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Current risk landscape of point-of-care ultrasound in pediatric emergency medicine in medical malpractice litigation

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ABSTRACT

Background: Point-of-care ultrasound (PoCUS) is expanding as a diagnostic tool in pediatric emergency medicine. Pediatricians are apprehensive to take on the risk of malpractice from incorrect interpretation of PoCUS imaging, therefore limiting its use. Although current studies provide reassurance to this concern, none look directly at the risk for pediatric emergency medicine physicians. Our study aims to evaluate the current medicolegal risk landscape posed by PoCUS in pediatric emergency medicine.

Methods: A search of case law was performed utilizing the LexisNexis caselaw database for the period of January 2011 through December 2021. Initial search results were reviewed by the attorney co-authors for relevance to medical malpractice surrounding PoCUS. The remaining cases were reviewed by physician co-authors to ensure their relevance to both ultrasound and the acute care setting. Identified cases were then classified into categories as per the reason for the claim.

Results: No cases of malpractice litigation were identified that directly related to PoCUS. Ten cases of ultrasound in the acute care setting were identified, 7 of which were in pediatric patients. The majority of these cases related to appendicitis or testicular torsion. Of these 10 cases, 2 cases claimed failure to consider the ultimate diagnosis, but ultrasound would have been an appropriate study had the diagnosis been considered. Of the 8 remaining cases, 6 were based on failure to perform or delay performing ultrasound, 1 claimed that improper ultrasound study was initially performed, and 1 case was based on an improper diagnosis made by ultrasound.

Discussion: PoCUS does not appear to pose a significant risk of malpractice litigation in pediatric emergency medicine.

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1. Introduction

Over the last several decades, point-of-care ultrasound (PoCUS) has become a widely used tool in pediatric practice, both in the emergency department [1] (ED) and on inpatient wards [2]. PoCUS differs from traditional radiology-performed ultrasound in its focused nature. Specifically, radiology-performed ultrasound is performed by a radiology technician then sent to a radiologist for interpretation before it can be acted on by the treating clinician. With PoCUS, the ultrasound is performed and interpreted in real time by the physician in their care for

the patient at the bedside. There is evidence showing the benefits of using PoCUS in general emergency medicine given its efficacy in real-time diagnosis [3], accuracy in performing successful procedures [4], and increase in patient satisfaction [5]. An increasing number of studies have shown similar benefits in the pediatric population [6]. Recognizing these benefits, there has been a trend to incorporate PoCUS training into the standard curriculum for pediatric residency and fellowship programs [7–9].

Despite the benefits of PoCUS in clinical care, many physicians hesitate to use it in their practice. The most common barriers identified include limited access to equipment, lack of appropriate training and lack of confidence in image acquisition and interpretation [10,11]. This in turn can lead to a fear of litigation arising from incorrect interpretation of obtained images.

Medical malpractice is defined as an act or omission by a physician during treatment of a patient that deviates from the standard of care in the medical community and causes an injury to the patient [12].

Abbreviations: PoCUS, Point-of-Care Ultrasound; ED, Emergency Department; PEM, Pediatric Emergency Medicine; Peds, Pediatrics; NYS, New York State; CT, Computerized Tomography; US, Ultrasound.

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In order to prove medical malpractice, a plaintiff must prove by a preponderance of the evidence that there was a departure from the standard of care and that the departure from the standard of care was the proximate cause of the plaintiff's alleged injuries [13]. The statute of limitations varies by state and provides the length of time that a plaintiff has to commence a lawsuit from the date of the alleged departure (for example, generally in New York, 2.5 years from the date of the alleged malpractice for an adult patient and no more than 10 years for a pediatric patient) [14,15]. The plaintiff begins the litigation by serving a Summons and Complaint on all defendants [16], which includes the date of the alleged malpractice as well as the nature of the claim against the defendants. Once served, the defendant must appear in the action, usually by having their counsel interpose an answer on their behalf addressing the allegations in the Complaint [17]. The next stage in litigation is known as the discovery stage [18], which involves the parties exchanging documents [19] and conducting depositions [20], which are oral questions and answers given by designated witnesses such as the physicians involved in the medical care. Once the discovery has been completed, a trial date can be set [21]. The parties can request a summary judgment, which is a motion filed by a party requesting the court to dismiss the case. In order to prevail on a motion for summary judgment, the parties must prove to the Court's satisfaction, that there is no genuine issue of material fact for the jury to decide. Essentially, summary judgment is a trial on paper. If summary judgment is granted by the judge in favor of the defendant, the case is dismissed [22]. If summary judgment is denied, the case is sent to a trial judge. At trial, it is the jury's role to determine whether there has been a departure from the standard of care and whether that deviation was a proximate cause of the plaintiff's injuries [23].

