


Point-of-care ultrasonography in Norwegian out-of-hours primary health care

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ABSTRACT

Objective: The objective of this study is to determine the extent of ultrasound availability in Norwegian casualty clinics and estimate the prevalence of its use.

Design: A retrospective study based on a national casualty clinic registry and data from reimbursement claims.

Setting: Out-of-hours primary health care in Norway.

Subjects: All Norwegian casualty clinics in 2016 and reimbursement claims from 2008 to 2015.

Main outcome measures: Percent of casualty clinics with ultrasound, types of ultrasound devices and probes, reasons for/against ultrasound access, characteristics of clinics with/without ultrasound, frequency of five ultrasound indications and characteristics of the physicians using/not using ultrasound.

Results: Out of 182 casualty clinics, 41 (23%) reported access to ultrasound. Mobile (49%) and stationary (44%) devices were most frequent. Physician request was the most common cited reason for ultrasound access (66%). Neither population served by the casualty clinic nor distance to hospital showed any clear association with ultrasound access. All of the five ultrasound reimbursement codes showed a substantial increase from 2008 to 2015 with 14.1 ultrasound examinations being performed per 10,000 consultations in 2015. Only 6.5% of physicians performed ultrasound in 2015 and males were significantly more likely to use ultrasound than females (OR 1.85, 95% CI: 1.38–2.47, $p < .001$), even when adjusted for age, speciality status and geography.

Conclusions: Although the use of ultrasound is increasing in out-of-hours Norwegian primary health care, most casualty clinics do not have access and only a minority of physicians use ultrasound.

ARTICLE HISTORY

Received 25 November 2016
Accepted 1 February 2017



KEYWORDS

Point-of-care ultrasonography; ultrasound; out-of-hours; emergency health care; Norway; casualty clinic

Introduction

In Norway, out-of-hours emergency health care is primarily managed by casualty clinics ('legevakt') staffed mainly by general practitioners (GPs). They serve a gatekeeper function to specialized health care for all patients in need of acute medical attention [1]. Only a minority of critically ill patients, predominantly in urban areas, are admitted directly to hospital by ambulance services. The casualty clinics are managed by the municipalities and operate independently of the hospitals. They vary greatly from high-volume urban clinics staffed by multiple physicians and nurses to the low-volume rural clinics with on-call physicians only and great distances to the nearest hospital. In this out-of-hours service, it is the role of the physician to diagnose, treat, admit or arrange follow-up if needed.

History and physical examination remain the cornerstones of all medical diagnostics, also in the casualty clinics. In this fast-paced environment, physicians must make decisions often based on limited and incomplete information. The availability of diagnostic and therapeutic equipment varies between clinics [2]. While most have access to ancillary testing such as basic blood tests and electrocardiogram (ECG), only the minority have the possibility to do radiologic imaging occasionally needed for a definite diagnosis. Patients presenting to the casualty clinics are undifferentiated and cover the entire spectrum from minor illness to life-threatening emergencies [1]. In the acutely ill patients, the physical examination alone is frequently unreliable and attaining the correct diagnosis can be challenging. Although these patients are often referred for admission, incorrect initial diagnosis or therapy could

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increase morbidity and mortality and lengthen hospital stay [3,4].

Development of mobile and hand-held ultrasound devices has given clinicians an opportunity to immediately perform ultrasound at the bedside. Relatively inexpensive and readily available, point-of-care ultrasonography (POCUS) has proven useful in resource-limited emergency care settings [5]. POCUS improves diagnostic performance compared with physical examination alone, shortens time to correct initial therapy, and may improve patient follow-up [6,7]. Even novice ultrasonographers with limited training show high accuracy in certain studies [5,8].

Access to ultrasound devices has increased substantially over the last decades with widespread availability in emergency care settings being reported [9,10]. Even the scope of emergency medicine ultrasound is expanding beyond the traditional 'Focused Assessment of Sonography in Trauma' (FAST), obstetric and abdominal examinations, to encompass a wide variety of clinical presentations and improving the diagnostic capabilities of emergency clinicians.

