

LUMBAR PUNCTURE

PRACTICE GUIDELINE[®]

DOCUMENT SUMMARY/KEY POINTS

- A lumbar puncture (LP) is a procedure whereby a needle with a stylet is introduced into the lumbar subarachnoid space in order to obtain a specimen of cerebrospinal fluid (CSF).
- LP may be contraindicated if raised intracranial pressure (ICP) is suspected because of significantly altered level of consciousness, focal neurological signs, bulging fontanelle or papilloedema. In such cases a brain imaging scan should be considered first to rule out a space occupying lesion causing the raised ICP.
- The presence of a bulging fontanelle or papilloedema may be suggestive of significantly raised intracranial pressure. If a lumbar puncture is performed in this situation, there is a risk of brain herniation which may lead to significant neurological sequelae or even death. The safety of LP should be considered and discussed by the treating team. If unsure, an LP should be deferred for further consideration.
- The exception to the above point would be children with idiopathic intracranial hypertension. In this patient group LP is both diagnostic and therapeutic.
- Administration of nitrous oxide is known to increase cerebral blood flow and therefore increase intracranial pressure. It may be important to consider this if the only purpose of the lumbar puncture is to measure intracranial pressure.
- It is important for CSF specimens to be transported to pathology as soon as they are collected.
- Body fluids (CSF and blood) are potential biohazards. Staff at risk of splash exposure should wear appropriate PPE during the procedure.
- For information on interpretation of CSF results please refer to [Infants and Children: Acute Management of Bacterial Meningitis: Clinical Practice Guideline](#)

This document reflects what is currently regarded as safe practice. However, as in any clinical situation, there may be factors which cannot be covered by a single set of guidelines. This document does not replace the need for the application of clinical judgement to each individual presentation.

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|------------------------|--|-----------------------------------|
| Approved by: | SCHN Policy, Procedure and Guideline Committee | |
| Date Effective: | 1 st January 2019 | Review Period: 3 years |
| Team Leader: | Clinical Nurse Consultant | Area/Dept: Neurology (CHW) |

CHANGE SUMMARY

- Early stylet removal technique in infants has been included
- LP training is now available via HITE online learning site
- Network document

READ ACKNOWLEDGEMENT

- **Training:** Medical officers performing this procedure should have observed the procedure performed by a senior clinician and had direct supervision performing the procedure before performing the procedure unsupervised. An eLearning Lumbar Puncture module is available as part of the **SkIP programme** which is available via HITE online learning site <https://www.heti.nsw.gov.au/education-and-training/my-health-learning>
- All clinical staff performing or assisting a lumbar puncture procedure are to read this document and acknowledge they understand the contents.

TABLE OF CONTENTS

| | | |
|----------|---------------------------------------|-----------|
| 1 | General Principles | 3 |
| 2 | Special Precautions..... | 3 |
| 3 | Lumbar Puncture Procedure..... | 4 |
| 3.1 | Team Time Out..... | 4 |
| 3.2 | Equipment Required | 5 |
| 3.3 | Preparation | 5 |
| 3.4 | Pain management..... | 5 |
| 3.5 | Procedure | 6 |
| 3.6 | Post Procedure Effects and Care..... | 10 |
| 3.7 | Troubleshooting | 10 |
| | <i>Encountering bone.....</i> | <i>10</i> |
| | <i>Poor CSF flow.....</i> | <i>11</i> |
| | <i>Traumatic /bloody tap</i> | <i>11</i> |
| 3.8 | Parent/Carer Education | 11 |
| 4 | References | 11 |

1 General Principles

A lumbar puncture is a procedure whereby a needle with a stylet is introduced into the lumbar cistern of the subarachnoid space. [The term may also be used to describe accessing the epidural space for spinal anaesthesia]. The spinal cord terminates at the level of L1- L2, and in order to prevent damage to the spinal cord the needle is introduced at the level of L3 - L4 or L4 - L5.

