Time Tracking of Standard Ultrasound Examinations in Pediatric Hospitals and Pediatric Medical Practices – A Multicenter Study by the Pediatric Section of the German Society of Ultrasound in Medicine (DEGUM)

Zeiterfassung von Standard-Ultraschalluntersuchungen in der pädiatrischen Praxis und Klinik – Eine multizentrische Studie der pädiatrischen Sektion der Deutschen Gesellschaft für Ultraschall in der Medizin (DEGUM)

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ABSTRACT

Purpose Ultrasonography is the primary imaging modality in pediatrics but still lacks sufficient reimbursement in Germany. In this multicenter study, national data for the duration of standard ultrasound in pediatrics were systematically documented in order to specify the actual time required.

Materials and Methods N = 10 hospitals (N = 5 university hospitals, N = 5 non-university hospitals) and N = 3 medical practices in Germany recorded the entire process of an ultrasound examination in a special protocol developed by the Pediatric Section of the DEGUM. The duration of each of seven single steps during ultrasonography (from data input to final discussion of the results) of different organ systems was logged.

Results In total, N = 2118 examinations from different organ systems were recorded. N = 10 organ systems were examined frequently (> 30 times). The total duration of an ultrasound examination was statistically significantly longer in hospitals compared to medical practices (median (IQR) 27 min. (18–38) vs. 12 min. (9–17), $p < 0.001$). The "hands-on" patient time was approximately one half of the total required time in both settings (49.9 % vs. 48.9 %). Ultrasonography of the abdomen and brain lasted longer in university hospitals than in non-university hospitals ($p < 0.001$, and $p = 0.04$, respectively). Cooperation and age did not uniformly correlate with the total duration.

Conclusion This study provides novel comprehensive national data for the duration of standardized ultrasound examinations of children and adolescents in Germany. These data are essential for a further evaluation of the economic costs and should support better remuneration in the future.

ZUSAMMENFASSUNG

Ziele Die Sonografie ist die primäre bildgebende Diagnostik in der Pädiatrie, wird in Deutschland jedoch unzureichend vergütet. Ziel dieser multizentrischen und systematischen Erhebung von Ultraschalluntersuchungszeiten in der Pädiatrie ist die erstmalige Analyse des tatsächlichen Zeitbedarfs.

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Material und Methoden N = 10 Kliniken (n = 5 Universitätskliniken, n = 5 kommunale Kliniken) und n = 3 Praxen aus Deutschland erfassten die Gesamtheit einer Ultraschalluntersuchung in einem eigens hierfür entwickelten Fragebogen der pädiatrischen Sektion der Deutschen Gesellschaft für Ultraschall in der Medizin (DEGUM). Es wurde der genaue Zeitaufwand für sieben definierte Untersuchungsschritte (von Dateneingabe bis Befundbesprechung) für verschiedene Organsysteme protokolliert.

Ergebnisse Bei insgesamt n = 2118 Kindern wurde eine Ultraschalluntersuchung eines Organsystems durchgeführt. N = 10 Organsysteme wurden häufiger als 30-mal untersucht. Die Untersuchungszeiten in Krankenhäusern waren mehr als doppelt so lange wie in der pädiatrischen Praxis (median (IQR) 27 min (18–38) vs. 12 min (9–17); p < 0,001). Die „Hands on"-Zeit am Patienten nahm jeweils fast die Hälfte der Gesamtdauer der Untersuchung in Anspruch (49,9 % vs. 48,9 %). Die Abdomen- und ZNS-Sonografie dauerte an Universitätskliniken länger als an kommunalen Kliniken (p < 0,001 und p = 0,04). Kooperation und Alter des Kindes hatten keinen einheitlichen Einfluss auf die Untersuchungszeiten.

Schlussfolgerungen Diese Studie zeigt erstmals dezidierte Daten zum zeitlichen Aufwand von Ultraschalluntersuchungen von Kindern und Jugendlichen in Deutschland. Die erhobenen Daten sind für eine reale Bewertung des Aufwands und der volkswirtschaftlichen Kosten der pädiatrischen Sonografie von elementarer Bedeutung und können in Zukunft als Grundlage für eine entsprechende Vergütung der erbrachten Leistungen dienen.