In Norway, GPs receive no formal training in the use of ultrasound and no level of competency or credentialing is needed to independently perform POCUS. Although some physicians attend dedicated ultrasound courses and become self-proficient, the majority refer all their patients in need of ultrasound to formal imaging. In most instances, radiology performed ultrasound is not immediately available and patients presenting to the casualty clinics must be admitted in order to obtain an ultrasound examination and to expedite diagnostic evaluation.

In 2007, 14% of Norwegian casualty clinics had access to ultrasound [2]. No studies on indications or the extent of its use is known to the best of our knowledge. With the growing use of POCUS worldwide the main objective of this study was to determine the current extent of ultrasound availability and estimate the degree of which it was utilized in the period from 2008 to 2015 in Norwegian casualty clinics. In addition, we analysed the possible association between ultrasound access and casualty clinic location and/or population basis, the characteristics of the physicians performing ultrasound and patients who were examined.

Material and methods

For this observational study, two different sets of data were collected, casualty clinic registry data from the 'National Centre for Emergency Primary Health Care' and reimbursement claims from the 'Norwegian Health Economics Administration' (HELFO).

The casualty clinic registry is a national registry containing information on organization, resources, equipment and local procedures of all Norwegian casualty clinics [10]. The National Centre for Emergency Primary Health Care updates the registry every second or third year through online surveys. The most recent survey was sent out by email February 2016 to clinic managers, most of whom are nurses or physicians with comprehensive knowledge about the clinic. Non-responders received two e-mail reminders and subsequent contact by phone until a complete dataset had been obtained. The 2016 survey included questions regarding ultrasound. Questions were developed by the first author and pre-tested by experienced and novice ultrasonographers and redefined for clarity and relevance. The clinics were asked about access to ultrasound (yes/no), the type of devices (stationary – patient moves to device/mobile – device moves to patient/hand-held/other) and ultrasound probes (linear/curvilinear/phased array/vaginal/other), and arguments as to why the clinic had/did not have access to ultrasound. Except for the first question, multiple answers could be chosen and a comment section was available for clarification. Data on population size of the casualty clinic district in 2015 and distance to the nearest hospital were collected from 'Statistics Norway' (SSB) and 'Google Maps', respectively. The clinics were divided into four categories based on both population size and distance to hospital in order to analyse the possible association with ultrasound access.

HELFO processes and keeps records of reimbursement claims from casualty clinic physicians. The 'National Centre for Emergency Primary Health Care' annually receives reimbursement data from HELFO in order to produce reports on casualty clinic activity. Patient data are de-identified and given an anonymous identification number prior to delivery. Furthermore, the data is not linked to individual municipalities and cannot be cross-referenced with data from the casualty clinic registry. After each casualty clinic consultation, the physician fills out a reimbursement claim containing information about the type of consultation, patient details, diagnosis, special procedures or laboratory investigations performed, time use and qualifications of the physician. As of 2008, six different ultrasound examinations became eligible for reimbursement in primary health care: confirmation and quantification of urinary retention, determination of fetal position prior to labour, first trimester bleeding, suspicion of peripheral vessel thrombosis, suspicion of gallbladder or aortic disease, and diseases of the soft tissues (abscesses, cysts and others). We analysed data from 2008 to 2015 to

estimate the frequency of five of the six ultrasound examinations. Data on urinary retention were excluded from analysis as we suspected that most examinations were performed by bladder scanner and not conventional ultrasound. Also 33 pregnancy-related reimbursement claims in males were assumed miscoded and removed from the material. Data were from out-of-hours only and included all electronic reimbursement claims (>99% of all consultations). Reimbursement claims analysed for physician characteristics contained 60.5% of all consultations in 2015, the remainder of the physicians were labelled unidentifiable as they received a fixed salary and the reimbursement claims were collected by the clinics themselves. Physicians were divided into groups of centrality, defined as a municipality's geographical location in relation to a centre where there are important central functions, and measured on a scale from 0 to 3, where 0 is least central (rural) and 3 is most central (urban) [11].