Both the LexisNexis and Westlaw databases are well validated and reliable sources commonly used by legal professionals to obtain information regarding medical malpractice litigation. Westlaw and LexisNexis have similar content [24], and thus many law firms have subscriptions to one and not the other [25].

To address the concern of increased litigation due to PoCUS, multiple studies have focused on malpractice claims associated with the use of PoCUS in clinical care. In 2012, Blaivas et al. reviewed cases that involved emergency physicians and the use of PoCUS [26]. Of those identified, there were no cases found where emergency physicians were sued for performing or interpreting PoCUS. However, they identified one case alleging the emergency physician failed to perform a PoCUS study in a timely fashion to identify an ectopic pregnancy. In 2016, Nguyen et al. looked at cases involving use of PoCUS in neonatology, and found that between January 1990 to October 2015, there were no cases of neonatologists or pediatric subspecialties being sued for PoCUS performance or interpretation [27]. Their study also identified two cases in which it was claimed that failure to perform a diagnostic test caused harm, and implicated PoCUS as an option for such testing. In 2021, Reaume et al. reviewed malpractice cases involving PoCUS and its use in internal medicine, pediatrics, family medicine and critical care [28]. They also confirmed that there were no cases against these specialties for their diagnostic use of PoCUS. These findings suggest that the use of PoCUS has not proven to be a significant risk for malpractice litigation, but the failure to use PoCUS when it is indicated may be considered an act of omission in malpractice claims. Of note, the above studies all identified cases through searches of the Westlaw database.

Although the frequency of malpractice claims against pediatricians in the United States are among the lowest of all specialties, the mean malpractice payments paid by pediatricians are among the highest [29,30]. Further, pediatric cases are among the lowest in terms of rates of case dismissal by a judge and highest in rates of claims that eventually go to trial [31]. Emergency medicine physicians similarly tend to be on the lower end of the spectrum in terms of having malpractice claims filed against them [32]. Pediatric emergency medicine (PEM) physicians represent the merger of these two specialties – pediatrics and emergency medicine.

We aim to determine if the trend identified in previous studies hold true in the current medical malpractice landscape, and to look specifically at the risk within the field of PEM.

2. Methods

In December 2021, the attorney co-authors conducted a search of case law using the LexisNexis database looking for cases filed over the last 10 years. The search was limited to this time period as the use and technology of PoCUS has changed remarkably over the last decade, and our goal was to determine if previously identified litigation trends hold true in the landscape of current PoCUS practice. The content searched was “cases.” Key terms separately searched were: “point-of-care ultrasound,” “ultrasound,” and “ultrasound & pediatric.” Jurisdictions separately searched were “all states.” As our institutions are located in New York State, we further searched “New York – state only.” No federal cases were searched. For each search conducted, the results were reviewed by the attorney co-authors for relevance to medical malpractice surrounding PoCUS. Cases which dealt with ultrasound in a diagnostic capacity or in an emergency setting were included as relevant. If ultrasound was not a key component of the case, then the case was eliminated as not relevant. Physician co-authors then reviewed the identified cases to confirm relevance to PoCUS. The remaining cases were classified into three categories based on the focus of the allegation: (1) failure or delay to perform ultrasound, (2) improper technique or ultrasound study, and (3) missed diagnosis on ultrasound. These cases were further reviewed for age of patient (pediatric or adult), year treatment provided and litigation outcome.

Although not presented in detail, attorney co-authors completed a similar preliminary review of the Westlaw database and found no additional cases of interest. As such, it was decided to focus further analysis on the results of the LexisNexis search results, as this database has not yet been cited in medical literature.

3. Results

No medical malpractice cases were retrieved in the jurisdictions “all states” and “New York –state only” for the key terms “point-of-care ultrasound.”

Table 1 delineates the number of cases retrieved in the jurisdictions “all states” and “New York –state only” for the key term “ultrasound” and “ultrasound & pediatric.”

