

The use of normal saline instillation in the intensive care unit by physiotherapists: a survey of practice in New Zealand

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ABSTRACT

Normal saline instillation is used by health professionals during the treatment of intubated patients within the intensive care unit, usually to enhance sputum yield. Its use is controversial; detrimental effects have been documented and evidence of any benefit is limited. Some studies have suggested routine use be discontinued. This study investigates the use of normal saline instillation in the intensive care unit by physiotherapists throughout New Zealand. A purpose-designed postal survey was administered to the senior physiotherapist in all intensive care units in New Zealand ($n = 25$). A response rate of 76% ($n = 19$) was obtained. Instillation of normal saline was reported as being practised in 79% ($n = 15$) of hospital intensive care units; however, physiotherapists reported being involved in this practice in only 58% ($n = 11$) of cases. Of the respondents who reported never using normal saline instillation (42%, $n = 8$), the majority based this on the lack of supporting evidence (37%, $n = 7$). Despite this, normal saline instillation continues to be widely practised in intubated patients in intensive care units in New Zealand. **Reeve JC, Davies N, Freeman J, O'Donovan B (2007): The use of normal saline instillation in the intensive care unit by physiotherapists. A survey of practice in New Zealand. *New Zealand Journal of Physiotherapy* 35(3): 119-125.**

Key Words: Normal saline instillation, intensive care unit, physiotherapists, survey

INTRODUCTION

The use of isotonic (0.9%) sodium chloride / normal saline instillation (NSI) prior to endotracheal suction in intubated patients has been widely practised for over two decades in intensive care units throughout the world (Çelik and Kanan, 2006). The purpose of its instillation has been to increase sputum yield by diluting and loosening thick secretions, lubricating the suction catheter, enhancing cough stimulation and secretion mobilisation thus increasing secretion clearance (Raymond, 1995). Despite these purported effects, best practice guidelines produced by the Joanna Briggs Institute (Thompson, 2000) have determined that instilling 0.9% sodium chloride prior to suctioning adults with an artificial airway is unsubstantiated, has potential deleterious effects and routine administration should be discontinued. The detrimental effects reported include reduced oxygen saturations (Kinloch, 1999; Raymond, 1995; Ridling, Martin, and Bratton, 2003), increased levels of dyspnoea (O'Neal et al 2001), and an increased incidence of lower respiratory tract contamination (Freytag et al 2003; Hagler and Traver, 1994).

Considering the potentially injurious effects and the scant evidence of any beneficial effect, it is surprising that authors continue to report widespread use in clinical practice. A study of 1665 nurses and respiratory therapists at 27 sites in the United States showed that 74% of

centres had protocols which recommended NSI for thick secretions (Sole et al 2003). The study reported that respiratory therapists were twice as likely to instil normal saline prior to suctioning as their nursing colleagues. Other studies from the United States have similarly reported that NSI continued to be commonly practised by respiratory therapists (French and Bauer, 2002), more frequently than nursing staff (Schwenker, Ferrin and Gift, 1998). Sole et al (2003) also found that 83% of their respondents did not base their practice on published reports, using instead their basic educational programmes and the practice of co-workers to inform their practice. Few studies outside the United States exist to determine current practice and no studies have investigated whether physiotherapy involvement in this practice differs from that of other healthcare workers.

Given the reported adverse reactions to NSI and an increasing number of recommendations to avoid the practice this study aims to:

- i. Survey current physiotherapy use of NSI in intubated patients in Intensive Care Units (ICUs) throughout New Zealand (NZ)
- ii. Determine the rationale for the use of NSI in intubated patients in ICUs
- iii. Identify trends in the variability of administration of NSI throughout NZ.
- iv. Identify factors that influence current physiotherapy practice regarding the use of NSI in NZ.

METHOD

Procedure

As NSI is used in the treatment of intubated patients in ICUs, we identified hospitals in NZ with an ICU from:

- the Health sector New Zealand directory 2001 – 2002;
- an internet search of ICU facilities in NZ;
- telephoning hospitals directly;
- consultation with student clinical placement organisers.

