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Feeding tube safety: National guidance is unsafe and must change

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Abstract

National guidance advises post-procedure pH or X-ray checks to prevent use of tubes misplaced in the respiratory tract; this occurs in 0.017% of placements. However, post-procedure checks cannot prevent the in-procedure pneumothorax in 0.43% or pneumonia from contamination in 0.20%. Extrapolated for annual Europe + USA tube placements there would be ~ 71,500 complications.

Mid-procedure CO2 checks or guided tube placement can prevent 96–100% of these complications whilst pre-emptive bridle securement reduces risk by 40% by obviating the need for most tube replacements. Together these methods would radically reduce holistic risk and cost.

National guidance is obsolete and disincentivises improvements in patient safety. In-procedure tube position checks, pre-emptive bridling and evidence-based training should be recommended.

Keywords

CO2 check, guided, misplacement, nasogastric, nasointestinal, pH, pneumonia, pneumothorax, tube, X-ray

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Data and definitions

Complications are separated into lung trauma (predominantly pneumothorax, plus haemothorax, hydropneumothorax) and infection (predominantly pneumonia, plus empyema) Appendix 1. Calculations of the population burden are based on Appendix 1 risks (Appendix 2).

Limitations of current national guidance

Annually, Europe and the USA use 11 million feeding tubes to deliver feed, fluid and drug treatment.[1,2] 'Blind' placement by non-specialist professionals predominates, where tube position is unknown until an end-procedure check. Final position checks are restricted to tube aspirate pH or chest X-ray recommended by national alerts,[3,4] position papers[5] professional guidelines[6] and reports.[2] However, these checks can only prevent the 0.017% of tubes misplaced in the respiratory tract that are used (Appendix 1).[7] Unfortunately, in-procedure, respiratory misplacement occurs in 1.65%, pneumothorax in 0.43% and associated pneumonia in 0.2%, thus, post-procedure checks cannot prevent ~97% of lung complications (Appendix 1). Misplacement almost doubles pneumonia risk[8] and misplacement risk *per se*, rises from 2.1% to 32% after one misplacement and pneumothorax risk rises from 5.1% after 1 misplacement to 36.4% after ≥3[9]. This highlights the need to avoid multiple tube placements. Finally, checks using a pH threshold of 5.5 have the additional risk that regurgitated acid falsely indicates gastric position where up to 5% of tubes remain undetected within the oesophagus risking aspiration pneumonia.[7,10]

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This paper shows that tube placement-associated complications are common, but most are preventable using in-procedure checks or reduced by bridle securement precluding tube replacement. The country-level impact on risk is indicated along with the regulatory mandates necessary to achieve it.

Advantages of in-procedure checks

In-procedure checks detect most risks. A mid-procedure (35 cm depth) X-ray[11] reduced in-procedure pneumothorax by 76.3% (0.38% to 0.09%).[9] However, mid-procedure CO2 checks or guided tube placement are more practical. Detecting high CO2 in the trachea (nose-ear-sternal notch depth)[12] reduced pneumothorax risk by 96% (0.43% to 0.018%)[7] but requires an end-of-procedure check (pH, X-ray) to confirm safe position. Guided tube placement tracks an electromagnet (EM: Cortrak™, ENvue®) or uses direct vision via a tube-tip camera (IRIS®). Expert operators achieve near-zero complications (Cortrak: 0.005%; IRIS: 0%).[7,13–15] Non-expert Cortrak use caused more pneumothoraces from undetected tube misplacements (0.10% vs blind: 0.017%) [5].[7] However, this EM-trace misinterpretation was likely a function of inadequate training and manufacturer trace description being subjective, with incomplete guidance regarding artefacts.[7,13,15–22] Conversely, evidence-based guidance describes lung and gastrointestinal position from angles, measurements and flexure patterns, plus how to detect and correct trace artefacts.[13,20] This objective interpretation facilitates 1:1 training and assessment of operator expertise. In contrast, ultrasound is unable to detect lung placement and has a high (7%) rate of false 'safe signals'.[23]

In-procedure checks also reduce the median depth of tube misplacement beyond the carina from 17 cm for blind placement to 11 cm for Cortrak guided-tube placement and <0 cm for direct vision (IRIS tubes) or CO2 checks.[7] Interestingly, rates of respiratory misplacement are inversely related to lung penetration: 1.65% blind, 11% Cortrak, 17.5% IRIS and 19% mid-procedure CO2 check.[7,12–14] Many blindly placed tubes may therefore enter the respiratory tract, then elicit clinical symptoms, prompting withdrawal prior to confirmatory X-ray. For this reason resultant complications may be underestimated because they are not connected with a misplacement.