Upon attorney review, only 14 cases were found to be relevant to medical malpractice involving ultrasound. On physician review, 1 case was eliminated; although an ultrasound was performed, case allegations were more clearly focused on the interpretation of a CT-scan, and recommendations of the radiologist based on the study. Of the remaining cases, 10 were identified as relevant to acute care; the remaining 3 cases dealt more with long-term or follow-up outpatient care [33–35]. Of those 10 acute-care cases, 7 were in pediatric patients. Most of the cases involved the diagnosis of appendicitis; cases involving the diagnosis of testicular torsion were second most frequent (Table 2).

Two cases alleged failure to consider the ultimate diagnosis; in both, had the ultimate diagnosis been considered, US would have been an appropriate diagnostic test. Of the 8 remaining cases, 6 were based on failure to perform or delay to perform ultrasound, 1 claimed that improper ultrasound study was initially performed, and 1 case was based on an improper diagnosis made by ultrasound. See Fig. 1.

A summary of each of the 10 identified acute-care cases in which ultrasound was as a relevant factor is listed below:

3.1. Case 1 [36,37]

- o Medical Summary: In November 2007, the plaintiff arrived at the hospital complaining of abdominal pain. White blood count and a computed tomography (CT) scan were ordered. Both were normal

Table 1

Malpractice cases initially identified through LexisNexis search of national case law. Rows represent search jurisdiction, either through the country, or limited to New York State (NYS). Columns represent keyword search terms.

	"Ultrasound"	"Pediatric" & "Ultrasound"
NYS	544	186
National	1642	932

and the plaintiff was discharged. The plaintiff saw his personal physician, later that same day, and it was determined that the plaintiff had no clinical signs of appendicitis and was suffering from constipation. The following day, the plaintiff returned to the hospital where an ultrasound determined that the plaintiff had acute appendicitis.

- o Legal Summary: The trial court determined that the plaintiff raised a question of fact pertaining to the use of further testing by his personal physician and denied the summary judgment motion of that defendant. However, the court granted summary judgment on behalf of defendant hospital for initial care. The personal physician ultimately settled before trial for an unknown amount.

3.2. Case 2 [38,39]

- o Medical Summary: In June 2009, the infant plaintiff presented to the ED with a complaint of abdominal pain. After physical examination, the physician discharged the plaintiff without ultrasound testing. Plaintiff later reported back to ED where appendicitis was diagnosed.
- o Legal Summary: The trial court determined that there were triable issues of fact to be decided by the jury, including whether failure to use ultrasound testing in the initial visit was a departure of the good and accepted standard of medical care, and therefore denied defendant's motion for summary judgment. The defendant ultimately settled for \$250,000 in 2015.

3.3. Case 3 [40,41]

- o Medical Summary: In July 2010, the plaintiff presented with complaints of abdominal pain. X-Ray imaging was ordered, and the plaintiff was ultimately discharged. The plaintiff returned, at which time ultrasound revealed ruptured appendicitis.

Table 2

Malpractice cases identified as relevant to ultrasound in medical decision making over a 10-year period. The year indicated is the year case was filed. In only one case did the claim revolve around the interpretation of an ultrasound (italicized). In the cases in which the ultimate diagnosis was not considered (*), had the diagnosis been considered, ultrasound would have been an appropriate diagnostic test. Abbreviations: Pediatric patient (Peds), Ultrasound (US), Computed Tomography (CT), New York State Jurisdiction (NYS).

Year	Peds?	NYS?	Diagnosis	Claim
ACUTE CARE CASES – ULTRASOUND DIRECTLY RELATED				
1 2011	✓	✓	Appendicitis	Failed to pursue further testing
2 2012	✓	✓	Appendicitis	Failed to perform US
3 2014	✓	✓	Appendicitis	Failed to diagnose appendicitis
4 2020	✓	✓	Appendicitis	Performed wrong US study
5 2012	✓	✓	Testicular torsion	Delayed to order repeat US
6 2017	✓	✓	<i>Testicular torsion</i>	<i>Failed to diagnose on initial US</i>
7 2020	✓	✓	Testicular torsion	Failed to repeat US
8 2016	✓	✓	Urinoma	Failed to perform US
ACUTE CARE CASES – DIAGNOSIS NOT CONSIDERED*				
9 2018	✓	✓	Appendicitis	Failed to consider appendicitis
10 2018	✓	✓	Testicular torsion	Failed to consider torsion
OUTPATIENT/LONG-TERM CARE CASES				
11 2015	✓	✓	Breast mass	Failed to US entire breast
12 2020	✓	✓	Cholelithiasis	Failed to perform pre-operative US after gallstones identified on CT
13 2020	✓	✓	Testicular cancer	Failed to perform US

- o Legal Summary: The plaintiffs argued that the initial ED physician who treated the child departed from the standard of care in failing to diagnose appendicitis when they ordered X-ray imaging rather than ultrasound studies. The trial court found that there were issues of fact and denied defendant's motion for summary judgment. The lawsuit was tried in November 2015 and the jury awarded \$450,000 to the plaintiff.