Introduction

Ultrasonography is the most important real-time bedside imaging technique in pediatrics. It is omnipresent in every clinical and outpatient setting and, with respect to Germany, is solely carried out by physicians. The opportunity of the interpersonal encounter and relationship between patient and physician as well as an individual assessment during the examination is a major advantage of the "German" approach [1, 2]. In addition to general applications, pediatric sonography helps to address specific clinical questions, like the presence and specific characteristics of congenital heart anomalies [3], brain disorders [4, 5], neonatal pathologies [6, 7], and genital abnormalities [8]. These examinations are technically and temporally demanding, and sometimes even complicated by a lack of cooperation or agitation of the child. As shown in adults by Nürnberg et al. [9] and Schuler et al. [10], the reimbursement of ultrasound examinations in Germany is still insufficient and not cost-covering. Unfortunately, a detailed data basis for pediatric ultrasound examinations in order to verify the expected additional time requirements is not available. With the increased application of contrast-enhanced ultrasound (CEUS) in pediatrics [11–14], the use of ultrasound imaging could expand and other investigations such as computed tomography (CT) and magnetic resonance imaging (MRI) might be avoided [15]. Certainly, these new ultrasonic techniques extend the investigation time, consume more resources, and are more expensive – another reason to work towards better remuneration. With respect to costs and applications, point-of-care ultrasonography (POCUS) [16–19] and reorganization of human resources are already broadly discussed in the ultrasonic community [20–23].

Given the variety of indications, emerging imaging techniques and the importance of the use of ultrasound in pediatrics, and to permit adequate quality, corresponding remuneration is required. Thus, the objective of this multicenter study was to determine the duration of standard pediatric ultrasound examinations in hospitals and medical practices to record the different time requirements for each examined organ system and also to determine potential time-consuming factors.