Holistic risk and cost

Position checks compared

Pre-empting pneumothorax by mid-procedure CO_2 screening for respiratory misplacement is relatively cheap, while guided tube placement, though complex and expensive, immediately confirms both in- and end-procedure tube position.[24] In contrast, while pH checks are cheap, 44% fail to confirm gastric position[25] necessitating X-ray, and neither end-procedure pH or X-ray prevent pneumothorax (£2773) or pneumonia due to lung contamination (£3904-8829).[26–28] As yet unmeasured costs accrue from delayed X-ray where in 51% of patients systemic antibiotic, anti retroviral and chemotherapy treatment was beyond their 2h thresholds.[29,30] In addition, there is significant clinical risk, and therefore potential cost, of X-ray done off-ward.[31]

Tube securement

Tubes secured by adhesive tape have high rates of inadvertent patient tube removal and slippage (open ICU: 31–36%; single rooms: 53%)[32] adding risk from replacement and interrupted treatment. Tube loss occurs in 82% of ward-based stroke patients despite additional precautions of mittens (31%) and 1:1 observation (5.4%).[33] Average 'tube life' was 2 days, <25% of the enteral episode and X-ray confirmation delayed feed and drugs 9 h per tube placement, losing 18.8% of feeding time. Pre-emptive bridling is associated with a 1:2 cost:saving ratio,[34] associated with the reduction in tube loss (53% to <10%), more tubes reaching redundancy (18% to 63%),[32] something that improves over time (Figure 1). Although bridle placement is contraindicated by consent refusal, unsafe nasal anatomy and violent agitation, it was practical in the vast majority of patients. Even anatomical problems can be safeguarded by placing the bridle under direct vision[14] and risk from agitation can be mitigated by use of hand mittens or clonidine where appropriate. Pressure sore and sinusitis complications are possible with both bridles and tape, but minimised by correct fitting.[34]

Impact

In-procedure checks and nasal bridling offer major reductions in direct risk of pneumothorax, pneumonia (Figure 2) and associated cost. Further clinical and cost benefits should accrue by optimising drug and nutritional delivery.

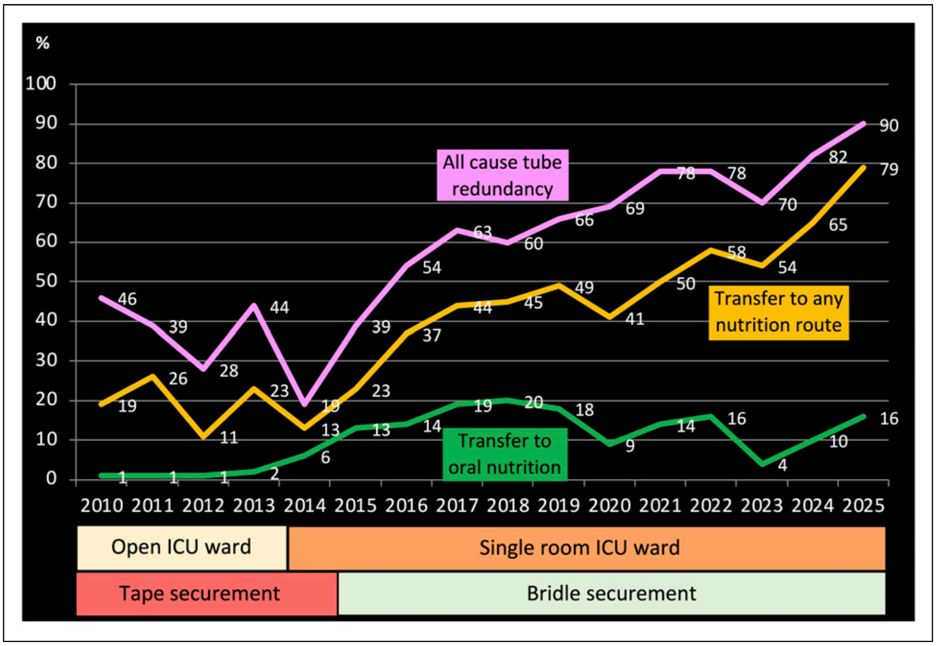

Figure 1. Effect of single patient rooms and bridle securement (©Taylor, 2026 – with permission).
* Extended audit from 2018[32] of 1625 nasointestinal tubes, Bristol, UK.