Twenty-five hospitals were identified. As none of the surveys previously undertaken in this area were felt to fully reflect NZ practice, a questionnaire was designed for the purpose. The questionnaire comprised 24 questions divided into three sections; demographic and general information, information specific to the technique used in the administration of 0.9% sodium chloride / normal saline such as volumes used, and a section on factors influencing practice. To ease completion and facilitate an increased response rate the majority of questions were closed but offered respondents an opportunity to comment where appropriate. Further details of the survey structure and content can be seen in Table 1.

Given the small number of ICU's in NZ and thus the limited number of potential respondents, the pilot study was conducted at two hospitals with ICUs, using a senior physiotherapist one grade below the targeted respondents. Comment on structure, question design, ease of completion, content and flow were sought and minor changes were made following this. The same hospitals, but with different physiotherapists, were used in the final survey.

Following this, the questionnaire was distributed by post in April 2006 to the senior respiratory / ICU physiotherapist of each of the 25 hospitals identified.

The senior physiotherapist was selected to complete the survey in the belief that their response would best reflect the practice of physiotherapists in their ICU. A covering letter was included explaining the purpose of the questionnaire, identifying the researchers, and assuring confidentiality. A stamped addressed envelope was enclosed and a period of four weeks for completion was given, in an attempt to ensure good response rates. A follow-up letter was sent out after a three week period in an attempt to increase the response rate. Returning the questionnaire was taken to represent informed consent. Responses were only available to the authors and all data received was kept in a locked cabinet. Respondents were asked to consider that for the purposes of this questionnaire the term normal saline instillation (NSI) referred to the instillation of 0.9% sodium chloride into the endotracheal tube in intubated adults by physiotherapists. They were informed that it did not refer to the emergency use of NSI in the case of occlusion of the airway by a sputum plug.

Ethical permission for the study was obtained from the Auckland University of Technology Ethical Committee (AUTEK).

Data Analysis

All closed-question data was of the nominal / ordinal form and analysed using SPSS 14.0 for Windows using a variety of descriptive statistical methods. Additional comments were analysed individually and then agreed by all authors to reduce any biases and to reach a consensus on developing themes.

RESULTS

General data

A total of 25 questionnaires were distributed and 19 (75%) were returned completed.

Table 1. Structure and content of the survey

Section and subject	Question number	Examples of Topics Covered
1. General data	1 - 6	<ul style="list-style-type: none">• Health professionals using NSI• Frequency of individuals using NSI• Authority to use NSI• ICU protocols in place for NSI use• Type of humidification used• Type of suction system used
2. Administration of NSI	7 - 16	<ul style="list-style-type: none">• Perceived indications for NSI use• Types of patients NSI used for• Frequency of pre-oxygenating patient prior to use of NSI• Position of patient when administering NSI• Volume of saline used• Length of time between instillation of saline prior to suctioning• Adverse effects observed from NSI use
3. Influences on practice	17 - 24	<ul style="list-style-type: none">• Awareness of research on effects of NSI• Research or guidelines that have impacted on use of NSI• Opinion of standard of current evidence• Influences on use of NSI• Pressure from other health professionals regarding NSI use• Country trained in• Number of ICU's worked in• Length of time in current ICU

Note: A copy of the original questionnaire can be obtained upon request from the corresponding author.

The majority of respondents reported being qualified as a physiotherapist for over 10 years (n = 13, 68%) with the mean length of time qualified being 17.1 years (SD 12.39, range 3 – 46 years). Demographic data for respondents can be seen in Table 2.