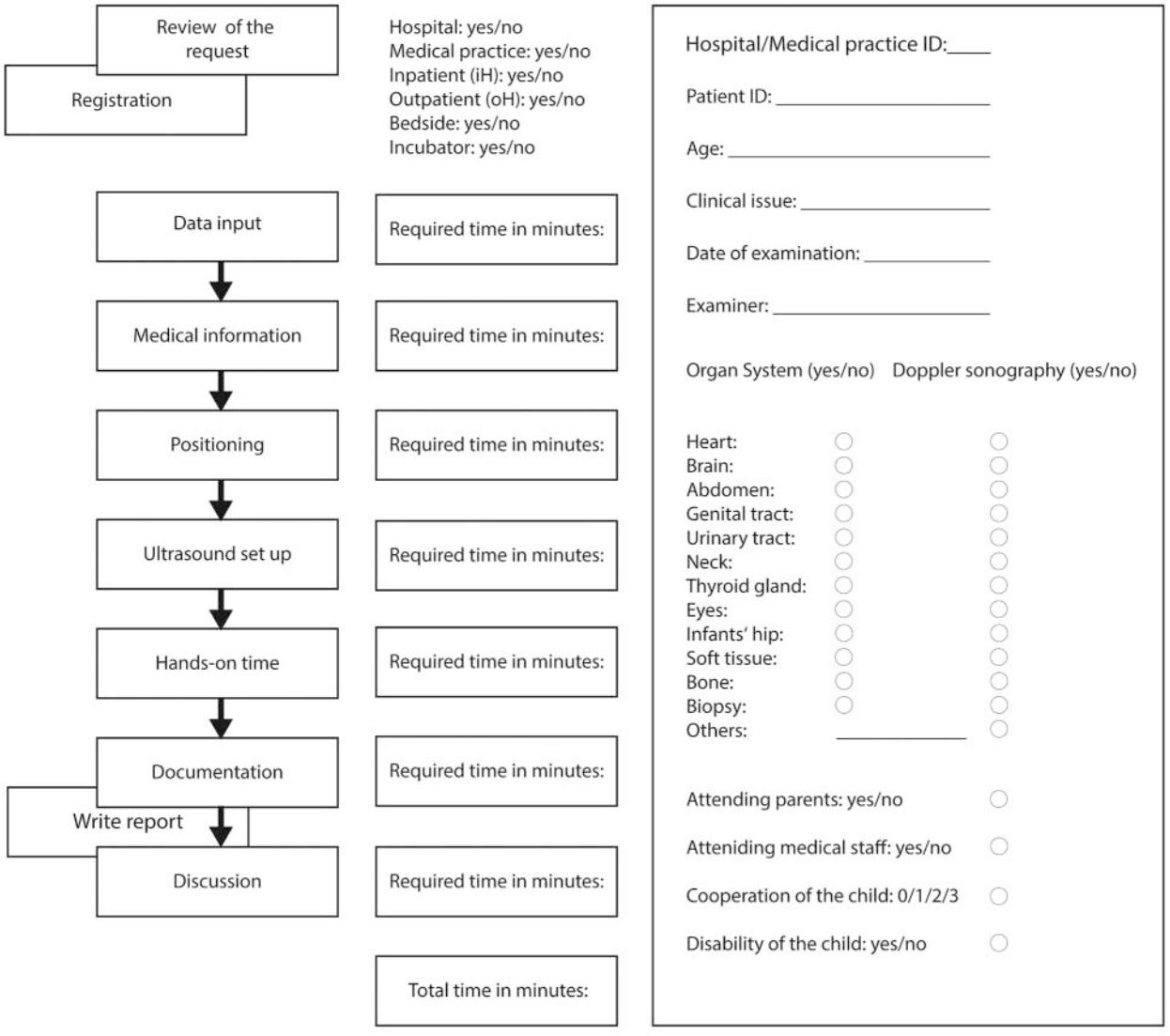
Methods

Study design

In three consecutive months in 2006, data from N = 10 hospitals (N = 5 non-university children hospitals and N = 5 university children hospitals) and N = 3 pediatric medical practices were prospectively collected. At each site, data were recorded by a professional investigator, qualified in pediatric sonography (certified as DEGUM level I or II), according to a special protocol as described below (▶ **Fig. 1, Supplementary Fig. 1**). Supervision, teaching and beginners were excluded, in order to achieve comparability for all participating sites and to record the actual time requirements. Examinations and documentation were carried out according to the recommendations of DEGUM (www.degum.de) and DGK (www.dgk.org) with respect to the organ systems. The local ethics committee waived publication of the data, with the statement that the anonymous and retrospectively completed data collection is not subject to consultation (No. 157_19 Bc).

Protocol and data acquisition

The study protocol was developed by the Pediatric Section of the German Society of Ultrasound in Medicine (DEGUM) in order to anonymously record all time requirements during a complete ultrasound examination. Data collection further included the following demographic and clinical features: type of institution (non-university hospital/university hospital/medical practice), type of visit (inpatient hospital (iH)/outpatient hospital (oH), age of the patient (age), examined region (abdomen, heart, urinary tract, brain, infants' hip, soft tissue, bone, thyroid gland, neck, genital tract, upper extremity, lower extremity, eye, testicles, spinal cord, etc.), use of Doppler ultrasound (y/n), clinical issue (free text), cooperation of the patient (0 = none, 1 = poor, 2 = moderate, 3 = good), attendance of medical staff (y/n) and presence of the parents (y/n). Time tracking for diagnostic ultrasound examinations was recorded in seven individual categories (▶ **Fig. 1**): data input: time for file preparation and data input into the device, medical information: time for giving a short intro-



▶ **Fig. 1** Time tracking of standard ultrasound examinations in pediatrics – the protocol/study protocol was developed by the Pediatrics Section of DEGUM. Seven single categories during an ultrasound examination of one defined organ system were recorded. Further data collection included demographic and clinical features.

duction/medical information to the child/parents, positioning: time for correct positioning on the examination couch, ultrasound setup: device setup, "hands on" time: actual examination time, documentation of the medical findings, discussion of the medical findings with the child/parents, total time: from data input to end of discussion.

Statistical analysis

Continuous variables are given as median and interquartile range (IQR). Categorical variables are provided as numbers and percentages. Missing data points were excluded from the final analysis. The unpaired two-sided t-test, assuming equal variances, was used for recorded parameters. In cases of unequal standard deviation, Welch's correction was applied. Correlations are given by Pearson's coefficient. All analyses were performed by GraphPad Prism (Version 7.00 or newer, GraphPad Software, La Jolla, CA, USA) and SPSS (Version 24, IBM SPSS Statistics, IBM Corp., Armonk, NY, USA). All statistical tests were two-sided and P-values < 0.05 were considered statistically significant.

