Evidence Table:

Reference *(include title, author, journal title, year of publication, volume and issue, pages)*	**Evidence level (I-VII)**	**Methods, key findings, outcomes or recommendations**	**Critical Appraisal of the Evidence** *(consider study design and scope, methodological strengths and weaknesses etc)*

Roberts, A., Shaw, A., Boomsma, S.E., & Cameron, C.D. (2015). *Effect of casting material on the cast pressure after sequential cast splitting, 37* (1), 74-77.	III Experimental study with mixed design analysis of variance	• Cast immobilization can cause complications that include joint stiffness from prolonged immobilization, pressure sores and skin breakdown, thermal injury from cast placement, cast saw burns sustained during removal, and compartment syndrome. • tight bandaging has the potential to cause prolonged blockage in arterial flow, resulting in ischemia and contracture • A 75% pressure decrease occurred with the cotton padding group following cast bivalve, with an additional 10% decrease after the padding was released. • The decrease in pressure after releasing the cast padding was more significant for the synthetic (20%) and waterproof padding groups (25%). • The application of a loose elastic bandage after complete release of the cast elevated the cast pressure to a point that was significantly higher than the cast pressures after cutting the cast padding. • The degree of pressure elevation varied based upon padding type with synthetic and waterproof cast padding groups demonstrating higher pressures than the cotton padding groups. • Although compartment syndrome is relatively rare, it is a serious complication that should be considered in all populations, especially those who are unable to alert the care provider.	**Strengths** • Use of human volunteers • Results are like those of previous studies • The authors report that no other studies have investigated the effect of different types of cast padding to cast pressures in comparison with cotton padding. **Limitations** • experimental methods. • Results may not be able to be extrapolated to the acutely injured forearm • The experiment does not involve paediatric population • Not specific to hip spicas

Gockley, A., Hennrikus, W., Lavin, S.T., Rzucidlo, S., & Rieghard, C. (2015). Transportation of children in spica casts in the USA. *Journal of Pediatric Orthopedics B, 24* (4), 277-280.	IV	Aim & Method: To report the outcomes of children transported in spica casts in terms of safety and complications, and to report the additional costs associated with a car seat loaner program that adheres to the AAP guidelines. This study was performed at an academic hospital in Pennsylvania and involved a chart review of 52 patients with orthopaedic disorders that required application of a spica cast. Key Points • Pediatric orthopedic patients in spica casts require treatment for their transportation needs. • The American Academy of Pediatrics guidelines use weight as the criteria selection of appropriate restraining device. Key Findings • 18% of patients were transported home by ambulance as they could not be safely restrained in the available car seats or lived in families that did not own a car. • 23% of patients had a delay in discharge due to difficulties arranging safe transportation in the spica cast. • No accidents were reported. • The most common barrier to using appropriate restraints was rental costs. • Parental compliance with recommended car seats/restraints improved with the implementation of a car seat loan program. • Recommendations: implementation of a hospital loaner program for car seats and restraints; hospitals should use a hospital van to transport some children with special needs rather than paying the cost of ambulance transportation; training of multiple medical assistants, nurses, and therapists can reduce a delay in discharge due to lack of available trained therapists to fit car seats (especially over the weekend).	**Strengths** • Initiative can be implemented in other centres. • Compares results to previous studies on a similar topic. **Limitations** • Retrospective study design. • Small sample size. • Focuses on USA car seating laws and regulations. • Reports that no patients from the sample group were in an accident during transportation but this does not prove level of safety/risk the child in the case of an accident.

Horn, P.L., & Badowski, E. (2015). Postoperative Spica Cast Care: RN Comfort-Level Survey Score Improvement After a 30-Minute Educational Video. *Orthopedic Nursing 34,* (6), 334-337.	III Analytical observational study	Method: the development and implementation of an educational tool that would build competence in spica cast care in nurses, thereby reducing skin complications. • Spica casts are used to immobilize paediatric patients who have sustained femur fractures of undergone hip surgery. • Casts usually stay in place for 4-6 weeks. • Improper postoperative care can lead to unplanned, increased morbidity. • A spica cast is applied to part or the entire trunk of the body or part/all of one or more extremities. • Patients <8 years are placed in spica casts for the treatment of femur fractures when there is less than 3cm of shortening. • Bone healing is usually complete in 6-8 weeks. • Most morbidity results from skin injury. • Patients at risk for skin complications include those in inconsistent foster care, inappropriate home care, those who aren't toilet-trained, and transportation issues for follow-up care. • Health-care costs for patients with skin injuries due to hip spicas was significantly higher than for those without skin injuries. • A waterproof tape is used in the groin area and should stay in place for the duration of the cast and replaced only if soiled. • Future research is required to investigate patient education and casting interventions that reduce skin complications. Key findings: • Patients who were found to have a higher incidence of abrasions, macerated skin, rashes, and/or fungal infections, had inappropriately placed waterproof tape and moleskins pieces (petals). • There was a statistically significant improvement in nurses' comfort level with spica cast care post education. • Cast techs in the orthopaedic clinic noted that cast care was consistently appropriate after RN education. • There were no adverse skin events related to spica cast care 5 months after the education project.	**Strengths** • Focuses on nursing education to improve patient care and improve parent education. • Ethically safe • **Weaknesses** • Single centre study • The study only measured nurses comfort level in performing spica care before and after education, rather than formally measuring the occurrence of skin complications. • No control group

