



# Prehospital Endotracheal Intubation: Assessing the Risk of Endotracheal Tube Migration During Transfer

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## INTRODUCTION

Endotracheal tube (ETT) misplacement is a recognised and common complication of intubation, including inadvertent endobronchial intubation and oesophageal intubation [1]. Whilst oesophageal intubation can be recognised swiftly using end-tidal carbon dioxide (EtCO<sub>2</sub>) monitoring, migration of the ETT either endobronchial or herniation of the ETT cuff through the glottis, can go unrecognised with significant consequences [2,3]. Undertaking a transfer of an intubated patient is recognised to carry risk, including the risk associated with ETT migration and misplacement. Clinicians rely on ETT markings to assess depth of ETT, alongside clinical signs to assess appropriate positioning. We reviewed the documented insertion depth of ETTs from prehospital intubations in adult patients and compared these to documented ETT depth upon arrival to our Major Trauma Centre in order to assess the incidence of migration during transfer.

## DESCRIPTION

Data was collected over approximately a 2.5 year period between 2019 and 2021 for all patients following a prehospital intubation and transfer to University Hospitals Coventry and Warwickshire. All adults over the age of 16 years were included, who were primary transfers and were either trauma or non-trauma patients. Goodman's criteria were used for standard comparison of ETT insertion depth; whereby the distance of the ETT from the carina should be 5 cm ± 2, with ETT reference mark of 23 cm for men and 21 cm for women [4].

Patient notes were examined and recorded ETT depth, based

on ETT markings, at discrete entries for different episodes in the patient's pathway; prehospital intubation, arrival into Emergency Department (ED) and on arrival into Intensive Care Unit (ICU) or theatres were noted. The distance of the ETT tip from the carina on admission trauma computer tomography (CT) or chest x-ray (CXR) and whether or not this met Goodman's criteria was noted. Any documentation of ETT manipulation from intubation to arrival in ICU was identified.

## RESULTS

117 patients underwent a prehospital emergency anaesthetic (PHEA) during this time period with only 32 of these patients having complete data sets. Of these, 22 had different ETT depths noted during their journey, giving a potential incidence of tube migration of 67%. 10 of these were documented to have gone on to be purposefully manipulated.

Upon review of the imaging, 19 (59%) appropriately met Goodman's criteria, whilst two (6%) cases of unrecognised endobronchial intubation found on CT were identified.

When reviewing all the entire 117 cases, 7 (22%) patients were found to have endobronchial intubation or ETT abutting the carina on their initial imaging and are therefore considered unrecognised misplacement.

Although not all data points were available for all patients, 34 patients did have an ETT depth documented for prehospital placement and arrival in ED. 19 had no difference in ETT depth from the prehospital intubation to arrival in ED and 15 had a difference in ETT depth. This difference ranged from 1 cm to 5 cm, with 2 cm being the average difference.

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The most common reason for incomplete data sets were due to absent documentation of the prehospital ETT depth or the depth of ETT on arrival into ED.

## DISCUSSION

This audit has revealed that within our data set, we have evidence of ETT misplacement, a proportion of which go unrecognised and are only corrected once seen on imaging. The clinical implication of this is unclear, but unintentional endobronchial intubation can lead to complications such as hypoxia and pneumothoraces [2].

There are several limitations to this audit. Firstly, there are no in hospital or pre-hospital guidelines on the optimal length of distance of ETT at the teeth, using ETT markings. This is likely due to phenotypic variability across patient populations, which are likely to have a direct impact the position of the ETT tip from the carina [5]. Goodman's criteria has been widely referenced to determine radiological positioning of ETT, however, it is a single centre study based on a small sample size some years ago [1]. Therefore may not be truly relevant to our population.

In situations whereby ETT depth placement was documented, there was little explanation whether this correlated to markings at the teeth or to the lips, which aligned with our own anecdotal departmental practice.

Ultimately, the most significant factor was the discrepancy in documentation. This is likely to be limited due to the often critical nature of the patient's condition, impacting the quality of documentation and recorded observations. Furthermore, this creates a bias; any intervention or adverse events are more likely to be documented than in circumstances where there is a lack of either. However, the impact of endobronchial intubation or ETT misplacement is likely to be greater than that reported from our dataset based on the sheer absence of recorded information. Speculatively, we have attributed the reason behind variations in tube placement as a result of differences in equipment (videolaryngoscopes), clinician experience and human factors [3,6].

Our audit has raised a key consideration; what can we do to reduce the incidence of ETT misplacement, or increase early detection, to maintain patient safety? Further research is needed in this area to be able to ascertain whether changes in equipment, education or culture are necessary to improve prehospital patient safety.

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## CONFLICT OF INTERESTS

None declared.

## INDIVIDUAL CONTRIBUTIONS

**VL:** Data collection, data analysis, literature review, co-author

**AJ:** Co-author

**LM:** Supervising consultant

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