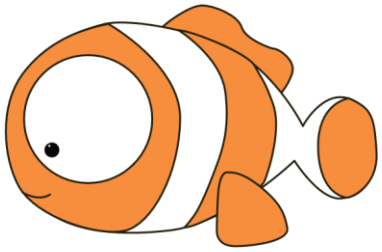
EASTRN

East of England AnaestheticS Trainee Research Network

EAST OF ENGLAND ANAESTHETICS TRAINEE RESEARCH NETWORK PROJECT 2024-2025

NEMOE

Neuromuscular Monitoring in the East of England



Version 1.0

PROPOSAL DETAILS

PROJECT TITLE	Neuromuscular monitoring in the East of England (NEMOE)		
SUBMITTED BY	EASTRN committee	**PROJECT TYPE**	Service evaluation
EMAIL	Eastrn.eoe@gmail.com		
PROJECTED START DATE	November 2024	**PROJECTED COMPLETION DATE**	January 2025

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1. NEMOE OVERVIEW

1.1 Introduction

There is now international consensus that quantitative neuromuscular monitoring should be used in all anaesthetics where neuromuscular blockade is used[1,2]. The Seventh National Audit Project (NAP 7) of the Royal College of Anaesthetists found that where neuromuscular blockade is monitored, the recommended standard of quantitative assessment is used in only 24% of cases[3]. The potential consequences of inadequate neuromuscular reversal are well documented and include increased pulmonary complications, prolonged recovery length of stay and decreased patient satisfaction[4].

The two primary arguments levied against the use of quantitative monitoring may be classified as attitudinal and financial[5]. There may be persisting hubris amongst anaesthetists when it comes to neuromuscular blockade assessment, with some advocating for the use of clinical signs of adequate reversal or looking to qualitative monitoring alone. Meta-analysis data shows that both these methods are inadequate with up to one-third of patients suffering residual neuromuscular blockade[6]. Concerns of the additional financial cost of quantitative monitors may also be without merit. Analysis of potential complications of inadequate reversal suggest that the per-patient cost of appropriate monitoring is small compared to the cost of treating complications[5,7].

Additionally, with the increasing availability of the rocuronium binding agent sugammadex, some may be under the impression that residual neuromuscular blockade is a problem of the past. The unfortunate reality is that without appropriate quantitative monitoring even reversal with sugammadex is fallible[8]. Whilst sugammadex may provide more reliable reversal than more traditional agents, quantitative monitoring has the further benefit of guiding appropriate dosing[9].

Anecdotally, it is clear amongst trainees within the East of England that the degree to which quantitative monitoring is available and utilised varies greatly. It is unclear the gap in provision that needs to be bridged to reach the modern recommendations. The degree to which attitudes and misunderstanding act as a barrier to improving patient safety when considering neuromuscular monitoring is also not known.

1.2 Aims of NEMO

1. To identify the current ability of anaesthetic departments in the east of England to provide qualitative and quantitative neuromuscular monitoring.
2. To investigate anaesthetists' understanding of, and their attitudes towards, quantitative neuromuscular monitoring.
3. To identify barriers to wider adoption of quantitative neuromuscular monitoring.
4. To audit current practice of neuromuscular monitoring.

1.3 Why you should contribute to NEMOE

NEMOE provides an opportunity for trainees of all stages to contribute to a large regional project. All contributors will be provided evidence of their involvement to use in support of the relevant HALO domains. Any publications produced as a result of this project will credit all those who have participated.

1.4 Explanation of roles

Site lead role:

We would expect all EASTRN site leads who have already been allocated to take a primary role in the administration of NEMOE at their site. There can be up to two site leads per trust.

- Attend briefing session prior to the start of the study period.
- Acquire local audit departmental approval and confirm this with the EASTRN committee.
- Liaise with the consultant supervisor at site.
- Take responsibility for site questionnaires of monitoring provision.
- Identify period of data collection for audit component.
- Manage local contributors in carrying out survey and audit component of the project.
- Organise access to audit data collection form for local contributors and arrange upload of audit forms.
- Communicate with EASTRN team when components of project are complete.

Local contributors:

Local contributors should be identified and managed by the site lead, with support from the central committee and local consultant lead.

- Liaising with site lead for access to relevant forms for survey and audit.
- Advertisement of anaesthetist survey.
- Data collection for audit.