Indications for lumbar punctures are:

- To collect a specimen of cerebrospinal fluid (CSF) for diagnostic studies. (microbiologic, serologic, cytologic or chemical analysis). E.g. febrile unwell patient with suspected or possible meningitis.
- To obtain a measurement of the CSF pressure.
- To evaluate CSF flow dynamics and pressure
- Intracranial pressure monitoring
- Administration of intrathecal medications. (e.g. antibiotics and cancer chemotherapy).

2 Special Precautions

- Lumbar puncture is contraindicated in children who are shocked or significantly unwell as they may not tolerate the procedure. See also indications to delay LP in the NSW Meningitis Clinical Practice Guideline.
https://www1.health.nsw.gov.au/pds/Pages/doc.aspx?dn=GL2014_013
- Performance of a lumbar puncture when a child is suspected of having raised intracranial pressure may be contraindicated. Neuroimaging should be considered for any child with papilloedema, significantly altered conscious level or focal neurologic signs prior to lumbar puncture. The presence of a bulging fontanelle or papilloedema most likely indicates significantly raised intracranial pressure. However be aware that the absence of papilloedema does not rule out significant raised intracranial pressure. If a lumbar puncture is performed in the presence of papilloedema there is a risk of brain herniation which leads to significant neurological sequelae or even death. The exception to this is children with idiopathic intracranial hypertension, a diagnosis that must not be made until other causes of raised intracranial pressure are excluded.
- Significantly altered conscious level and/or the presence of new neurological signs such as pupil abnormality may also indicate increased intracranial pressure. The presence of any cutaneous or osseous infection at the LP site including lesions of meningococcaemia is a contraindication to lumbar puncture. This is due to the risk of infection spreading to the CSF.
- Unless the benefits outweigh the risks, lumbar puncture should not be performed in the child who is receiving anticoagulant therapy or has other coagulation defects e.g. thrombocytopenia. **NB:** Although rare, these patients are at risk of epidural, subdural and subarachnoid haemorrhage.

- Administration of nitrous oxide is known to increase cerebral blood flow and therefore increase intracranial pressure. It may be important to consider this if the only purpose of the lumbar puncture is to measure intracranial pressure.

3 Lumbar Puncture Procedure

Note 1: An eLearning Lumbar Puncture module is available as part of the **SKIP programme** available via HITE online learning site <https://www.heti.nsw.gov.au/education-and-training/my-health-learning>

Note 2: When performing a lumbar puncture hand hygiene and aseptic non touch technique principles must be adhered to^{8,9}. (Hand Hygiene training is available via HETI on line site <https://www.heti.nsw.gov.au/education-and-training/my-health-learning>) “*The aim of aseptic non touch technique is to prevent the transmission of micro-organisms to wounds or susceptible sites, to reduce the risk of infection.*”¹

- Aseptic non touch technique refers to the identification of ‘key parts’ by not touching them either directly or indirectly. This is the single most important step in achieving asepsis².
- Key parts refer to the parts that if contaminated with micro-organisms increase the risk of infection.
- Aseptic non touch technique is achieved by using sterile equipment and ensuring that the sterile component of the product does not come into contact with a non-sterile surface.³
- Aseptic technique includes performing hand hygiene at the following times:
 - *prior* to setting up for the procedure and
 - *prior* to application of non-sterile/sterile gloves⁴ and
 - At completion of procedure

3.1 Team Time Out

As a Level 2 or 3 Procedure as noted in the Ministry of Health “Clinical Procedure Safety” Policy Directive⁶, the team must STOP and confirm the following prior to the procedure:

- i. Proceduralist and assistant/s introduce themselves to the patient/parents/carers.
- ii. Written consent⁷ must be obtained by the Medical Officer if procedure is performed under sedation or general anaesthetic.
- iii. Patient’s identification.
- iv. Positioning of the patient.
- v. Essential imaging is available (if necessary)
- vi. Allergy / adverse reaction check
- vii. Special medications have been given
- viii. Implants and special equipment (if any)
- ix. Consider anticipated critical events