McDowell, M., Nguyen,S., & Schlechter, J. (2014). A comparison of various contemporary methods to prevent a wet cast. *Journal of Bone and Joint Surgery American*, 96 (99), 1-5.	IV Experimental study (no human subjects)	Method: An experimental study was performed utilizing casts that were applied in a uniform standardized manner onto a plastic mannequin model. No human subjects were used. The aim of the study was to compare contemporary methods to protect casts from water by assessing effectiveness, costs, and ease of use. Findings suggest that each method tested was effective in preventing most of the water absorption. The double plastic bags with duct tape is the most effective, most user-friendly and most cost-effective way to protect casts from water.	**Strengths** • Low cost experiment. • The study's purpose is to improve patient and family education and patient/family experience • This area has not been studied extensively (lack of available evidence to support current practice). • Good repeatability and reproducibility • Authors suggest directions for future research. **Limitations** • Because movement was kept to a minimum when submerged, the results might not accurately reflect the amount of activity that patients may have. • The assumption of some of the materials (CVS cast protector, Dry Pro cast cover, and elastic rubber bands) being able to function properly for the entire six weeks of cast care. • Also, the use of mannequins instead of human subjects might not be an ideal interface. On the contrary, by using plastic mannequins, water would be absorbed entirely into the cast instead of into human skin, which can retain moisture and causing perspiration to be absorbed in the cotton layer, leading to inaccurate measurements of absorption. • Skin irritation from tape adhesive was also a concern that was not assessed with the experimental design. • Investigator bias was another limitation. Application of casts, protective methods, and analysis of ease of use were done by a single investigator (S.N.), so it is likely that there will be variations in results if done by a large group of users.

Bae, D.S., Valim, C., Connell,P., Brustowicz, K.A., & Waters, P.M. (2017). Bivalved Versus Circumferential Cast Immobilization for Displaced Forearm Fractures: A Randomized Clinical Trial to Assess Efficacy and Safety. *Journal of Pediatric Orthopaedics, 37* (4), 239-246.	II Randomized control trial	Method: • From 2009 to 2011, a randomized clinical trial of all patients presenting to a level 1 pediatric trauma center with displaced forearm fractures was performed. • Skeletally immature children between 4 and 16 years of age with displaced distal or mid-diaphyseal radius and/or ulna fractures requiring CR and cast immobilization were eligible. • subjects were randomized to either bivalved or circumferential casts in a 1:1 ratio; treatment allocation was determined by drawing from prepackaged, sealed envelopes with assignments made based on an age-stratified (4 to 10 y and 11 to 16 y) randomized block design. Outcomes: There were no differences in remanipulation/surgery rates, radiographic LOR, or final radiographic alignment in patients treated with bivalved versus circumferential above-elbow casts. 2 patients required conversion to bivalve casts due to pain and swelling, there were no documented cases of compartment syndrome or permanent neurovascular compromise. The overall rate of cast saw injury was approximately 0.5%. The risk of late displacement and need for remanipulation remains, there are no significant differences in maintenance of reduction, need for surgery, or complications between bivalve or circumferential above-elbow casts. **Implications for guideline:** • immobilization carries the risk of neurovascular compromise and/or compartment syndrome. • With impending or evolving neurovascular compromise, prompt cast removal and surgical fracture stabilization is recommended. • Although neurovascular compromise is rare, the potential functional consequences are considerable. For this reason, bivalving casts after CR of acute fractures has been advocated. • cast saw use on the acutely injured, swollen limb carries a risk of saw burns and thermal injury. • the reduction in compartment syndrome risk with bivalving is assumed but has not been studied. • little to no published information is available regarding the effect of bivalving in pediatric patients treated for acute fractures of the forearm or distal radius.	**Strengths** • randomized control trial • 3-year study period • Good sample size **Limitations** • no subgroup analysis was performed to determine the effect of fracture location or single versus both bone injury on fracture stability • The need for re-manipulation and/or surgery was based upon the judgment of fellowship-trained pediatric orthopaedic surgeons. No objective radiographic criteria were universally utilized to guide decision making. • Did not outline own limitations. • Single centre study. • Not specific to hip spicas