2 METHODOLOGY

2.1 Study components

NEMOE is comprised of 3 components:

1. Site questionnaire
2. Neuromuscular monitoring audit
3. Anaesthetist survey

1. Site questionnaire

A single online survey will be completed for each trust. The purpose of this questionnaire is to determine the availability of qualitative and quantitative monitoring at that location. The questionnaire will first ask site leads to determine how many theatres there are at each trust where neuromuscular blockade may be given. In general, any location with an anaesthetic machine where you would be expected to provide a general anaesthetic with neuromuscular blockade should be included.

Potential locations would include but are not limited to:

- Main theatres
- Maternity theatres
- Cardiac catheterization laboratories with anaesthetic machines

Excluded locations:

- Resuscitation bays
- Procedure rooms where general anaesthetics are not delivered

We would ask these then be grouped into geographic locations where it would be reasonable for neuromuscular monitors to be shared so that the relative distribution of devices can be determined. The questionnaire will then explore the current provision of neuromuscular monitors. This aspect will likely require discussions with staff involved in equipment provision for example the equipment lead, a senior ODP or theatre manager, and visiting theatres to assess equipment availability. For a summary of quantitative monitors see the appendices.

A link to the online survey will be provided to site leads. The deadline for survey return will be 31/01/2025.

2. Neuromuscular monitoring audit

This snapshot prospective audit seeks to determine current practice around use of neuromuscular blocking drugs, reversal agents, monitoring and documentation.

Audit results will be gathered within a 5 day period (Monday to Friday) chosen by the individual site lead within the data collection period. Data will be collected on cases completed between 8am and 8pm. There is no requirement for data to be collected every day within the 5 day period.

Data collection period: 13/01/25-31/01/25

Whilst there is no minimum number of cases to be collected we would hope that over a 5 day period most centres would be able to collect data on at least 15 cases. We would also encourage inclusion of a variety of specialties but there is no set minimum.

A paper audit form has been created for data collection which should be returned to the site lead when completed. Online site-specific data collection forms will be provided to each site lead to upload the paper forms giving them the opportunity to check for duplicates and address any issues with data collected. **No patient identifiable information will be collected by the central study team.**

Location:

Any theatre list where neuromuscular monitoring is likely to be used can be chosen to monitor.

Inclusion criteria:

- Adult (≥18 years of age)
- Undergoes general anaesthesia where a neuromuscular blocking agent is used
- The case is completed between 8am and 8pm within the 5 day data collection window chosen by the site lead.

Data collection:

Audit data should be collected by the site lead or a collaborator. They should not be directly involved in the decisions surrounding neuromuscular monitoring for each case. Ideally the person completing the proforma should not be affiliated with the list being monitored. Some of the audit questions will involve talking to the anaesthetist responsible for the patient's neuromuscular blockade, monitoring and reversal. This will likely require those collecting audit information to be sufficiently available to visit the list in real time and we would encourage the use of educational development time or study leave for this purpose. Data collectors should make it clear to the treating team that the data collected forms part of a service evaluation project only, where the patient and anaesthetist are both anonymised.

3. Anaesthetist survey

The survey will ask for basic demographic details including trust and grade before exploring anaesthetist's approach to, and opinions of, neuromuscular monitoring. This will be used to describe current attitudes and practice as well as identify barriers to increased utilisation of quantitative monitoring. It will be necessary to provide a breakdown of the total number of anaesthetists eligible to complete the survey within your department during the site questionnaire. This will be used to determine a survey response rate.

Some possible suggestions to facilitate survey uptake might include:

- Providing a QR code at teaching or clinical governance.
- Visiting theatres at opportune moments to ask anaesthetists the survey questions or to show them the QR code.

The site lead will be responsible for advertising and encouraging engagement with this survey.

The anaesthetist survey should be publicised following the completion of the theatre audit. The survey will close to further responses on 14/02/2025.

2.2 Data security and site requirements

There will be no patient identifiable information collected by the central committee in this service evaluation and audit. Any patient demographics recorded on paper audit forms should not be included when audit results are uploaded.

3 DISSEMINATION AND REPORTING

Study findings will be disseminated and publicised following analysis via:

- Email correspondence to the trainee network and trainee newsletter.
- Regional conference presentation.
- Site level data will be available upon request.
- Peer-reviewed academic publications if accepted.

4 CONFLICTS OF INTEREST AND FUNDING

There are no conflicts of interest amongst the authors on the EASTRN committee and no fundings sources.

5 REFERENCES

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9. Iwasaki H, Kurosawa A, Iida T, Sasakawa T, Kanda H. Use of intraoperative neuromuscular monitor reduces the reversal dose of sugammadex: a single-center retrospective study. J Anesth. 2020;34(2):276-280. doi:10.1007/s00540-020-02739-1

6 APPENDICES

6.1 Site evaluation form

Sites will be provided with a link to the online data collection form. This form is recreated here for site leads to preview the information they will need to collect.