3.2 Equipment Required

- Sterile gloves and surgical mask¹
- Lumbar puncture equipment needed includes manometer, dressing pack, aperture drape, 3 way tap, 2mL syringe, 25G needle, 22G spinal needle with stylet, CSF tubes and adhesive dressing. *(Some units across the network have this equipment already prepared in 'lumbar puncture kits').*
- Appropriate size lumbar puncture needle. Match the length of the needle to the depth of subcutaneous tissue at the injection site. For Neonates/newborns, use 25Gx25 mm.
- Injectable local anaesthetic: for neonates or children - Lignocaine 1% [50mg/5mL], maximum dose 4.5mg/kg/dose. For neonates, consideration can be given to using oral sucrose instead of injectable local anaesthetic. **See Sucrose: Management of Short Duration Procedural Pain in infants Practice Guideline**
<http://webapps.schn.health.nsw.gov.au/epolicy/policy/4022>
- Alcoholic chlorhexidine 0.5% in 70% alcohol (or *aqueous* chlorhexidine for neonates)
- CSF tubes
- Topical anaesthetic cream (eg LMX 4 or Emla) [to be applied at least 30 minutes prior to the procedure in children older than newborns if time permits].
- Clear occlusive dressing.
- Sedation/analgesia as determined by Medical Officer.

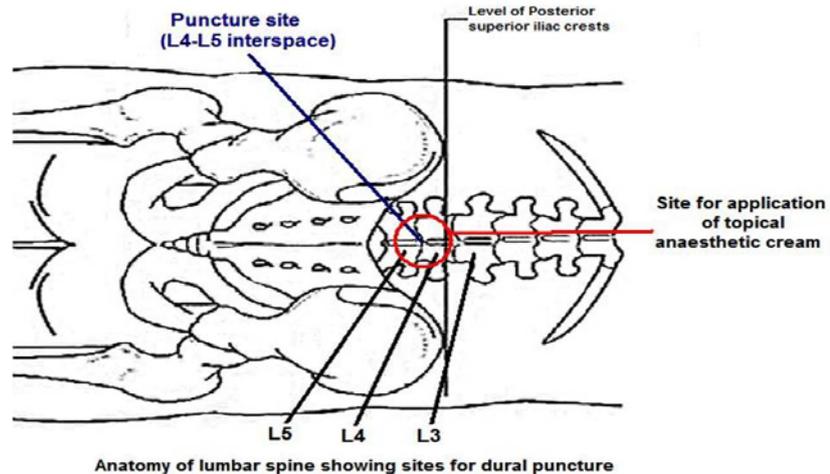
3.3 Preparation

- Ensure privacy is maintained.
- Ensure the Procedure has been fully explained to the parents/carers and the child as appropriate. In addition, provide them with the **SCHN Lumbar Puncture Fact Sheet**.
https://www.schn.health.nsw.gov.au/files/factsheets/lumbar_puncture-en.pdf
Parent/carer's involvement should be encouraged and are permitted to remain with the child where appropriate.

3.4 Pain management

- Apply topical anaesthetic cream to the LP region between the 3rd and 5th lumbar vertebrae half an hour prior to procedure in children, if time permits.
(refer to **Picture 1** and local guidelines for administering Topical Anaesthetic Agents)

Picture 1



- In order to assist with the minimisation of procedural pain in infants, sucrose may be administered. Refer to [Sucrose: Management of Short Procedural Pain in Infants Practice Guideline](http://webapps.schn.health.nsw.gov.au/epolicy/policy/4022). <http://webapps.schn.health.nsw.gov.au/epolicy/policy/4022>
- Medical Officer (MO) assesses prior to commencement regarding the need for sedation. Sedation must be ordered by the MO prior to use (if required). See **Procedural Sedation (paediatric Ward Clinic & Imaging Areas)** <http://webapps.schn.health.nsw.gov.au/epolicy/policy/4358>
- If an accredited nurse is not available and if necessary, the pain team should be consulted for use of nitrous oxide on the ward if appropriate (noting that nitrous oxide is known to increase cerebral blood flow thereby increasing intracranial pressure). If a patient is having nitrous for the LP they must be fasted for minimum of 2 hours and longer if other sedation is going to be used. Refer to Procedural Sedation (Paediatric Ward, Clinic and Imaging Areas) Procedure Practice Guideline link above
- Consider the assistance of Child Life therapist (if available) to assist with explanation of the procedure and distraction techniques during the procedure.