Clarke, S., & McKay, M. (2006). An audit of spica cast guidelines for parents and professionals caring for children with developmental dysplasia of the hip. *Journal of Orthopedic Nursing*, *10*, 128-137.	VI Audit	• An audit of parents and health professional's information on spica cast care specific to children with DDH. • Baseline assessment using audit and questionnaire which can be then used in future to assess efficacy of clinical guidelines. • 73% of parents had to contact the hospital for advice or reassurance • Parents wanted troubleshooting information and general spica cast guidelines following discharge • Both groups needed the leaflet to include pictures **Implications for Guideline**: Both health care professionals and parents need thorough education. An audited guideline which provides specific information regarding spica care for health professionals: • Check the condition of the cast and skin regularly • Change position regularly-2 hourly during the day and 4 hourly overnight until the cast is dry and support with pillows • Nappies should be changed more regularly • The cast should be firm and fit snuggly • When dry a reinforcing layer can be applied. • Eat smaller meals and place patient in upright position	**Strengths** Questionnaires were analysed using SPSS Following the audit a revised booklet was proposed which will follow with a post test- this could then provide health care workers with a standardized leaflet for spica cast guidelines. Good description of group characteristics which is important if the study is to be replicated and compared with implementation of a new guideline. The guideline used was found to be useful by 99% of staff therefore assessment and management guidelines clinically important. Most studies focus on education of parents therefore added focus on education of nurses provides more meaningful implications. **Limitations** Convenience sample of 44 parents and 44 health professionals Did not outline own limitations More detailed questionnaires regarding spica care i.e. how many were soiled, could have allowed greater comparison to follow up on the impact the guideline has in reducing complications and improving care. No discussion of interviewer bias or how they tried to reduce it. Responses from telephone interviews were not clearly transcribed or discussed in the analysis of data. Conclusive statements such as "confirmed to be necessary" were invalidly made Recommendation to develop new guideline very specific to institute and no findings generalized for other nursing areas.

DiFazio, R., Vessey, J., Zurakowski, D., Hresko, M.T., & Matheney, T. (2011). Incidence of skin complications and associated charges in children treated with hip spica casts for femur fractures. *Journal of Pediatric Orthopaedics*, *31(1*), 17-22.	III Retrospective Case control study	• Retrospective study analysing all cases of spica cast placement for femur fractures treated at a major tertiary care children's hospital between 2003-2009 • Final sample included 300 children. • 77 children experienced varying degrees of skin complications. • Of the skin complications; 81.8% caused by soiling, 5.2% by cast pressure, 1.3% foreign object, and 11% had no documented cause. • 24 of these children required a hip spica change in theatre • The median fee for a change of spica cast in theatre was a median 12,719 USD. • Significant predictors of skin complications were identified and included age below 2 years (*P*<0.001), presence of child abuse as the mechanism of injury (*P*<0.001), and spica cast placement >=40 days (median) (*P*=0.03) • Skin complications are associated with significant financial cost • Future research needs to address ways to decrease the incidence of skin complications • Identified that higher risk in younger age associated with lack of toilet training and that parents may therefore benefit from additional teaching on diapering techniques and need to be encouraged to perform frequent diaper changes. **Implications:** Spica cast treatment is associated with many skin complications highlighting the need for strict skin care and toileting during hospitilisation and appropriate parent education	**Strengths** Appropriate design choice Good use of statistical analyses to create meaningful findings. Univariate analysis was used to test association and multivariate statistics were applied to identify predictors of skin complications. Statistical significance was set a priori at 2-tailed *P* value less than 0.05. Case control study- Skin complications vs. no skin complications. Statistical analyses performed using SPSS 18.0 Characteristics are well described and representative of the population which enhances generalizability Strong discussion for implications to practice and good recommendations for practice as well as for further research. **Limitations** Single Centre study Unable to reveal causal relationships Did not discuss limitations to own study. Possibility that preexisting differences may be a plausible alternative explanation for any observed group differences on the dependent variable-no random selection therefore cannot exclude extraneous unknown factors for variance. Not discussed as limitation or discussed in interpreting results Study relies on medical documentation which can be unreliable No consent gained from participants or explanation of consent process or ethical considerations of using health records.