NEMOE SITE SURVEY

The purpose of this survey is to explore the provision of neuromuscular monitors within the East of England.

Please work in combination with your equipment and theatre leads to determine the necessary information.

If you have any questions concerning the definitions used within this survey please contact the EASTRN team for clarification at eastrn.eoe@gmail.com.

- *Trust/Hospital*
- *Anaesthetic records, personnel and neuromuscular governance.*
    - *Does a departmental guideline for neuromuscular monitoring exist for your Trust?*
    - *Does your department have a local/departmental champion for neuromuscular blockade?*
    - *Is the anaesthetic chart used in your theatres electronic or paper?*
    - *Does your anaesthetic chart (paper or electronic) have a dedicated space for the recording of information relating to the use of neuromuscular monitoring?*
    - *If your anaesthetic chart is electronic, do the results of neuromuscular monitoring automatically feed in to the anaesthetic record?*
    - *What is the availability of sugammadex within your trust?*
    - *What is the total number of anaesthetic personnel within your department? This will be used as a denominator to produce a survey response rate to the opinion and knowledge survey which will be publicised separately.*

Theatre and equipment breakdown

To better understand the provision of neuromuscular monitoring equipment this section of the survey investigates the separate geographic locations where neuromuscular blocking drugs can be given and the number of operating theatres at each location. For each of these locations you will need to provide a breakdown of available neuromuscular monitors.

Which theatres are we interested in?

We would like to include any theatre where it is expected patients will receive neuromuscular blockade. In addition to general theatres, this would also include, for example, maternity theatres as an anaesthetic involving neuromuscular blockade is given there on a regular basis. You should not however include, for example, a procedure room in which only local or regional anaesthesia is used.

What do we mean by 'locations'?

We will ask how many different geographically distinct theatre groups there are at your trust in which it would be reasonable for neuromuscular monitoring equipment to be shared. For example, two groups of adjoining theatres could be considered as one location. A group of theatres in an entirely separate building which would make the sharing of neuromuscular monitors impractical would be considered as a separate location. An entirely separate site also operated by your trust would similarly be counted as a separate location. Questions will be asked about monitoring provision for each separate location.

For example:

A trust has 3 areas of the hospital with operating theatres which regularly use neuromuscular blocking drugs. They are far enough away from each other that the sharing of neuromuscular monitoring is not possible. These would be given the description of...

Descriptor for location 1: Main theatres

Descriptor for location 2: Maternity theatres

Descriptor for location 3: Day surgery

- *How many locations would you like to include in this survey?*
- *Location 1*
    - *What would you like to use as a descriptor for this location? e.g main theatres, day surgery, maternity*
    - *How many theatres where neuromuscular blocking drugs may be given are in this location?*
    - *How many qualitative nerve stimulators are available at this location?*
    - *What types of quantitative neuromuscular monitors are available at this location? If the neuromuscular monitors at this location can perform more than one type of monitoring then please tick all boxes that apply*
    - *How many quantitative neuromuscular monitors are available at this location?*

6.2 Anaesthetist survey

The following questions will be asked in the anaesthetist survey:

- Demographics
    - Which hospital/trust are you currently based at?
    - What is your professional background?
- Neuromuscular monitoring practice
    - In what proportion of cases do you use qualitative neuromuscular monitoring (i.e peripheral nerve stimulator with visual or tactile assessment of response) when neuromuscular blockers are used?
    - How often do you document use of neuromuscular monitoring and monitoring results?
    - When did you last receive teaching or undergo self-education about neuromuscular monitoring?
    - If using sugammadex for reversal, how does this influence your decision to use neuromuscular monitoring?
    - Do you have access to quantitative neuromuscular monitoring (e.g acceleromyography, electromyography) in your primary place of work?
- Quantitative neuromuscular monitoring (available)
    - What is your preferred method of neuromuscular monitoring?
    - In what proportion of cases do you use quantitative neuromuscular monitoring (e.g acceleromyography, electromyography) when neuromuscular blockers are used?
    - At which points during anaesthesia do you utilise quantitative neuromuscular monitoring? Please tick all that apply
    - How confident are you in the use of quantitative neuromuscular monitors (e.g acceleromyography, electromyography)?
    - What would increase your use of quantitative neuromuscular monitors? Please choose all that are applicable
    - Are there any other barriers that you see to wider, more regular adoption of quantitative neuromuscular monitoring?
- Quantitative neuromuscular monitoring (not available)
    - How confident are you in the use of quantitative neuromuscular monitors (e.g acceleromyography, electromyography)?
    - Would you like to see quantitative neuromuscular monitors introduced to your department?