3.5 Procedure

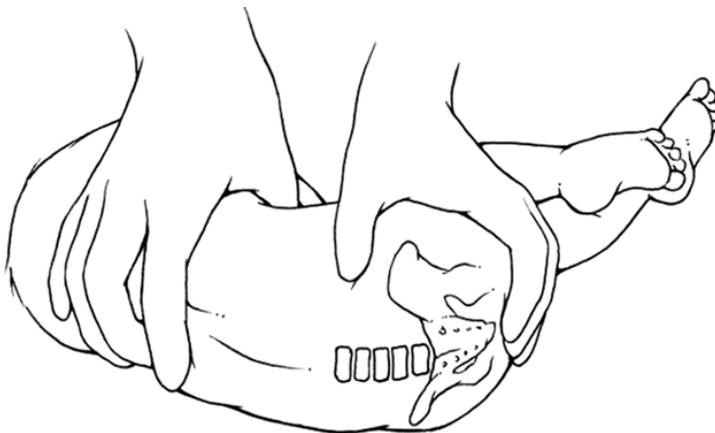
Hand hygiene and aseptic non-touch technique principles must be adhered to.

1. Assistant washes hands for one minute and prepares trolley and equipment (refer to [Hand Hygiene Policy](http://webapps.schn.health.nsw.gov.au/epolicy/policy/4305) <http://webapps.schn.health.nsw.gov.au/epolicy/policy/4305>)
2. Medical officer dons surgical mask, washes hands for three minutes and dons gloves in approved manner.
3. Assistant removes the clear occlusive dressing and wipes away the residual topical anaesthetic cream from the child's skin. The medical officer then prepares the skin at the site with alcoholic chlorhexidine 0.5%.
4. The aperture drape is placed over the site.

5. Positioning the patient:

- **Infants:** refer to Picture 2 and note the following:
 - i. Avoid over flexing of neck as can lead to respiratory compromise.
 - ii. Avoid pushing down on back of head as this will upset the baby who will arch backwards. The baby will then be out of the correct position for this to be a successful tap.
 - iii. The risk of there being trauma to site and or spine will also increase if needle is insitu when baby moves/wriggles etc.

Picture 2



Another position that can be used is sitting the infant up (see Picture 3). This position should not be used if needing to measure ICP.