Data were imported to and analysed in IBM SPSS Statistics 23[®] (IBM Corp, Armonk, NY). Comparisons were done by frequency tables and Pearson Chi-square analyses. To further analyse the influence of doctors' characteristics on the adoption of ultrasound technology, we performed a multiple logistic regression analysis, using physician's sex, age, GP speciality and centrality as independent variables. Dependent variable was use or no use of ultrasound during 2015.

As the data from HELFO are anonymous, the 'Norwegian Social Science Data Services' assessed the material as exempted from mandatory notification. For the same reason, the 'Norwegian Labour and Welfare Administration' concluded that there was no need to apply for dispensation from professional secrecy requirements.

Results

There were 182 casualty clinics in Norway in 2016 and all of them filled out the survey with questions regarding ultrasound. Out of these, 23% (41/182) responded that they had at least one ultrasound device permanently available. Mobile devices were the most prevalent with 49% (20/41), 44% (18/41) had a stationary device, while 24% (10/41) had a hand-held device. Curvilinear and linear ultrasound probes were the most prevalent with 80% (33/41) and 76% (31/41), while the vaginal probe and the phased array were less common with 37% (15/41) and 17% (7/41), respectively. When asked why the clinic had access to ultrasound (Table 1), physician request was the most common cause. Six clinic managers commented that

co-localization with another health facility was a factor as to why they had access. Among the non-access group lack of specially trained physicians was the most frequent factor whilst seven clinics stated an intention to purchase a device in the not-too-distant future. Distribution of clinics by population and distance to hospital is shown in Table 2. Neither population size ($p=.13$) nor distance ($p=.29$) showed statistically significant associations with ultrasound availability.

The total number of casualty clinic consultations in Norway remained relatively stable throughout the study period with about 1.35 million/year. There was a steady increase in all of the five ultrasound indications (Figure 1) from 2008 to 2015 with 1893 examinations reimbursed in 2015 and 7828 for the entire period. Examinations of the gallbladder and aorta were the most prevalent with 3381 examinations in total. In 2015, one ultrasound examination was reimbursed per 709 consultations (1893/1,342,521) or a rate of 14.1 per 10,000 consultations at a national level. Including only clinics with ultrasound the rate was 33.9 per 10,000.

When pregnancy-related examinations were excluded the rate of female ultrasound examinations were 5.6/10,000 consultations compared to 4.9/10,000 in males. Patient sex distribution and mean age for the different ultrasound indications are shown in Table 3.

Table 1. Why casualty clinics have ($n=41$) or do not have ($n=141$) ultrasound available. Multiple answers possible.

Response categories	N	%
Reasons for ultrasound access		
Far from hospital	15	37
Far from X-ray	7	17
Requested by physicians	27	66
Specially trained physicians	15	37
Other	16	39
Reasons against ultrasound access		
Do not see the need	33	23
Financial	44	31
Not requested by physicians	61	43
Lack of specially trained physicians	63	45
Other	35	25

Table 2. Distribution of casualty clinics by population size, distance to hospital, and ultrasound availability.

Casualty clinic characteristics	Ultrasound availability (%)
Population served by the casualty clinic	
0–2999 ($n=35$)	31
3000–14,999 ($n=73$)	16
15,000–49,999 ($n=48$)	18
50,000+ ($n=26$)	35
Distance to nearest hospital (km)	
0 ($n=37$)	19
1–39 ($n=54$)	17
40–99 ($n=55$)	24
100+ ($n=36$)	33