Table 2. Demographic details of survey respondents

	n (%)
Physiotherapy training	
New Zealand	10 (53%)
Zimbabwe	3 (16%)
United Kingdom	2 (11%)
Canada	1 (5%)
India	1 (5%)
ICU experience (breadth)	
Overseas and NZ	14 (74%)
NZ only	5 (26%)
> 1 ICU	17 (90%)
> 5 ICUs	6 (32%)
ICU experience (time)	
< 6 months	4 (21%)
< 4 years	12 (63%)
> 10 years	7 (37%)

Key : ICU – Intensive Care Unit, NZ – New Zealand

Use of NSI by health professionals

NSI was reported as being used in 79% (n = 15) of hospitals, while four (21%) respondents reported NSI was never practised in their ICUs by any health professionals. Respondents were asked *which* health professionals in their ICU used NSI. Physiotherapists in 11 (58%) hospitals reported using NSI with two (11%) of these centres being paediatric ICUs. Four (21%) respondents reported that physiotherapists never used NSI in their units but that other health professionals did. In no units were physiotherapists the only health professionals to use NSI. Respondents reported that the other health professionals involved in NSI in their ICUs were nurses (n = 8, 42%) and medical staff (n = 5, 26%).

A total of 79% (n = 15) of respondents, including those that did not currently use NSI in practice,

reported having the authority to administer NSI if they believed it to be appropriate. Three (16%) respondents reporting needing clearance from an intensivist prior to use of NSI. Nonetheless, only four (21%) respondents indicated that their hospital had a written protocol governing the administration of NSI.

Respondents were asked about how frequently they used NSI in their practice and the rationale for this. Results can be seen in Table 3.

Indications for NSI

Of those respondents reporting using NSI (n = 11, 58%), all of them determined that they would use NSI *only* when other methods for clearing thick secretions had failed. Two (11%) of these respondents also reported that it may be used to check or stimulate a cough reflex.

Respondents were asked which patient groups they considered suitable for NSI. All considered sedated patients suitable, with seven (37%) respondents considering alert and orientated patients suitable for NSI, and five (26%) respondents also considering confused patients suitable.

Technique of administration of NSI

Of those respondents reporting using NSI (n = 11, 58%), eight (42%) reported *always* preoxygenating patients prior to NSI, and three (16%) respondents reported *sometimes* preoxygenating, usually on the basis of previous desaturation on suctioning. One (5%) respondent reported a specific unit protocol of *not* preoxygenating prior to airway suction.

The volume of normal saline used during treatment was ascertained. Of those respondents reporting using NSI (n = 11, 58%), Table 4 shows the volume of NSI *most regularly* used by physiotherapists at one time and over a total treatment session. Table 5 shows the *maximum amount* the respondents deemed safe to instil, both at one time and over one treatment session. There is considerable variation in the amounts respondents both used and considered safe to use.

Table 3. Frequency of use of NSI by physiotherapists

Frequency of use	n (%)	Rationale for frequency of use (where stated)
Never used	8 (42%)	- No evidence to support x 7 - Potential risks associated with use x 2 - Colleagues influence x 1 - Rarely have ventilated patients x 1 - Small vials of 0.9% saline not available x 1
In under 50% of patients	10 (53%)	- Used if other modalities been unsuccessful x 1 - Where clinically indicated only x 2 - To facilitate secretion clearance not cleared by regular suctioning alone x 1 - Very rarely used x 2
In approximately 50% of patients	1 (5%)	- Often patients have loose secretions which clear without NSI x 1
In over 50% of patients	0 (0%)	
Always	0 (0%)	

Table 4. Volume of saline most regularly used at one time and over total treatment session.

Volume of saline mls	At one time n = 11 (%)	Over a total treatment session n = 11 (%)
<1	2 (11%)	0 (0%)
1 – 5	7 (37%)	4 (21%)
6 – 10	1 (5%)	3 (16%)
11 – 20	0 (0%)	3 (16%)
Missing	1 (5%)	1 (5%)

Table 5. Responses regarding the maximum volume of saline considered safe to use at one time and over total treatment session

Max volume of saline safe to instil... (mls)	At one time n = 11 (%)	Over a total treatment session n = 11 (%)
0.5	1 (5%)	0 (0%)
2	1 (5%)	1 (5%)
5	5 (26%)	3 (16%)
7	1 (5%)	0 (0%)
10	2 (11%)	3 (16%)
20	1 (5%)	3 (16%)
Missing	0 (0%)	1 (5%)

Patient position during NSI varied. In six (31%) cases respondents reported instilling saline without changing the patients' resting position. One (5%) respondent reported instilling normal saline with the affected lung uppermost (suggested by the respondent as being for optimal ventilation perfusion matching), whilst four (21%) respondents instilled the normal saline with the affected lung dependent (suggested by respondents to be followed by reversing the position for treatment purposes).