Picture 3

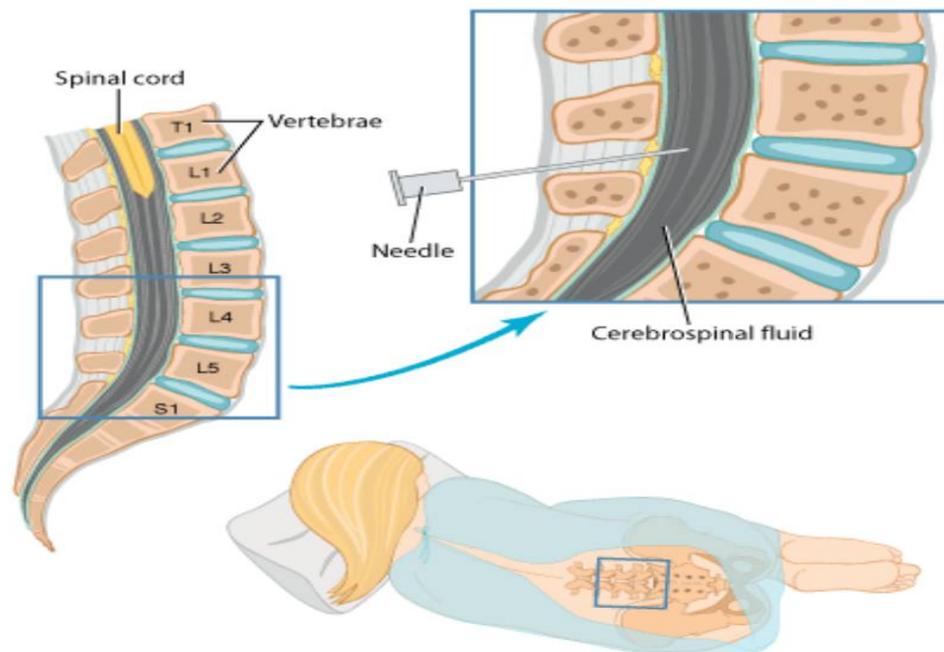


- **Child:** Assistant positions child in the lateral recumbent position with hips and knees flexed and drawn up towards their chin, and their head flexed towards their knees.

Gentle assistance is required to restrain the child's arms. Positioning in this way facilitates access to the lumbar subarachnoid space and minimises the child's movement throughout the procedure.

NB: The degree of restraint and flexed positioning required for an infant will be less than in the older child. In addition to this it is sometimes necessary to alter the child's position slightly during the procedure in order to facilitate the drainage of CSF.

Picture 4



6. Local anaesthetic injection is checked and the appropriate dosage administered to the skin at the site. *Remove antiseptic solution from set-up prior to preparing medication for injection into spine.* [[MoH Safety Notice 010/10](#)]
7. The medical officer identifies the correct site at L3 - L4 or L4 - L5 (see picture 4 above).
8. Ensure the child is correctly positioned and the local anaesthetic has had adequate time to take effect.
9. The medical officer selects appropriate lumbar puncture needle size. Grasping spinal needle with bevel facing upwards. Ensure that the patient's back is perpendicular to the bed.

Use the following table to guide choice of length of spinal needle

| Size of Needle (length) | Height of child | Approx age of child |
|-------------------------|-----------------|---------------------|
| 2cm | <50cm | Pre-term neonates |
| 3cm | 50-80cm | <2yo |
| 4cm | 80-120cm | 2-5yo |
| 5cm | 120-150cm | 5-12yo |
| 6cm | 150-180cm | >12yo |

Insertion distance has been correlated with height of child, and is approximately equal to $0.03 \times \text{height (cm)}$.

10. Insert the needle slowly through the skin in to the subarachnoid space, aiming towards the umbilicus.
11. Leave the stylet in situ while traversing epidermis and subcutaneous fat.
12. In infants, gently remove it before it passes through the dura into the subarachnoid space, and continue advancing the needle slowly until CSF flows back. In older children, continue advancing the needle until there is decreased resistance or the needle has been inserted half its length. The stylet is then gently removed and the presence of CSF indicates correct placement. **CAUTION:** The distance for entry into the theca in infants and particularly neonates is extremely small so the needle must be advanced very slowly (millimetre by millimetre) in order to avoid a traumatic tap
13. If no CSF is present consider reassessing patient position and recommence procedure.

NB: A stylet should always be used to prevent the rare occurrence of a spinal epidermoid tumour.

NB: If the first attempt in obtaining CSF is unsuccessful, a second attempt can be made. If that second attempt is unsuccessful, consult a senior colleague for further advice as to the need for pursuing the test. Following this, the procedure should either be abandoned or another skilful operator (e.g. anaesthetist) is called.

14. In certain cases CSF pressure will need to be measured. CSF pressure is measured with the manometer. For the purposes of accurately measuring CSF pressure, the flexed position needs to be relaxed temporarily by extending the child's legs. In addition to this it is important to ensure that the distal end of the manometer is open to the atmosphere. NB: Administration of nitrous oxide is known to increase cerebral blood flow and therefore increase intracranial pressure. It may be important to consider this if the only purpose of the lumbar puncture is to measure intracranial pressure.
15. The CSF specimen is collected by holding the collection tube/s under the needle until a sufficient amount has dripped in (0.5 – 1.0mL) OR the intrathecal medication is administered. A paired blood glucose level should be collected e.g. suspected glut1 deficiency, CNS infection.