3.4. Case 4 [42,43]

- o Medical Summary: In August 2014, the plaintiff presented as a walk-in patient with a positive home pregnancy test at a medical clinic where defendant was on staff. Plaintiff complained of very sharp abdominal pain and nausea at appointment. Plaintiff was referred to co-defendant radiologist for pelvic ultrasound to evaluate pain. The next day, plaintiff experienced pain and was transported by ambulance to and ED where ultrasound study did not indicate that the appendix was visualized. Subsequent MRI revealed acute appendicitis without perforation. Laparoscopic appendectomy was performed and discovery of an acutely inflamed, perforated and gangrenous appendix was noted. Days later, the plaintiff was diagnosed with a spontaneous abortion.
- o Legal Summary: Plaintiff claimed that there was a departure from the standard of care when she was not referred to emergency room when the initial ultrasound did not reveal the cause for her right abdominal pain. Additionally, plaintiff claimed that there was a departure from the standard of care in the technique used to conduct the initial ultrasound study. The trial court believed that the plaintiff raised issues of fact to be determined at trial and denied defendants' motion for summary judgment. The lawsuit is ongoing as of October 2021.

3.5. Case 5 [44,45]

- o Medical Summary: In February 2008, the two-year-old plaintiff reported to hospital with rash and swelling of the scrotum. He was evaluated for possible testicular torsion using ultrasound, which showed positive blood flow bilaterally. A second ultrasound ordered approximately 12 h later revealed testicular torsion.
- o Legal Summary: The plaintiff argued that failure to order repeat ultrasound in a timely fashion was a departure from the standard of care. The trial court determined that there were issues of fact to be heard at trial and denied defendant's motion for summary judgment. The lawsuit is ongoing as of October 2021.

3.6. Case 6 [46]

- o Medical Summary: In March 2013, the thirteen-year-old male plaintiff woke up with severe pain in his left testicle and sought care in the ED. There, plaintiff received a physical exam and an ultrasound of his testicles. The ultrasound findings, seen and interpreted by the radiologist, were not consistent with testicular torsion at the time. Following discharge, plaintiff's testicle swelled to the "size of a baseball". He underwent another ultrasound days later and was then diagnosed with left testicular torsion.
- o Legal Summary: Plaintiff argued that the defendant doctors failed to detect plaintiff's testicular torsion on initial ultrasound. The trial court denied defendant's motion for summary judgment, which was later upheld by the Court of Appeals. The outcome is not available to the public.

3.7. Case 7 [47,48]

- o Medical Summary: In April 2015, the plaintiff reported to hospital with pain in the right testicle. Ultrasound was performed on