- Quantitative neuromuscular monitoring - would like to see monitor introduction.
    - You have answered that you would like to see quantitative neuromuscular monitors introduced to your department - please tick any of the reasons below for why this might be or provide your own reason as 'other'
- Quantitative neuromuscular monitoring - would not like to see monitor introduction.
    - You have answered that you would not like to see quantitative neuromuscular monitors introduced to your department - please tick any of the reasons below for why this might be or provide your own reason as 'other'
- Neuromuscular monitoring opinions
    - Residual neuromuscular blockade is an important clinical problem
    - Clinical tests are adequate to exclude the presence of postoperative residual neuromuscular blockade
    - Neuromuscular monitors should be used in all cases where neuromuscular blockers are used
    - QUANTITATIVE neuromuscular monitoring (e.g acceleromyography, electromyography) should be used for all patients where neuromuscular blockade is used
    - What is the current national and international recommendation for monitoring neuromuscular blockade

6.3 Audit proforma

Neuromuscular monitoring in the East of England (NEMOE)

Audit data collection proforma

Inclusion criteria to audit:

- Age equal to or greater than 18.
- Received neuromuscular blocking agent during their anaesthetic.

Please complete both pages of this proforma. When completed return it to your project site lead.

DEMOGRAPHICS:

MRN/NHS number:				Age (years):	
ASA grade:		Weight (kg):		Approximate anaesthetic duration (minutes) :	
Operation:				Specialty:	
Urgency:	Immediate ☐	Urgent ☐	Expedited ☐	Elective ☐	
Primary mode of anaesthesia:	TIVA ☐		Inhalational ☐		
Grade of anaesthetist responsible for decisions around neuromuscular blockade, monitoring and reversal:					

NEUROMUSCULAR BLOCKING AGENTS:

Please include the name and total dose of neuromuscular blocking agent administered

Drug:	Total Dose (mg):

NEUROMUSCULAR BLOCKADE REVERSAL:

Please include the total dose given. Tick here if NO neuromuscular blockade reversal was given: ☐

Drug:	Total Dose (mg):
Sugammadex	
Neostigmine	

CASES WHERE NO NEUROMUSCULAR MONITORING WAS USED:

Please tick here if NO neuromuscular monitoring was used in this case: ☐

Which clinical tests were used to assess adequacy of neuromuscular blockade reversal? (tick all that apply)

Head lift ☐	Hand grip ☐	Sustained bite ☐	Tidal volume ☐	None ☐	Other:

If neuromuscular monitoring was not used, was there any reason given why not?

Please turn over for further questions

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NEMOE

Neuromuscular monitoring in the East of England (NEMOE)

Audit data collection proforma

QUALITATIVE Neuromuscular Monitoring

1. Was QUALITATIVE neuromuscular monitoring used in this case? YES ☐ NO ☐
   If no, please ignore the rest of this box.
2. At which points during the case was QUALITATIVE neuromuscular monitoring used? Tick all that apply

Before neuromuscular blockade	Intra-operatively	Pre-reversal	Post-reversal	End of case where no reversal used
☐	☐	☐	☐	☐

3. Was the use and outcomes of the QUALITATIVE neuromuscular monitoring documented?

Fully documented	☐	Partially documented	☐	Not documented	☐

4. Which location(s) were used for QUALITATIVE neuromuscular monitoring? Tick all that apply

Ulnar nerve (Adductor pollicis muscle)	Facial nerve (Orbicularis oculi /corrugator supercilii muscles)	Other:
☐	☐	

5. Was neuromuscular reversal given? (TOF=Train of four)

YES	
What was the TOF count PRIOR to reversal:	
Not performed: ☐	Not documented: ☐
What was the TOF count AFTER reversal:	
Not performed: ☐	Not documented: ☐

NO	
What was the TOF count at end of anaesthesia:	
Not performed: ☐	Not documented: ☐

QUANTITATIVE Neuromuscular Monitoring

1. Was QUANTITATIVE neuromuscular monitoring used in this case? YES ☐ NO ☐
   If no, please ignore the rest of this box.
2. What type of QUANTITATIVE monitoring was used? Tick all that apply (see protocol for summary if unsure)