Herman, M.J., Abzug, J.M., Krynetskiy, E.E., & Guzzardo, L.V. (2011). Motor vehicle transportation in hip spica casts: Are our patients safely Restrained? *Journal of Pediatric Orthopaedics, 31(4),* 465-468.	IV Therapeutic study	• 31 children recruited • Concluded that the majority of children in hip spica casts are not safely restrained when traveling in a car. • Of the 31 children only 31% were transported by the method recommended on discharge and therefore 69% were not properly restrained. • Limited financial resources of families were the primary reason for failing to use the correct restraint type. Use of a loan system or financial assistance may improve compliance. • Better parental education is needed to improve compliance **Implications:** Many patients were not being safely restrained highlighting the importance of properly fitting the patient and educating the parents on using the appropriate restraint advised. Loaner programs help improve compliance with appropriate car seating method.	**Strengths** While limited encouraged other institutions to reassess the safety and efficacy of their car seating protocols **Limitations** Limited to the experience of the physiotherapist in fitting the child into the correct restraint. Small sample size limited to those patients being treated in a single urban pediatric hospital. The use of a validated questionnaire may have yielded more significant information that could have helped explain poor compliance further. A table would have illustrated descriptive statistics more effectively. Study identified patients were not being appropriately restrained but had little scope to make any recommendations from their findings.

Newman, D.M., & Fawcett. (1995). Caring for a young child in a body cast: impact on the care giver. *Orthopaedic Nursing, 14(1),* 41-46.	VI Landmark Study; Qualitative descriptive	• Sample size of 30 mothers who were the primary care giver for a child in a hip spica. • Mothers found it impossible to continue usual household, social and community activities without the help of family members. • Mothers reported being "frightened," "tired," and "overwhelmed" • Mothers repeatedly cited the need for more information about caring for their child at home. • Mothers reported problems such as skin excoriation due to urine leakage, and odor and skin problems due to excretions seeping into casts. • Positioning and lifting were a problem for most mothers. Half of the mothers reported back aches, muscle pain and shoulder aches. • Appropriate car seat and wheel chair access issues were identified by mothers. • Significant feelings of social isolation expressed by mothers. **Implications**: Caring for a child in a hip spica is stressful for parents. Nurses need to ensure parents have good family supports in place. Thorough parental education on cast care is essential. Study identifies importance of proper lifting. Nurses themselves need to ensure appropriate transferring of patient to prevent back injury and also need to educate parents on appropriate lifting. Physiotherapy or occupational therapy may be required. Incontinence issues and cast care are important issues in nursing care and education.	**Strengths** Identified the need for further qualitative studies to be conducted with larger sample sizes to verify or expand the findings of this study. Also identify the need for quantitative research to allow the examination of relationship between variables in adaptation as well as quantify care givers responses to create more meaningful inferences. Included a section highlighting the suggestions for nursing interventions. Use of open ended questionnaire yielded quality evidence Design also allowed for descriptive statistics to add meaning to the participant's qualitative responses. While not statistically significant the findings offer rich detail to support the importance of nursing assessment and education in hip spica care. **Limitations** Study completed in 1995 however is referred to throughout recent studies in the area and provides excellent insight into parent's perceptions of caring for child in a hip spica adding to nursing knowledge. Did not discuss effect of interviewer bias on participant's responses. Variance between contexts of interview responses not discussed. Some participants interviewed by research assistant at the clinic some filled out the questionnaire and returned via mail with no questions by the interviewer and some were interviewed in their homes. The variances have the potential to influence responses. None of the tests were statistically significant due to the small sample size.

Reed, C., Carroll, L., Baccari, S., & Shermont, H. (2011). Spica cast care. A collaborative staff led education initiative for improved patient care. *Orthopaedic Nursing*, *30(6*), 353-358	Exploratory VI	• One of the most challenging aspects of caring for incontinent children in hip spicas is maintaining healthy skin integrity • Described the nurse led initiative to change practice in view of an increase in phone calls about and readmissions for rash, skin breakdown, and foul smelling casts. • Common practice throughout children's hospitals for spica cast diapering included the use of an absorbable pad and tucked diaper. • Staff and parent education programs have potential to decrease incidence of skin breakdown.	**Strengths** Good description of literature review highlighting they had actually researched the topic in determining there was little evidence of best practice related to spica cast toileting and diapering Providing a detailed experience of successful nursing innovation provides an exemplar for improving patient care The article provides a model for further patient care quality improvement projects. **Limitations** Actual data on the number of increased calls or admissions would have created more meaningful findings and areas for further comparative research The audit on the efficacy of new guidelines was poorly explained. No information was given regarding the time period of follow up, or exact tools used in assessing efficacy Reported a decrease in phone calls about skin care issues however with no numerical data poor level of evidence. Conclusions reached did not reflect evidence shown in article ie Findings from this audit demonstrated a decreased incidence of skin breakdowns and readmissions. Overall focus shifted from analyses of skin care assessment to the effectiveness of the education and patient quality improvement initiative overall which was the main point in discussion and conclusion section.