Respondents were asked how long they would normally wait after NSI before suctioning the airway. Responses varied widely with three (16%) respondents reporting suctioning immediately, three (16%) respondents suctioning within one minute of NSI and five (26%) respondents reporting "minutes" between NSI and suctioning.

Of all respondents, only three (16%) reported witnessing adverse events during the use of NSI. These were reported as bronchospasm (n = 1, 5%) and paroxysmal coughing (n = 2, 11%).

Influences upon practice

Respondents were asked whether they were aware of research conducted into the effects of NSI. Results can be seen in Figure 1 with the majority (69%) of respondents aware of the literature but unable to name key papers. Four (21%) respondents reported being unaware of current research findings. Respondents were also asked if any key literature had informed their practice and if so which. Only one (5%) respondent cited specific literature. Despite a limited awareness of specific literature, when asked what, in their opinion, was the overall quality of the body of the

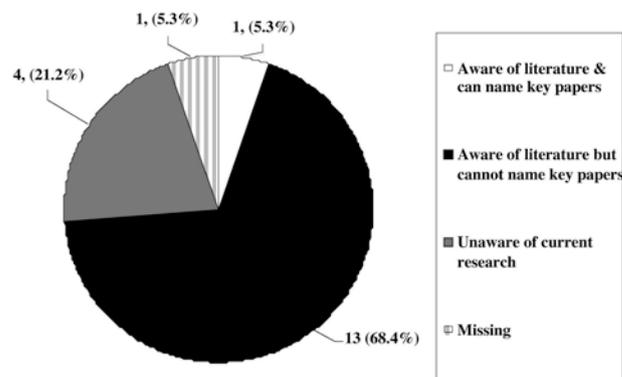


Figure 1. Research awareness

evidence for NSI, no-one reported the evidence as good or excellent and the majority of respondents considered the quality of the literature to be only fair (n = 5, 26%) or poor (n = 5, 26%). Eight (42%) respondents stated that they were unsure of the overall quality of the literature. Of the respondents who reported never using normal saline instillation (42%, n = 8), the majority based this on a lack of supporting evidence (37%, n = 7).

Respondents were asked to rank on a five-point Likert scale the importance of a number of factors influencing their decision whether to administer NSI. Results can be seen in Table 6.

DISCUSSION

Despite the small population size, the response rate to this survey can be considered good and representative of the population targeted (Oppenheim, 1992). These results should not be extrapolated to the wider physiotherapy population beyond New Zealand as, despite many respondents having worked previously overseas, their practices in previous positions were not ascertained. Nor should these results on the technique of administering NSI be taken to represent any other health professionals practice than physiotherapy. It is acknowledged that whilst this survey targeted senior physiotherapists in ICUs this does not necessarily reflect the practice of any other physiotherapists working within the ICU or elsewhere and practice may vary.

This survey determined that of the respondents using NSI (n=11, 58%), all are using it on a non-routine basis, utilising NSI when all other methods for clearing secretions have failed. Despite NSI being widespread practice in critical care units for many years, the literature that investigates the efficacy of NSI in sputum removal (and its associated effects) is dated and of variable quality. Recent systematic reviews have concluded that, given the limited volume of evidence and the dearth of any high quality (Level I or II) evidence, 0.9% sodium chloride instillation cannot be not substantiated by the literature (Thompson, 2000). With a lack of further experimental studies in the years following publication of this systematic review, other authors have determined that the routine use of NSI should

Table 6. Factors influencing physiotherapy practice

Influencing factors n (%)	1 No influence	2	3	4	5 Very influential
Personal experience	0 (0%)	2 (11%)	1 (5%)	9 (47%)	6 (32%)
Established practice	1 (5%)	3 (16%)	4 (21%)	9 (47%)	0 (0%)
Literature recommendations	0 (0%)	1 (5%)	6 (32%)	7 (37%)	3 (16%)
Protocol	3 (16%)	2 (11)	4 (21%)	3 (16%)	4 (21%)
Other	0 (0%)	0 (0%)	1 (5%)	1 (5%)	0 (0%)

be discontinued as a treatment technique until research demonstrates any physiological benefits for the procedure (Çelik and Kanan, 2006). Others have argued that the practice should not be implemented as routine procedure (Ackerman, 1993; Ackerman, Ecklund, and Abu-Jumah, 1996; Ackerman and Mick, 1998; Hagler and Traver, 1994; Kinloch, 1999; Raymond, 1995).