Acceleromyography (AMG)	☐	Electromyography (EMG)	☐	Kinemyography (KMG)	☐

3. At which points during the case was QUANTITATIVE neuromuscular monitoring used? Tick all that apply

Before neuromuscular blockade	Intra-operatively	Pre-reversal	Post-reversal	End of case where no reversal used
☐	☐	☐	☐	☐

4. Was the use and outcomes of the QUANTITATIVE neuromuscular monitoring documented?

Fully documented	☐	Partially documented	☐	Not documented	☐

5. Was neuromuscular reversal given? (TOF=Train of four)

YES	
What was the TOF ratio PRIOR to reversal (%):	
Not performed: ☐	Not documented: ☐
What was the TOF ratio AFTER reversal (%):	
Not performed: ☐	Not documented: ☐

NO	
What was the TOF ratio at end of anaesthesia (%):	
Not performed: ☐	Not documented: ☐

6.4 Exemplar clinical governance form

Title: Neuromuscular monitoring in the East of England

Category: Local/regional

Type of audit: Initial

Start of audit: 01/2025

Estimated completion of audit: 02/2025

1.To identify barriers to wider adoption of quantitative neuromuscular monitoring.

2.To audit current practice of neuromuscular monitoring.

Standards:

‘Use a quantitative neuromuscular blockade monitor whenever neuromuscular blocking (NMB) drugs are administered. This includes before induction, throughout anaesthesia, and until the train-of-four ratio is greater than 0.9.’

Standards source:

Association of Anaesthetists' 2021 guidelines for standards of monitoring

Audit being carried out in response to:

National audit project 7

Data collected from: Inpatients

Division: Surgery and anaesthetics

Specialty: Anaesthesia

6.5 Example publicity message

An example message to engage collaborators is shown below:

Hello all,

As your East of England Anaesthetics Trainee Research Network (EASTRN) local Rep I have an exciting project for you to contribute to in the week starting:

Why should you contribute to this project?

a. *It is an opportunity to contribute to a regional project*
b. *You will be given evidence to support your research and QI Halo*
c. *All the materials for data collection have already been prepared*
d. *The results will be presented widely and hopefully improve patient care*

What does it involve?

Neuromuscular monitoring in the East of England (NEMOE) is a trainee network project investigating practice surrounding neuromuscular monitoring.

There will be 3 parts which you will be able to contribute to:

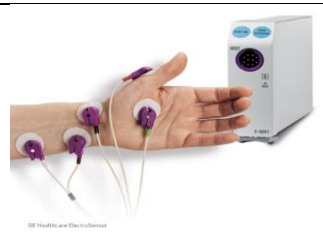
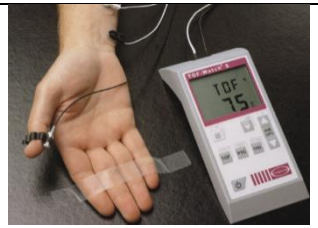
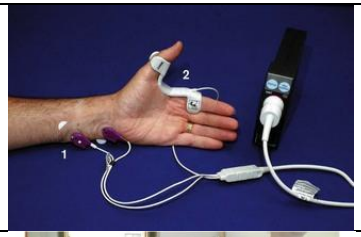
1. A single site questionnaire where we will be assessing the provision of neuromuscular monitoring.

2. A theatre audit looking at use of neuromuscular blockade, monitoring and reversal across a 5 day period. Inclusion criteria will be adult patients receiving neuromuscular blocking drugs.

3. A staff survey investigating anaesthetists' thoughts and opinions on neuromuscular blockade and monitoring best practice.

Please let me know if you have any questions or wish to get involved!

6.5 Quantitative neuromuscular monitoring summary

Type of quantitative monitor	Image	Sensor	Measures	Advantages	Disadvantages	Devices for clinical use
Electromyography		Electrodes	Measures compound muscle action potential	- Movement of muscle is not required. - Can be used on many muscle groups	- May be affected by electronic devices and diathermy	Datex-Ohmeda NMT ElectroSensor
Acceleromyopgraphy		Piezoelectric crystal	Acceleration of digit	- Easy to use - Most widely used internationally	- Potential for train of four ratio overestimation and baseline ratios >1 - Free movement of muscle required	Classic AMG: TOF-Watch InfinityTrident NMT Pod 3D AMG: STIMPOD TOFscan
Kinemyography		Piezoelectric crystal	Movement of digit (which generates voltage in the sensor)	- Easy to use	- Free movement of muscle required	Datex-Ohmeda NMT MechanoSensor
Mechanomyography		Force transducer	Force of contraction	- Precise - Gold laboratory standard	- Not used in clinical setting	None