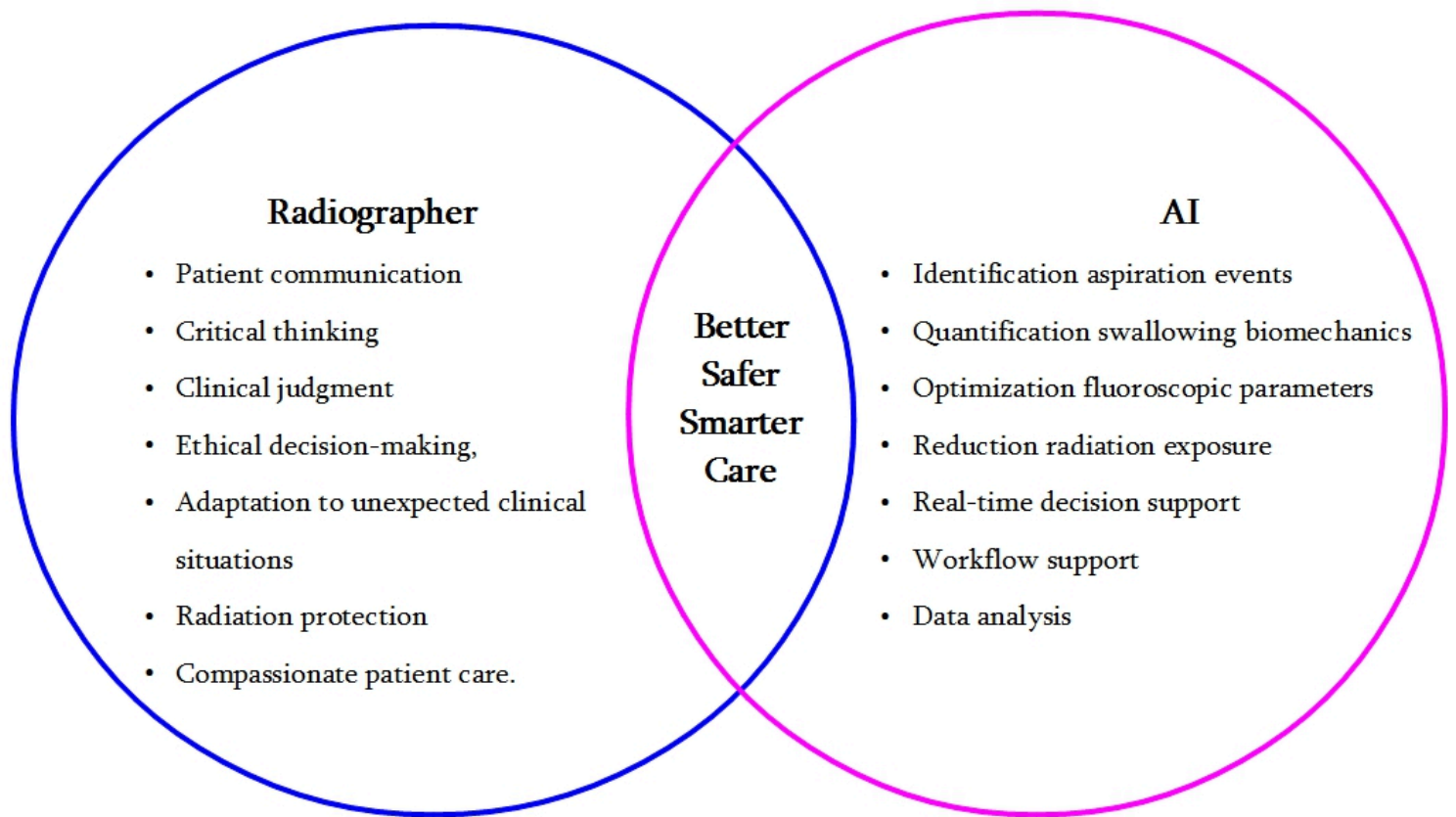


Figure 5

Radiographer and Artificial Intelligence: A Collaborative Future