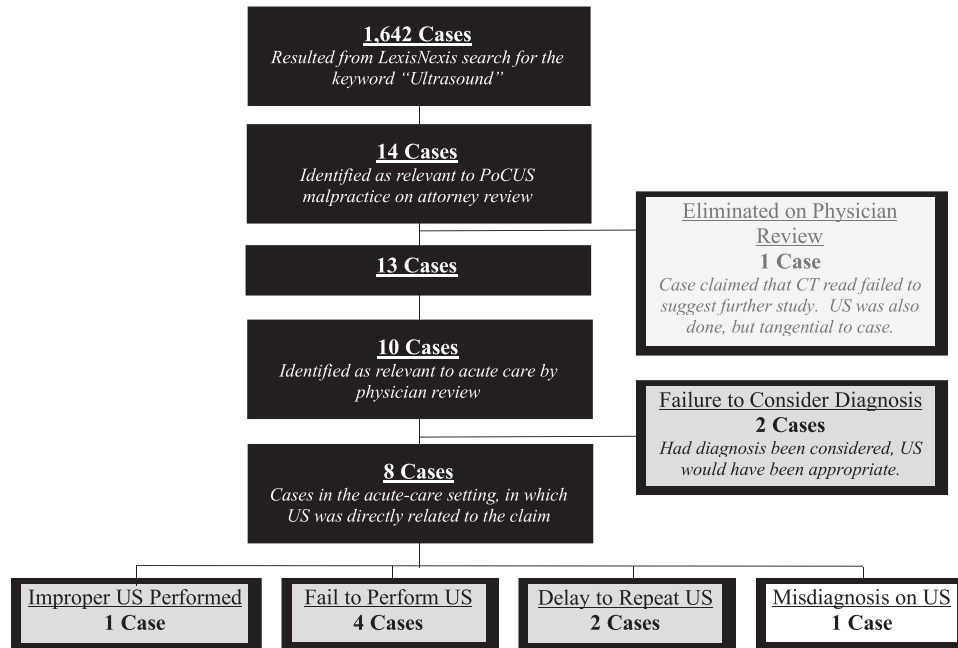


Fig. 1. Identification of malpractice claims related to ultrasound. Note: no cases were found on a search for "point-of-care" ultrasound. Abbreviations: Point-of-Care Ultrasound (PoCUS), Ultrasound (US).

plaintiff's right testicle and testicular torsion was ruled out. Plaintiff was diagnosed with epididymitis and discharged. Plaintiff claims that while at the hospital, his testicle un-torsed and later re-torsed and defendant's failure to perform repeat ultrasounds was a departure of the standard of care.

- o Legal Summary: The trial court determined that there were triable issues of fact to be determined by the jury and denied the defendant's motion for summary judgment. The lawsuit is ongoing as of October 2021.

3.8. Case 8 [49]

- o Medical Summary: In October 2008, the 10-year-old plaintiff reported to his primary physician 10 days after a percutaneous kidney biopsy with vomiting and fever. The defendant doctor ordered a urinalysis but did not order an ultrasound. Plaintiff was diagnosed with viral gastroenteritis. Ongoing vomiting and abdominal pain continued until March 2009 when a pediatric gastroenterologist ordered abdominal ultrasound revealing a urinoma.
- o Legal Summary: The Court of Appeals upheld a July 2015 bench trial that awarded \$225,000 in favor of the plaintiff. Through case proceedings, the defense argued that the plaintiff's mother was negligent in delaying re-evaluation when symptoms continued. The court addressed this, acknowledged that plaintiff's urinoma would have been discovered if ultrasound was performed in October 2008.

3.9. Case 9 [50,51]

- o Medical Summary: In December 2011, the plaintiff reported to ED with abdominal pain. Labs and ultrasound were performed. Appendicitis was not considered in diagnosis. He was advised to follow up with a gastroenterologist and discharged. He continued experiencing discomfort but did not vomit or have diarrhea. Plaintiff returned to ED, with complaints of right lower quadrant abdominal pain,

fever, vomiting and diarrhea. CT was ordered and diagnosis of appendicitis with perforation was made.

- o Legal Summary: The trial court granted the gastroenterology defendant's motion for summary judgment but denied summary judgment to the emergency medicine defendant and diagnostic radiology defendant. The lawsuit was tried in February 2020 and the jury found in favor of the latter defendants.

3.10. Case 10 [52]

- o Medical Summary: In March 2014, the plaintiff sought emergency medical care for abdominal and flank pain. Defendant doctor ordered IV fluids, Zofran, and CT scan. No ultrasound was ordered. Plaintiff was diagnosed with umbilical hernia and discharged. When symptoms did not improve, plaintiff sought treatment at another facility the following day where ultrasound was performed, and a diagnosis of testicular torsion was made.
- o Legal Summary: The trial court granted defendants' summary judgment motion, which was reversed by the Court of Appeals such that the case was remanded to trial. Final case outcome was not available on public search.

4. Discussion

The results of our review substantiated that there were no cases specifically alleging medical malpractice due to PoCUS. The results of our review of cases in which the allegations focus on ultrasound also support that PoCUS was not at issue in either emergency medicine or pediatrics. Our conclusion is that neither physicians nor health systems have experienced an increase in medical malpractice risk related to PoCUS despite the increased use of PoCUS [53].

Previous studies showed that in malpractice cases where PoCUS use was involved, they were often due to a failure to perform PoCUS [26,27]. Out of nearly 1700 cases reviewed here, only 14 were found to be relevant to medical malpractice stemming from PoCUS. None of these cases,

though, were directly related to a PoCUS study, but rather were focused on ultrasound in general. The vast majority were again due to failure to perform an appropriate ultrasound study in a timely fashion. Only one case related to improper interpretation of the ultrasound images that were obtained.