These recommendations have been made on the basis of documented adverse events following NSI, including reduced arterial and venous oxygen saturations (Ackerman, 1993; Kinloch, 1999; Ridling et al 2003), an increased incidence of dislodgement of bacteria from endotracheal tubes potentially increasing nosocomial infection risk (Freytag et al 2003; Hagler and Traver, 1994), and possible changes in haemodynamic parameters (Akgul and Akyolcu, 2002). Despite these reported risks, only 2 (11%) of respondents to this survey documented actual occurrence of adverse events during their treatment interventions. Audits of adverse events when NSI is utilized during treatment would be a useful addition to the ongoing debate about the use of NSI in clinical practice.

Whilst adverse effects of NSI have been reported in the literature, some authors have found no significant detrimental effects to the patients following NSI (Bostick and Wendelgass 1987; Grey, MacIntyre and Kronenberger, 1990). Nonetheless, the claim that NSI enhances the removal of secretions through stimulation of a cough reflex and / or decreased adherence of secretions remains unclear, unsubstantiated and methodologically poorly investigated, with studies failing to differentiate between percentage of normal saline and sputum retrieved (Bostick and Wendelgass, 1987; Grey, MacIntyre and Kronenberger, 1990) and reporting statistically significant but clinically insignificant differences (Ackerman and Gugerty, 1990). Indeed, authors have suggested that normal saline / 0.9% sodium chloride and mucus are immiscible and that mixing water with mucus in vitro does not render it less viscous even after vigorous shaking (Demers and Saklad, 1973). This concept has been widely cited in the literature, although Demers and Saklad did not support or scientifically document how they arrived at this conclusion (Raymond, 1995) and clearly requires further study. Another often cited study radioactively labelled normal saline to determine its distribution and retrieval

in five dogs and two human subjects (Hanley, Rudd and Butler, 1978). Despite the limitations of the population used, findings suggested that NSI was unnecessary as it could not effect secretions beyond main stem bronchi (there was no saline located in peripheral airways up to 30 minutes following instillation), and over 80% of saline was not recovered by suction (Hanley et al 1978). Another small pilot study in humans has considered the same question by radioactively labelling and comparing direct instillation with inhaled nebulised 0.9% sodium chloride administration using Single Photon Emission Computed Tomography (Klockare et al 2006) to determine delivery. Patients were maintained in the supine position only during measures and small subject numbers necessitate this study being replicated and extended. However these preliminary findings showed that the majority of saline instilled directly via the endotracheal tube was primarily distributed to the posterior portion of the right lower lobe (median of 44.2%), which was significantly more than during nebulisation but that nebulised saline was distributed more uniformly both between lungs and within lungs. These authors and others have suggested that deposition in the most dependent portion of the lung may increase the propensity for ventilator associated pneumonias (Hagler and Traver 1994; Richards et al 1999). In this survey respondents primarily reported choosing to directly instil saline in the position in which they found the patient. The effect of position prior to instillation, the likelihood of reaching the target area, and the method of instillation of saline should be given further attention both within clinical practice and in the research arena.

This survey found widespread variation in both the use and administration practices of NSI. As all recent literature has suggested that routine use of NSI be discontinued, there have been no recent guidelines developed for administration of normal saline / 0.9% sodium chloride. As NSI continues to be utilised by physiotherapists despite the absence of any high quality evidence and guidelines, the apparent variation in practice seen in this study could be expected. Further studies to determine both beneficial and detrimental effect of NSI on oxygenation indices and haemodynamic status as well as effects of direct instillation upon the airways, mucous membranes, and lung parenchyma should be considered if NSI is to continue.