Results

Participant characteristics and time requirement for standard ultrasound examinations

In total, N = 2118 children underwent standardized ultrasound of one organ region either in a medical practice (N = 231) or in a hospital (N = 1887). The median age of the examined children was

▶ **Table 1** Duration of seven single steps during pediatric ultrasonography.

		hospital (H)		medical practice (P)	
time for:	**n**	**time in minutes median (IQR)**	**n**	**time in minutes median (IQR)**	**p**
data input	1856	2 (1–3)	231	0.5 (0.5–1)	< 0.001
medical information	1843	1 (0–2)	231	0.5 (0.5–1)	< 0.001
positioning	1856	1 (1–2)	231	0.5 (0.25–1)	< 0.001
ultrasound setup	1839	1 (1–1.5)	231	0.5 (0.5–1.0)	< 0.001
examination time	1851	12 (9–20)	231	5 (4–9)	< 0.001
documentation	1850	5 (2–8)	231	2 (1–3)	< 0.001
discussion	1842	1 (0.5–3)	231	2 (1–3)	0.41
total time	1886	27 (18–38)	231	12 (9–17)	< 0.001

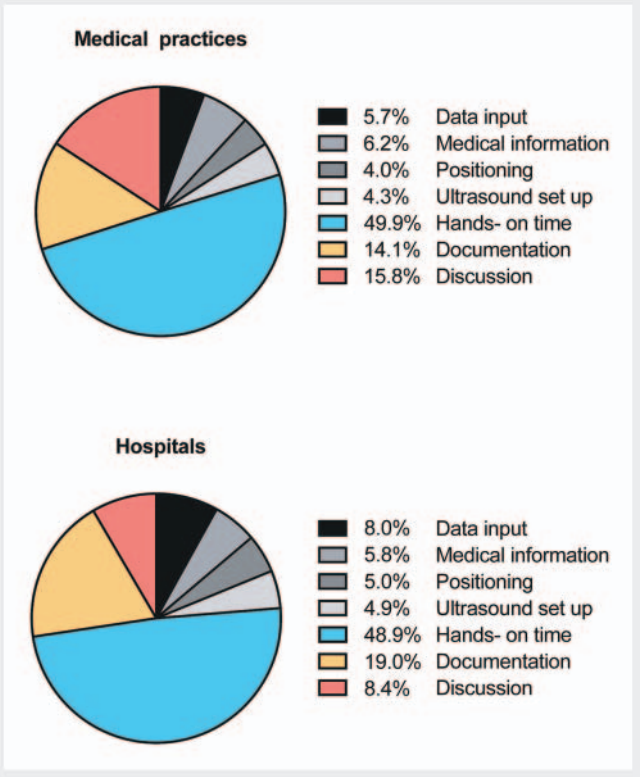
Recorded time in minutes given as median and IQR. Seven single categories during an ultrasound examination of one defined organ system were recorded: data input: time for file preparation and data input in the device, medical information: time for giving a short introduction/medical information to the child/parents, positioning: time for correct positioning on the examination couch, ultrasound setup: time for device setup, examination time: actual "hands on" patient time, documentation: time for documentation of the medical findings, discussion: time for discussion of the medical findings with the child/parents. P-values < 0.05 were considered statistically significant.

4 (IQR 0.3–10) years. The entire duration of one ultrasound examination was statistically significantly longer in hospitals than in medical practices (median (IQR): 27 min (18–38) vs. 12 min (9–17), p < 0.001). Every step of the examination, from data input to the final appraisal, needed more time in the hospitals than in the medical practices (all p < 0.001), with the exception of discussion of the medical findings with the child/parents/guardian (p = 0.41) (Details are shown in ▶ **Table 1**).

The percentage distribution of the time exposure for each step during an ultrasound examination was similar between the clinical and ambulant setting, but notably, the discussion of medical findings was a bigger part of the elapsed time in medical practices than in clinical settings (15.8 % vs. 8.4 %, ▶ **Fig. 2**). The "hands-on" patient time took approximately one half of the time in both settings (49.9 % vs. 48.9 %, respectively, ▶ **Fig. 2**).

Frequency of recorded ultrasound examinations (defined organ systems)

Of the 2118 ultrasound examinations, one examination in a hospital was excluded because the anatomical region was not documented. The ten participating hospitals (H1–H10) recorded 1886 (89.1 %, mean±SD examinations per hospital 188.6 ± 135.8) and the three medical practices (P1–P3) 231 (10.9 %, mean ± SD examinations per practice 77.0 ± 56.5) ultrasound examinations of different defined organ systems. In total, 21 different organ systems were examined. Of those, 10 were examined frequently (more than 30 times): abdomen N = 747, heart N = 490, urinary tract N = 290, cranial/brain N = 229, infants' hip N = 113, soft tissue N = 71, bone N = 47, thyroid gland N = 39, neck N = 36, genital tract N = 31, whereas the other organ systems were only examined occasionally (e. g. upper extremity, lower extremity, eye, testicles, spinal cord, etc.).