Sparks, L., Ortman, M.R., & Aubuchon, P. (2004). Care of the child in a body cast. *Journal of Orthopaedic Nursing, 8,* 231-235. doi: 10.1016/j.joon.2004.09.003	VII Expert opinion	• Present information gained from literature, internet resources, the authors experience and parents of the child. • Practical advice for nurses and parents. • Parents need both verbal and written instructions from nurses. • It is extremely important to examine the child's skin at least twice a day. • Parents and nurses should assess child's circulation and sensation • The edges of the cast should be made smooth with waterproof tape. • The cast needs to be protected from urine and stool. • Need frequent nappy changes. • An inner pad should be tucked under the cast and covered with a larger nappy for babies. • Older children can use bedpans and bottles • Constipation can be an issue for the child in a body cast. • The child can be positioned supine, prone, or side lying and should be turned at least four times a day. • All children need to be secured properly when riding in automobiles. • Nurses need to consider the family's strengths, limitations and needs in providing discharge education	**Strengths** While limited in its evidence base this article provides a comprehensive guide on specific clinical assessment and care needs. **Limitations** Use of non-reliable sources i.e. yahoo search engine. Limited ability to generalize findings of article No critical appraisal of literature or different techniques Limited use of articles-only 5 reference articles. Unknown credibility of data, based on authors experience however no discussion of authors credentials. Poor validation of findings therefore should be used in conjunction with evidence based research

Zielinski, J., Oliver, G., Sybesma, J., Walter, N., & Atkinson, P. (2009). Casting technique and restraint choice influence child safety during transport of body casted children subjected to a simulated frontal MVA. *The Journal of Trauma*, 66, 1653-1665. doi: 10.1097/TA.0b013e3181a4c0f4	IV Well designed cohort study with control group	• Children fitted into casts may not fit into traditional car seats requiring alterations to the seat or restraint. • Study conducted to provide data describing the influence of a hip spica cast during transportation of small children in the event of a frontal motor vehicle accident. • In general traditional child restraints accommodate children in hip spica however the addition of the hips spica increases the majority of injury metric magnitudes. • Study demonstrated that there are varied effects on basic physiologic functions for body casted children based on the method of restraint. • Restraints which place the child forward facing with the face in proximity to the cast should be avoided • Based on mixed results of study unable to advocate or oppose different seating positions • Overall best performance for 12 month age was observed with traditional car seat or lying down with a lap and shoulder belt. However this would be catastrophic in a side on collision. • While unable to provide clear recommendations due to variability in results some results alarming in adverse effect on child and therefore still need to be acknowledged. **Implications:** Specific instructions should be communicated to parents before discharge by the child seat technician to ensure proper fit and function during subsequent transport. Study unable to conclude the effect the presence of hip spica has on different restraints and how it impacts the child's safety, however highlights the vigilance needed in ensuring appropriate fitting of care seats.	**Strengths** Tested 2 hypothesis Used a control non casted dummy which previous studies lacked and allowed comparisons to be made showing that although both uncasted and casted children passed current standards casted children had an increased susceptibility to injury forces. Testing methods comply with the federal motor vehicle safety standards which are appropriately referenced. Provides suggestions for optimal method of casting to allow child to fit in a traditional car seat however acknowledges limitations of recommendations. **Limitations** Limited ability to generalize findings as car seats used specific to area manufacture availability. In answering the first hypothesis of the challenges faced when installing the car seat, method was obscure and not replicable. Based on assessors reports and didn't describe fitting process so that it could then be replicated. Only one individual's experience. "the following challenges were noted.." Wasn't clearly explained in method how this was tested nor was it mentioned as a limitation. Would have been more effective to assess and compare challenges faced by parents in safely securing the child in the car seat. They hypothesized that that the cast would increase the challenge of safely and correctly securing the child in the vehicle. Explanation of data analysis confusing. Limited to frontal collisions only Yes they found that it was challenging to secure a child with a hip spica however their single experience and method makes generalization to other centers difficult.