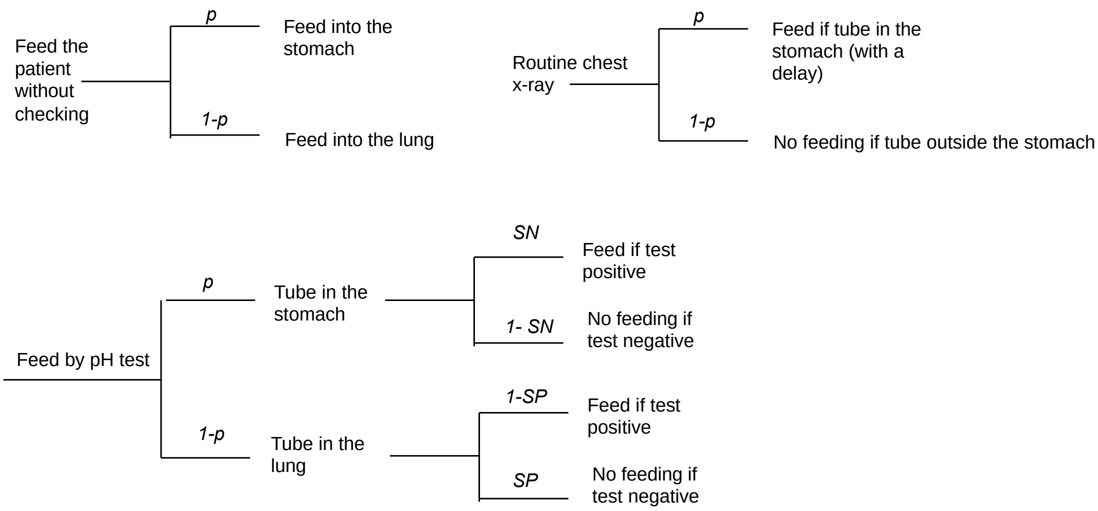
Appendix 1. Setting up boundary values in the analysis

Consider three feeding strategies, namely to feed all patients without checking (feed all), send all patients for chest x-rays (routine x-rays) and to test the pH and only feed given a low pH but no feeding when the pH is above the threshold. Note that the last strategy is different from the recommended pH test whereby a high pH would trigger the use of chest x-rays.

There is general agreement that routine x-ray is safer than testing pH which is again safer than to feed all. From this we can make certain deductions in terms of the perceived safety of outcomes and probability distributions.

To illustrate, consider a simplified scenario where the tube is either inserted into the stomach or lung. The three strategies can be represented in decision trees:



We assume, as in the main text, that stomach feeding has the maximum safety score of 100 whereas lung feeding has the minimum safety score of 0. No feeding when the tube is outside the stomach (i.e. lung) is also safe (score 100). However, feeding following chest x-rays incurs a delay and therefore is less than ideal. So is no feeding when the tube is placed inside the stomach. Let

- *p* to denote the probability of stomach placement and *1-p* the probability of lung placement;
- *x* to denote safety of feeding into the stomach with a delay, x<100;
- *y* to denote the safety scores assigned to no feeding given stomach placement and y<100;

- *SN* be the sensitivity of the pH test and
- *SP* be the (lung) specificity of the pH test.

By aggregating safety scores and probabilities (see Appendix 3) we assess the safety of each of the three strategies:

- Safety(Feed_all)=100*prob(stomach)+0*prob(lung)
- Safety(Xray)   =x*prob(stomach)+100*prob(lung)
- Safety(pH)   =100*prob(stomach)*SN+y* prob(stomach)*(1-SN)+ 0*prob(lung)*(1-SP)+ 100*prob(lung)*SP

Suppose we are primarily interested in pH cutoffs at 5.5 or lower. At this range, the test has a lung specificity at 1. Entering this value into the above equations, and after simplifications, we obtain an assessment of the relative safety of the three strategies in algebra forms:

- Safety(Feed_all)=100*p   -Eq.1
- Safety(Xray)=100-(100-x)*p   -Eq.2
- Safety(pH)= 100*p*SN+p(1-SN)*y+(1-p)*100   -Eq.3

Since routine x-ray is safer than the pH test which is safer than to feed all, the expected utility theory predicts that the safety scores will exhibit the relationship as in Eq1<Eq.3<Eq.2.

Firstly, given Eq.1<Eq.2, we have 100*p<100-(100-x)*p, or

x>100(2-1/p)   -Eq.4

Since *x* represents the safety of feeding with a delay (by chest x-rays), *x* must be less than 100. This means that the probability of stomach placement **$p > 0.5$**. This is why we set the risky scenario in the main text to have a 50% of tube misplacement rate.

Secondly, from Eq.3<Eq.2, we have 100*p*SN+p(1-SN)*y+(1-p)*100<100-(100-x)*p, or

x>100*SN+y*(1-SN)   -Eq.5.1

or

y<(x-100*SN)/(1-SN)   -Eq.5.2

Since y must be greater than 0, from Eq.5.2 we have ***x>100*SN***. That is, the safety of delayed feeding must be greater than the product of sensitivity of the pH test and 100 (the scaling unit).

To see what this means, consider the sensitivity of the pH test when the cut-off is 5.5. Our previous research (Hanna et al) established that the sensitivity of the pH is around 075 (0.743), thus the safety of feeding with a delay (*x*) must exceed 75 on the 0-100 scale for chest x-ray to be considered safer than the pH test. Based on Eq.5.2, suppose that delayed feeding has a safety score of 90, we can workout that no feeding when the tube is in the stomach will have a maximum score of 60.

In summary, from the simple preference ordering between the three decision strategies, we can set the boundary values as:

For pH cut-offs >=5.5	Range (minimum, maximum)	Corresponding value in paper
Stomach placements (probability *p*)	(0.5-1)	70%
Feeding delayed by x-ray (safety score x)	(100*SN, 100)	85
No feeding given stomach placements (safety score y)	(0, (x-100*SN)/(1-SN))	not applicable