It would appear from the results of this study that other health professionals in NZ may utilize NSI more frequently than physiotherapists. Indeed, in some instances physiotherapist respondents to this survey did not practice NSI despite other staff in their ICUs using the technique. Other surveys (Schwenker et al 1998; Sole et al 2003) undertaken in the United States suggest that “respiratory therapists” were more likely to use NSI than nursing staff. French and Bauer (2002) found that 67% of “respiratory therapists” used NSI occasionally and 24% used it routinely.

Of those physiotherapists never using NSI, the majority based their practice on there being no evidence to support it. Whilst over half of respondents continued to use NSI, no respondent suggested the quality of the literature on this subject to be any better than fair. Whilst “literature recommendations” ranked as an influential factor in the use of NSI, it was less influential than that of personal experience. The use of NSI in clinical practice reported in this and other studies (Schwenker et al 1998; Sole et al 2003) implies that, despite the potential adverse effects highlighted in the literature, health professionals continue to find NSI a useful treatment option in some of their patients. Whilst practitioners should consider that although studies documenting adverse effects are numerous, evidence to determine the efficacy of NSI in clearing secretions remains elusive. Further studies should be conducted to determine whether NSI has any effect on the dilution, mobilisation and clearance of secretions if this treatment is to continue to be utilized despite guidelines to the contrary.

Respondents also stated established practice was influential in their decision to use NSI. Sole et al (2003) found that the majority of “respiratory therapists” stated their practice in airway management to be most influenced by their basic educational programme (69%), policies (40%) and the influence of co-workers (32%). Practice was least influenced by continuing education (22%) and journal articles (15%). Educational institutes should remain aware of their influential role in upon clinical practice at undergraduate level, and continue to encourage the implementation of evidence-based practice where good quality evidence exists. Herbert et al (2005) suggest that practice can only be evidence-based when it uses high quality clinical research but acknowledge that where high quality research does not exist, good practice should be informed by knowledge from other sources such as expert opinion, personal or shared practice, patient preferences and lower quality research. This survey attempts to highlight what respondents consider good practice to be in the absence of any high quality literature or guidelines to this effect.

This survey also showed that an awareness of the recommendations from the general body of literature was greater than respondents’ knowledge of individual studies. With an increasing number

of systematic reviews being undertaken, it will be important to make their recommendations and conclusions more readily available to health professionals. Media such newsletters and websites may assist in furthering the application of evidence to clinical practice.

There are several limitations to this survey. Whilst having a good response rate, the respondents were senior physiotherapists who were selected because it was felt their responses might most accurately reflect the physiotherapy practice on their unit. Whilst an attempt to determine the practice of others was made, a survey investigating the use of NSI by other members of the healthcare team including other grades of physiotherapists, would give a more complete picture. The high mean length of qualification determined that many of the respondents had a considerable number of years experience and this may have influenced practice. Determining factors that might influence practice in more junior physiotherapists might demonstrate differing influences on practice. The use of NSI as a method of bronchoalveolar lavage or for emergency clearance of a blocked endotracheal tube was not established and thus all potential uses when using direct endotracheal instillation of saline were not established in this survey.

CONCLUSIONS

This survey has shown that some physiotherapists and other health professionals in NZ continue to use NSI as a means of enhancing sputum retrieval in intubated patients within the intensive care unit, although no physiotherapists used NSI as a routine intervention. All respondents felt the quality of the evidence available supporting NSI to be limited. The potential detrimental effects of NSI have been clearly established in the literature but further studies determining the efficacy of NSI on sputum retrieval are required if this practice is to continue to be utilized by health professionals.

Key Points

- Normal Saline Instillation continues to be used by physiotherapists in New Zealand as an aid to clearance of secretions in intubated patients within Intensive Care Units
- Differences exist between physiotherapists in the administration of NSI
- There is little high quality evidence to substantiate the use of NSI directly instilled into the endotracheal tube of intubated patients as an aid to clearance of secretions in the intubated patient

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