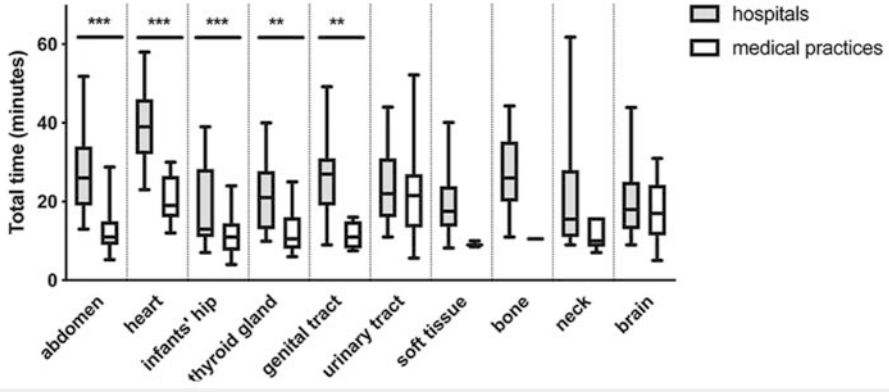


▶ **Fig. 2** Percentage of the required time for individual protocol steps/seven single protocol steps during an ultrasound examination of one defined organ system were recorded. The figure shows the percentage of required time for each of the seven single steps during all ultrasound examinations in pediatric medical practices and pediatric hospitals.

▶ **Table 2** Duration of different standard ultrasound examinations.

		hospital (H)		medical practice (P)	
ultrasound region	**n**	**time in minutes median (IQR)**	**n**	**time in minutes median (IQR)**	**p**
abdomen	643	26 (19–34)	104	11 (9–15)	< 0.001
▪ no doppler US	268	21.5 (17–30)	73	10.5 (8–13)	< 0.001
▪ with doppler US	375	29 (26–38)	31	13 (10–22.5)	< 0.001
heart	477	39 (32–46)	13	19 (16–26.5)	< 0.001
infants' hip	74	13 (11–28.25)	39	11 (7.5–14.5)	< 0.001
thyroid gland	28	21 (13–27.75)	11	10.5 (8–16)	0.005
genital tract	27	27 (19–31)	4	11 (8.1–15)	0.006
urinary tract	268	22 (16–31)	22	21.5 (13.4–27)	0.68
cranial/brain	213	18 (13–25)	16	17 (11.4–24.3)	0.26
soft tissue	68	17.5 (13.6–23.9)	3	9 (8.5–10)	0.07
bone	46	26 (20–35.3)	1	10.5	–
neck	27	15.5 (11–28)	9	10 (8.5–16)	0.06

Recorded time in minutes given as median and IQR. Recorded time for the 10 most frequently examined standard ultrasound procedures (total time). US = Ultrasound; P-values < 0.05 were considered statistically significant.



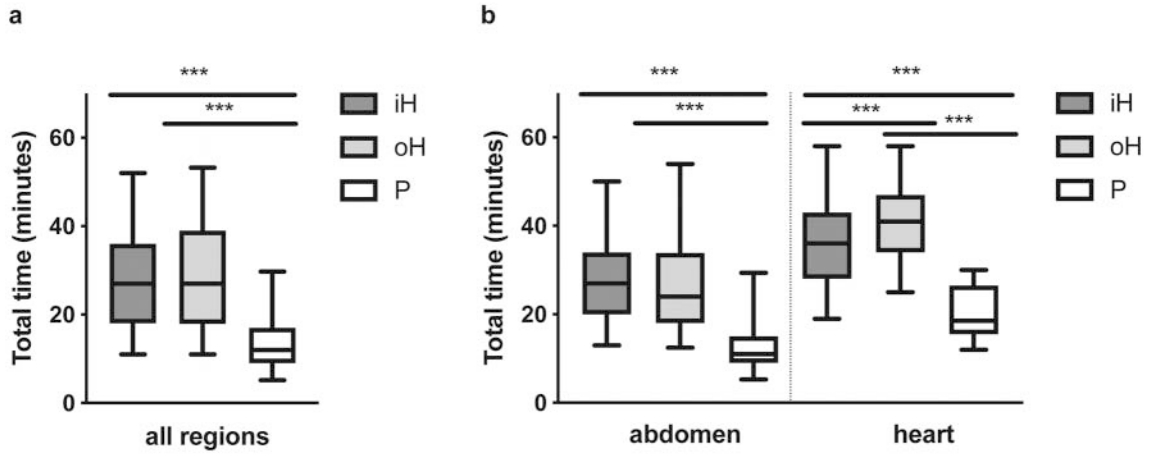
▶ **Fig. 3** Duration of different standard ultrasound examinations/recorded time in minutes given as median, IQR (box), and 5–95 % percentile (whiskers). Recorded time for the 10 most frequently examined organ systems (total time). Statistically significant time differences of examined organ systems between hospitals (H) and medical practices (P) were found for the abdomen, heart, infants' hip, thyroid gland and genital tract. ** = p < 0.01, *** = p < 0.001.