In cases of delay to perform ultrasound, PoCUS could help to fill the gap by providing a timely mode of imaging to inform clinical care, thus potentially mitigating this risk. Many PoCUS applications are easy to perform [54–56] with appropriate training. Therefore, in order to minimize medical malpractice risk, adequate training in PoCUS is necessary for PEM physicians to confidently order, perform and interpret images [57]. Cohen et al., surveyed PEM fellowship program directors in 2012, at which time, 42% of programs anticipated the implementation of a PoCUS curriculum in the next 5 years [7].

Of the cases resulted from our search, the majority were in relation to the diagnosis of appendicitis and testicular torsion. These diagnoses are among the top five in pediatric malpractice cases [58,59]. Of note, in these high-risk diagnoses, risk is not only isolated to ultrasound; simply failing to consider the diagnosis can result in medical malpractice risk. Studies have shown that with focused ultrasonographic training, PEM physicians can diagnose acute appendicitis with substantial accuracy [60] and ultrasound can be an effective rule-in test [61]. Ultrasound has a sensitivity of 37% and a specificity of 87% in diagnosing appendicitis. If the clinical suspicion for appendicitis is high, and ultrasound is not diagnostic, then CT or MRI is the gold standard for diagnosis [62]. PoCUS for the diagnosis of testicular torsion, although not as extensively studied in the pediatric population, also has shown promising results in obtaining an accurate and quick diagnosis [63]. Doppler ultrasonography has a sensitivity of 88% and a specificity of 98% for diagnosing testicular torsion [64]. The gold standard for this diagnosis is operative exploration. If clinical suspicion is high and ultrasound imaging does not reveal a torsed testicle, then serial physical exams or repeat imaging with doppler ultrasound is recommended. Given the high-risk nature of these diagnoses, radiology-performed ultrasound should be considered, especially when the PoCUS study fails to identify a diagnosis.

The LexisNexis and Westlaw databases are well validated and reliable searchable databases of case law. Previous studies in the medical literature surrounding PoCUS malpractice have cited the Westlaw database for evaluating medical malpractice litigation [26–28]. Unlike these previous studies, ours focused on LexisNexis, which may provide a different perspective. We further compared the search presented above to a preliminary search of Westlaw, which identified no additional relevant cases. As medical malpractice claims may be resolved prior to public court filings, there may be allegations surrounding PoCUS that cannot be identified by search of these databases. Additionally, new cases may be commenced for medical care already provided given the statute of limitations remains open. Nonetheless, as others have argued, if PoCUS proved to be a significant source of litigation, we would anticipate that such precedent-setting cases would be represented in these databases [28].

5. Limitations

Our search focused on cases that took place in the state courts of the United States such that we cannot make any conclusions about the risk posed in other legal jurisdictions. During our review of the cases which resulted from our search, we noted that a majority originated from New York state (NYS). However, when comparing states, there are many factors that could contribute to this finding. Differences in availability of ultrasound, the frequency of ultrasound use, and the number of patients with pathologies likely contribute to this observation. However, analysis of such differences is beyond the scope of this study, and we therefore cannot draw conclusions from the observed frequency of cases in NYS. What we do know is that NYS, especially Downstate, is known to be a leader in medical malpractice litigation claims [65]. Also, many states have robust tort reform, capping the maximum amount of money that

can be paid out from malpractice [66]. In the case of ultrasound, this may limit the frequency in which plaintiff's may be motivated to bring a claim. On a similar note, the observed higher frequency of cases involving pediatric cases likely has multifactorial explanation. One possible contributing factor is the longer statute of limitations for pediatric malpractice claims.

6. Conclusion

Overall, the results of this study suggest that the use of PoCUS in the pediatric emergency medicine setting does not pose a significant risk for malpractice litigation and may in fact provide a mode to decrease risk. With the expansion of PoCUS training into pediatric residency and fellowship programs, the use of PoCUS is expected to grow. Although only 1 case identified in our search dealt with the interpretation of ultrasound images by a radiologist, with the the growth of PoCUS, this type of risk may shift to the PoCUS practitioner rather than a radiologist. As such, the medicolegal landscape may evolve. For this reason, continued surveillance of malpractice case law is warranted.

Credit authorship contribution statement

Linda Solomon: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Maggie Emma:** Writing – review & editing, Writing – original draft, Investigation, Formal analysis, Data curation, Conceptualization. **Lisa M. Gibbons:** Conceptualization, Data curation, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Matthew P. Kusulas:** Writing – review & editing, Writing – original draft, Supervision, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of Competing Interest

None.

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