Due to sample volume constraints, if CSF Oligoclonal bands are ordered, the laboratory requires an absolute minimum of 0.5 ml collected into an additional 10ml black top CSF collection tube.

N.B. *If assistant is to hold specimen tube/s during collection, they should be wearing appropriate P.P.E. (surgical mask and glove/s).*

16. The specimen is labelled, placed in a biohazard bag and sent to pathology immediately. CSF collected for genetic/metabolic studies needs to be placed on ice and transported immediately to pathology.
17. In order to minimise the risk of post lumbar puncture headache, the stylet is reintroduced prior to withdrawal of the lumbar puncture needle. The lumbar puncture needle is then withdrawn in one quick motion and pressure applied to the site for at least one minute and an adhesive dressing (e.g. Band-Aid or Cutifilm dressing) is then applied.
18. If nitrous oxide has been used it is then discontinued.
19. The drape is removed.
20. Equipment is disposed of appropriately. Refer to: **Waste Management Policy**
<http://webapps.schn.health.nsw.gov.au/epolicy/policy/3649>
 - **NETS team:** adhere to local policy when at other NSW hospitals as advised by local staff.
21. Document in patient's health care record the name of procedure and *where relevant*, advice for clinical handover; equipment problems/issues and or incident/s and notify in IIMS.

3.6 Post Procedure Effects and Care

- Following the procedure bed rest is not required and the child may mobilise as desired.
- **Headache post-LP:** This is best managed with mild analgesia and allowing the child to rest as indicated by the degree of discomfort the child may experience. If the headache becomes severe or persists, the child may need medical review.
- **Leakage of CSF at the LP site may occur:** This is best managed by lying the child down and applying pressure to the site with a sterile piece of gauze. If the leakage persists the child will require medical review.
- **Infection** may occur as a result of the procedure or due to a CSF leak. If the child becomes unwell and/or develops a fever, medical review is required.
- **Tenderness at the LP site** and/or nerve root irritation may occur. This may be managed with mild analgesia and rest as required.

3.7 Troubleshooting

Encountering bone

- If there is firm resistance to advancement of the needle, bone may have been encountered. Review landmarks and consider partially withdrawing the needle and re-advancing in a more cranial or caudal direction. Ensure the needle is inserted in the midline perpendicular to the plane of the back.

Poor CSF flow

- If CSF flow is poor, this may be aided by gentle rotation of the lumbar puncture needle.

Traumatic /bloody tap

- If blood is obtained (not blood stained CSF), withdraw the lumbar puncture needle and prepare for another attempt with a new needle. Blood stained CSF is still useful for culture/PCR and will generally clear from the first tube to later tubes. Consider a subarachnoid haemorrhage as causing blood in the CSF if clinically appropriate. This can be confirmed by the presence of xanthochromia after the CSF is centrifuged.
- If unsuccessful, discourage multiple attempts and request senior medical review.

3.8 Parent/Carer Education

- Discuss the Procedure and the post-procedure effects with the parents/carers and the child as appropriate. Provide them with the [SCHN Lumbar Puncture Factsheet](https://www.schn.health.nsw.gov.au/files/factsheets/lumbar_puncture-en.pdf).
https://www.schn.health.nsw.gov.au/files/factsheets/lumbar_puncture-en.pdf
- Prepare the family or caregiver with strategies to manage the abovementioned potential side effects in the home environment.