Duration of different standard ultrasound examinations (frequently examined organ systems) in pediatric hospitals compared to pediatric medical practices

The total duration for a standard ultrasound procedure was recorded for each region and the duration for the frequently examined organs was compared between hospitals and medical practices. A highly statistically significant difference between hospitals and practices was found for the total time requirement for standard ultrasound of the abdomen, heart, infant's hip, thyroid gland and genital tract (p < 0.001–0.006). Additionally, abdominal ultrasound with or without Doppler sonography, although not specified in more detail, was compared and found to be different between the groups with high statistical significance (all p < 0.001). No time difference between the institutions was found for the urinary tract, brain, soft tissue and neck (p = 0.06–0.68). Details are presented in ▶ **Table 2,** ▶ **Fig. 3**.

Total duration for inpatient (iH) and outpatient (oH) ultrasound examinations in hospitals in comparison to medical practices (P)

Most of the hospitals provide ultrasound for iH as well as ultrasound for oH. The different time requirements for the entire ultra-



▶ **Fig. 4** Duration of standard ultrasound examinations in hospitals (inpatients (iH) and outpatients (oH)) and medical practices/recorded time in minutes given as median, IQR (box), and 5–95 % percentile (whiskers). Recorded time for standard ultrasound procedure (total time). Panel **a** shows no time differences regarding all examined organ systems between iH and oH, but statistically significant time differences compared to medical practices (P). Panel **b** shows the total time differences regarding the most examined organ systems (abdomen, heart). Whereas no time differences between iH and oH were found for abdominal ultrasound, echocardiography (heart) was faster in iH than in oH. *** = $p < 0.001$.

sound examination between both groups was investigated. Taking all examinations (oH: N = 974, iH: N = 912, and P: N = 231) into account, no difference between the iH and oH groups was found (27 min. (17.9–39) vs. 27 min. (18–36), $p = 0.18$). But again, a highly statistically significant difference between the duration for an entire ultrasound examination was found in the hospitals (iH and oH) compared to the medical practices (27 min. (17.9–39)/27 min. (18–36) vs. 12 min. (9–17), all $p < 0.001$) (▶ **Fig. 4**).

Total duration for ultrasound of the heart and abdomen in iH and oH in comparison to medical practices

Ultrasound of the heart (hospital, N = 477 and practices, N = 13) and abdomen (hospitals, N = 643 and practices, N = 104) was most frequently performed and showed different time requirements between hospitals and medical practices. Hence, a possible difference in the total time needed for an abdominal/heart ultrasound in iH, oH, and patients in medical practices was investigated.

Whereas, no difference between iH and oH was found for the time needed for an abdominal ultrasound (27 min. [20–34] vs. 24 min. [18–33.9], $p = 0.28$), ultrasound of the heart of inpatients was found to take less time than in outpatients (36 min. [28–43] vs. 41 min. [34–47], $p < 0.001$) but still more than in medical practices (36 min. [28–43] vs. 18.5 min. [15.5–26.5], $p < 0.001$) (▶ **Fig. 4**).

Total duration for standard ultrasound examinations in university hospitals compared to non-university hospitals