	New method	Result	Action	Tube-related risk by method Current	New	Europe+USA-wide* Clinical effect size
Pre-placement	Team assessment	Risk: benefit decision	Only those patients who can benefit should have tubes placed.	Futile intervention in some.	None	Unknown
10-18cm	Direct vision (IRIS tube)	Avoid glottis	Aim towards the oesophagus.	Unavoidable; tube position will not be known.	0%	Unknown
25-30cm	• CO_2 check or • Direct vision.	Detect trachea	Remove tube pre-carina; minimal contamination, no pneumothorax.	17.5-19% enter the respiratory trace.[10,12]	• 0.018% pneumothorax • 0.008% pneumonia. • 0% pneumothorax, minimal pneumonia risk.[5]	• ↓45361 pneumothorax • ↓21098 pneumonia. • ↓47300 pneumothorax • ↓22000 pneumonia.
35-45cm	EM tracing	Detect bronchial placement	Remove tube, reduced contamination, no pneumothorax.	Tubes position: • 8.6% bronchi. • 1.65% lung & • 17cm beyond the carina.[5] Leading to: • 0.43% pneumothorax • 0.2% pneumonia. • 0.07% death.	• 0.005% pneumothorax • 0.0006% pneumonia.	• ↓46750 pneumothorax • ↓21933 pneumonia.
>45cm	Direct vision or EM tracing.	Confirm gastric placement	Confirm tube in the stomach & facilitate intestinal placement.	• 27.5% are unsafe at X-ray requiring re-positioning.[24] • 16.6% needed re-X-ray & delay treatment 4.8h.	Immediate confirmation and ability to re-site the tube in real-time.	↑ medical/ nutritional treatment due to optimised tube access; clinical/ cost improvement unknown.
Post-placement	Nasal bridle	Pre-emptive securement	Check for nasal pressure sores.		>40% reduction overall through fewer tube placements.[30]	• ↓18920 pneumothorax • ↓ 880 pneumonia. • ↑ tube access → ↑ medical/ nutritional treatment; clinical/ cost improvement unknown.

Figure 2. Impact of in-procedure tube checks and securement (©Taylor, 2026 – with permission).
*11 million tubes.[1,2].

Conclusions and recommendations for new guidelines

Current guidelines for safe-guarding tube placement are obsolete and cannot prevent most risks. New guidelines to reduce holistic patient risk, staff burden and cost should include (Figure 3):

1. Training of:
   a. Operators in mid-procedure CO_2 checks and pre-emptive nasal bridle placement. The equipment and training cost is relatively low and offset by reducing complications, tube replacement and X-ray costs, while maximising treatment via retained tubes.
   b. Small, expert teams in real-time, guided tube placement. Capital and training cost is initially higher, but complication cost, delay to use and staff burden are minimised.
2. Validation of equipment and the interpretation of device readings to discriminate: (a) A 'respiratory' CO_2 level, (b) Anatomy in relation to the guidance trace or image.
3. Operator accreditation for guided tube placement, based on comprehensive, evidence-based training guides, as for X-ray,[4] not the currently inadequate and unvalidated manufacturer guides.[7,13–15]

Finally, where a new technology is validated to accurately confirm tube position, pH or X-ray checks should not be mandated as they add cost, staff burden, delay and therefore risk.

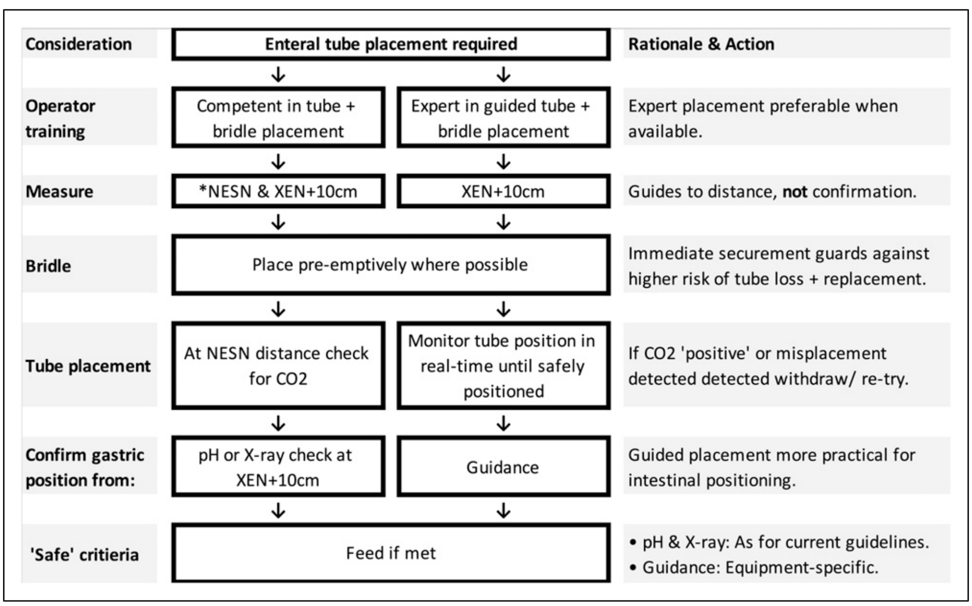

Figure 3. Pathway for new guidelines.
*NESN = Nose-ear-sternal notch, XEN = xiphisternum-ear-nose. NB: (NEX x 0.38696) + 30.37 + 6 cm is slightly more accurate than XEN+10 cm but more complex to use.[35]

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Author contribution

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Supplemental material

Supplemental material for this article is available online.

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