4 References

1. Preston RM. Aseptic Technique: Evidence-based Approach for Patient Safety. *Br J Nurs*. 2005 May 26 – June 8; 14(10): 540-2, 544-6.
2. Rowley S, Responsibility. A safe and efficient handling technique for IV therapy & other clinical procedures. United Bristol Healthcare Trust.
3. Hart S. Using an aseptic technique to reduce the risk of infection. *Nursing Standard*. 2007; 21(47):43-48.
4. Hemsworth S, Selwood K, van Saene R, Pizer B. Does the number of exogenous infections increase in paediatric oncology patients when sterile surgical gloves are not worn for accessing Central Venous Access Devices? *Euro J Oncol Nurs*. 2007; 11:442 – 447
5. Center for Disease Control and Prevention (CDC) Clinical Reminder: Spinal Injection Procedures Performed without a Facemask Pose Risk for Bacterial Meningitis. October 2011.
<http://www.cdc.gov/injectionsafety/spinalinjection-meningitis.html> {accessed 26/2/2014}.
6. NSW MoH Policy Directive Clinical Procedure Safety (20 October 2014)
http://www1.health.nsw.gov.au/pds/ActivePDSDocuments/PD2014_036.pdf
7. NSW MoH Policy Directive Consent to Medical Treatment - Patient Information [PD2005_406]:
<http://chw.schn.health.nsw.gov.au/o/documents/policies/policies/2013-9025.pdf>
8. Scott M, Stones J, Payne N. Antiseptic solutions for central neuraxial blockade: which concentration of chlorhexidine in alcohol should we use? *Br J Anaesth*. 2009 Sep;103(3):456.
9. Hebl JR. The importance and implications of aseptic techniques during regional anesthesia. *Reg Anesth Pain Med*. 2006;31(4):311
10. Baxter: (Baxter A et al. Local anaesthetic and stylet styles: factors associated with resident lumbar puncture success. *Pediatrics* 2006; 117: 876-881)
11. Nigrovic (Nigrovic L et al. Risk Factors for Traumatic or Unsuccessful Lumbar Puncture in Children. *Annals of Emerg Med* 2007; 49:762-771)

Background readings

- Cullery, D.J. et al. Nitrous Oxide in Neuro anesthesia Tried and True or Toxin? *Anesthesiology*. 2008;108 (4); 553-554.
- Ebinger, F. et al. Strict bed rest following lumbar puncture in children and adolescents is of no benefit. *Neurology*. 2004; 62(6):1003-1005.

- Ellis, J.A., Villeneuve, et al. Pain Management Practices for Lumbar Punctures: Are We Consistent? *Journal of Pediatric Nursing*. 2007; vol. 22 (6): pp. 479-487.
- Hanson, A.L. Ros, Simon, and Soprano, Joyce. Analysis of Infant Lumbar Puncture Success Rates, *Sitting Flexed Versus Lateral Flexed Positions*. *Pediatric Emergency Care*. 2014 Vol 30 (5): pp 311-314
- Khanh Dao Le, Long Lumbar Puncture: Clinician information. Best Practice: Evidence based Information Sheets The Joanna Briggs Institute Evidence Summary. January 2018.
https://tdnet-fulltext.s3.amazonaws.com/1000/GDID_19078_BDID_19078.pdf?AWSAccessKeyId=ASIAICEYA2ZVS67KJP5Q&Expires=1526511696&x-amz-security- (Accessed 17th May 2018)
- Lippincott, Williams and Wilkins. *Manual of Nursing Practice*. 2010; pp 484-485
- McGregor, D.G. et al. Effect of Nitrous oxide on neurologic Function after Intracranial Aneurysm Surgery. *Anesthesiology*. 2008; 108(4); 568 – 579.
- Royal Children's Hospital clinical practice guidelines (accessed May 2018)
- Schulga, P., Grattan, Rosemary, Napier, Craig, and Babiker, Mohamed, O.E. How to use ...lumbar puncture in children. *BMJ Arch Dis Child Educ Pract Ed*. 2015 Oct;100(5):264-71. {accessed 23/05/2018}
- Straus, S.E., et al. How Do I Perform a Lumbar Puncture and Analyze the Results to Diagnose Bacterial Meningitis? *Journal of the American Medical Association*. 2006; 296(16);2012-2022.
- Teece, S., Crawford, I. Bed rest after lumbar puncture. *Emergency Medicine Journal*. 2002; 19(5):432-433.
- Williams, J., et al. Diagnostic lumbar puncture: minimizing complications. *Internal Medicine Journal*. 2008; 38; 587-591.
- Yeong, Chee Cheen and Craig, Simon S. Paediatric lumbar punctures: How di paediatrics and emergency doctor differ? *Emergency Medicine Australasia*. 2017; 29 330-335.

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