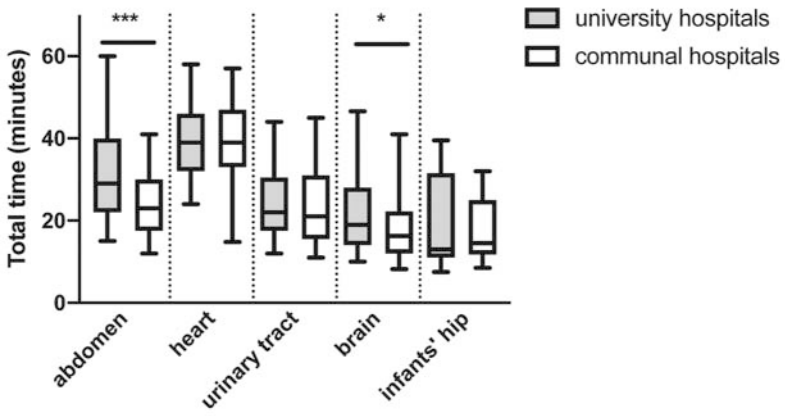
Next, a possible divergence of the time requirement for pediatric ultrasound between university hospitals and non-university hospitals was analyzed. The five most commonly investigated organ systems (abdomen, heart, urinary tract, brain, and infant's hip) were compared. Abdominal ultrasound showed a different time requirement between the groups with high statistical significance (university hospital N = 259 vs. non-university hospitals N = 384: 32.80 ± 15.26 min. vs. 24.69 ± 9.41 min., $p < 0.001$, ▶ **Fig. 5**). The time requirement for ultrasound of the brain also diverged between the settings (university hospital N = 107 vs. non-university hospitals N = 106: 22.80 ± 12.63 min. vs. 19.50 ± 11.09 min., $p = 0.04$, ▶ **Fig. 5**). In contrast, examination of the urinary tract, heart and infants' hip did not differ significantly between university and non-university hospitals.

Influence of cooperation, age and medical assistance on the total time requirement

Because most of the ultrasound examinations were standard ultrasound examinations of the heart (N = 490) and abdomen (N = 747), we investigated whether cooperation or age affected the duration of these examinations in the clinical or ambulant setting. A weak negative correlation between the examination time for standard ultrasound of the heart in the hospitals and the child's cooperation and age was found ($r = -0.23$, $p < 0.001$ and $r = -0.11$, $p = 0.02$, respectively). An inverse trend regarding cooperation was found in medical practices ($r = 0.77$, $p = 0.002$). However, no correlation to the age of the child was observed ($r = 0.13$, $p = 0.67$).

In contrast, a weak positive correlation was found between the examination time for abdominal ultrasound and cooperation and age in the clinical setting ($r = 0.13$, $p = 0.001$ and $r = 0.11$, $p = 0.007$, respectively). Only a weak positive correlation between the time for abdominal ultrasound and age was found in medical practices ($r = 0.26$, $p = 0.007$) (▶ **Table 3**).

Furthermore, the possible influence of the assistance of medical staff on the total time requirement for the most frequently performed examination (abdomen) was evaluated. Ultrasound of the abdomen took less time without assistance compared to in-



▶ **Fig. 5** Duration of standard ultrasound examinations in university hospitals and non-university hospitals/recorded time in minutes given as median, IQR (box), and 5–95 % percentile (whiskers). Recorded time for the five most frequently examined standard ultrasound procedures (total time). ***p < 0.001 *p = 0.04.

▶ **Table 3** Correlation between standard ultrasound, cooperation and age:

setting	organ		cooperation			age	
		n	r	p	n	r	p
hospital	abdomen	625	0.13	0.001	629	0.11	0.007
practice		104	–0.01	0.92	104	0.26	0.007
hospital	heart	475	–0.23	< 0.001	475	–0.11	0.02
practice		13	0.77	0.002	13	0.13	0.67

Age in months, cooperation grading 0 (no cooperation) to 3 (good cooperation), P-values < 0.05 were considered statistically significant, r = Pearson's correlation coefficient:

vestigations with assistance (N = 451 vs. N = 192) in hospitals (23 min. [18–33] vs. 28 min. [25–35], p = 0.018). Almost all examinations in medical practices were assisted (N = 5 vs. N = 99), and no significant time difference was detected, although an inverse trend was observed (17 min. [16–22] vs. 11 min. [9–14], p = 0.085).

Discussion

This multicenter study provides novel systematically recorded national data for the duration of pediatric ultrasound examinations in hospitals and medical practices in Germany. The data demonstrate that pediatric diagnostic ultrasound in hospitals is significantly more time-consuming when compared to medical practices. For the most frequently examined organs within this study (abdomen, heart), over 100 % more time was recorded for clinical settings.

In comparison, Reuß et al. [24] recorded a total time requirement of 21.7 min. for the upper abdomen and kidneys in adults, similar to our findings in pediatric hospitals (21.5 min.). The total duration of abdominal ultrasound without power Doppler in pediatric medical practices (median 10 min) was comparable to the time requirement shown by Nürnberg et al. [9] in adult patients (median 12 min) in a district hospital. Although the time requirement for the most frequently examined organ systems differed with regard to the settings, comparable examination times were found for urinary tract and brain ultrasound for patients in hospitals and medical practices. This might be partly explained by their well standardized examination procedures. The time requirements for ultrasound of the neck and soft tissue might be similar due to their small study area and the possibility of focused examinations. Hip sonography, the most standardized ultrasound examination in pediatrics [25], showed a significant difference between the settings (hospitals: 13 min. [11–28.25] vs. medical practices: 11 min. [7.5–14.5], p < 0.001). An explanation for these differences in examination times could be a different morbidity profile of the patients examined in hospitals, such as more severe cases, preterms, or earlier diagnostics (at the U2). However, data for further interpretation are not part of this study. Considering the percentage of the time requirement for the overall workflow in all examinations, medical practices and hospitals seem comparable. Especially the "hands-on" time was similar between the

settings (49.9 % vs. 48.9 %). However, medical practices were faster in every single step in terms of the absolute elapsed time, with the exception of the discussion of the findings.

The workflow could be affected by various factors, probably most affected by the severity and complexity of the cases, but also by the coordination of the team and standardization of the internal processes. Unremarkable findings might be more common in medical practices. Therefore, it would be desirable to investigate the final diagnosis of our patients in more detail. Another reason for faster examinations might be that medical practices are more economically driven. As previously shown in adults, the cost of ultrasonography is not even fully covered [9, 10]. Due to the inadequate reimbursement, medical practices are forced to work even more cost efficiently, whereas hospitals can partly compensate the deficit by mixed calculations or even by no profit expectations. The requirement to work quickly and efficiently or the need to initiate more diagnostics possibly leads to referrals of complicated and time-consuming cases to hospitals. Consequently, ultrasonography performed in hospitals may tend to be more time-consuming. This coincides well with our finding that brain and abdominal sonography took even longer in university hospitals than in non-university hospitals, probably due to complex neuropediatric and oncological questions/diagnoses, like suspected intracerebral or abdominal masses. In contrast, circumscribed organ systems like the urinary tract, take the same amount of time in university hospitals, non-university hospitals and medical practices.

Time requirements may further depend on the correct clinical question, the experience of the examiner, the preparation of the patients, and the assistance of medical staff. Cooperation of the patient or the age of the child had no uniform influence on the total time requirement. Interestingly, abdominal sonography in hospitals was quicker if staff members did not assist. This is most likely due to the fact that medical staff in hospitals is only requested to attend in complicated situations, e. g. critically ill patients or handling of multiple infusion lines. However, these findings are difficult to address with a lack of clinical data.

While discussion of findings and diagnosis is uniformly regarded as a physician's duty, delegation of ultrasound examinations or parts thereof to other health care professionals is not homogeneously handled across Europe [20–23]. Communication of the findings and the diagnosis will remain solely the duty of a physician because direct communication is essential for providing a sense of security to both the parents and the child. With regard to the German healthcare system, a well-trained physician, with the ability to decide about upcoming diagnostic or therapeutic steps, is required to perform the whole ultrasound procedure [26]. In this regard, the benefit of sonography performed by physicians outweighs its delegation to other professionals [1, 2, 27] – especially in the youngest patients, where focused symptom-based examinations (POCUS) are not feasible. Although the data of this multicenter study were recorded in 2006, the information is still very valuable. Since then, there has been hardly any change in the execution and standardization of routine pediatric ultrasound. Furthermore, these data could be used as a starting point for future studies addressing the limitations of the present study. First, a correlation between rated indications, e. g. screening, follow-up or complex examinations, pathological findings, final diagnosis and the duration of the examinations should be addressed. Second, technical information, as well as emerging techniques like CEUS might be addressed hereafter. More specifically, the study is limited by its data entries, such as solely dichotomous questions. With regard to Doppler sonography, the influence of the investigated quantity of blood vessels and further Doppler specifications are thereby disregarded and the data remain difficult to interpret. The evaluation of the different time requirements for echocardiography in children is strongly limited by the small number of cases in medical practices in our study. Nevertheless, the different time requirements are probably based on the number of unremarkable murmurs and healthy hearts in medical practices compared to complex heart diseases in hospitals. In addition, the total time requirement could be overestimated by the sequential time recording, when different examination steps were performed simultaneously. To draw further conclusions, the above-mentioned limitations should be addressed in future studies.

This multicenter study provides comprehensive national data regarding the duration of standard ultrasound examinations in children and adolescents and could help to ensure better remuneration according to the time requirement in highly specialized pediatric hospital care in the future.

Conflict of Interest

The authors declare that they have no conflict of interest.

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