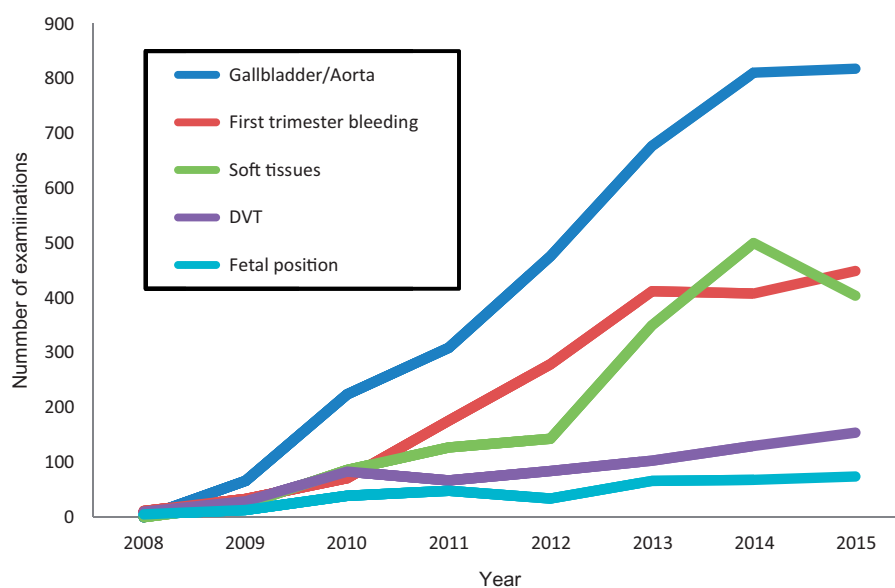


Figure 1. Total number of ultrasound reimbursements per year from 2008 to 2015.

Table 3. Age and sex distribution of patients examined by ultrasound from 2008 to 2015.

Examination	Female		Male	
	N	Age (95% CI)	N	Age (95% CI)
Fetal position	324	29.3 (28.2–30.4)	–	–
Bleeding first trimester	1829	29.3 (29.1–29.6)	–	–
Deep vein thrombosis	402	56.4 (54.4–58.5)	258	59.9 (57.9–61.9)
Gallbladder/Aorta	1943	45.3 (44.3–46.3)	1438	49.5 (48.3–50.7)
Soft tissues	844	42.3 (40.8–43.8)	790	43.3 (41.7–45.0)
Total	5342	39.1 (38.6–39.7)	2486	48.7 (47.8–49.6)

From 2008 to 2015, extended consultation time and laboratory services were reimbursed in 75.6% and 52.2% of ultrasound consultations, respectively, compared with 35.6% ($p < .01$) and 37.6% ($p < .01$) in the non-ultrasound consultations.

In 2015, 6.5% (259/3965) of casualty clinic physicians performed at least one ultrasound examination, a significant increase compared with 2.3% in 2010 and 4.6% in 2012 ($p < .01$). Of the physicians performing ultrasound in 2015, 73.7% were male compared with 59.1% in the non-ultrasound group. GP specialists accounted for 34.0% of the physicians in the ultrasound group, whilst 28.7% in the non-ultrasound group. Adjusted for age, GP specialist status and centrality males were significantly more likely to be ultrasound users compared with females (Table 4).

Discussion

From 2007 to 2016, there has been an increase in ultrasound availability in Norwegian casualty clinics from 14% to 23%, although the absolute increase in number of devices is likely to be lower as the number of

Table 4. Physician characteristics and odds ratio (OR) for use of ultrasound.

Variables	Unadjusted			Adjusted		
	OR	95% CI	<i>p</i>	OR	95% CI	<i>p</i>
Age (continuous)	1.02	1.01–1.03	.007	1.01	0.99–1.02	.214
Sex						
Female	Ref.			Ref.		
Male	1.94	1.46–2.58	<.001	1.85	1.38–2.47	<.001
GP specialist						
No	Ref.			Ref.		
Yes	1.28	0.98–1.67	.073	1.17	0.87–1.57	.296
Centrality						
0 (rural)	Ref.			Ref.		
1	1.26	0.84–1.88	.259	1.26	0.84–1.89	.264
2	0.46	0.31–0.68	<.001	0.45	0.31–0.67	<.001
3 (urban)	0.74	0.54–1.01	.054	0.75	0.55–1.03	.072

casualty clinics has decreased from 261 to 182 in the same period [2]. Emergency departments from other countries have reported much higher rates of ultrasound availability [9,10], albeit not directly comparable due to the structural organization of emergency health care in Norway with smaller volume clinics staffed by general practitioners.

In this study, we found no significant association between distance to hospital or population served by the casualty clinic and ultrasound availability. However, 37% of clinics listed distance to hospital as a factor for purchasing an ultrasound device. It seems likely that individual physician interest and competence play an important role, more so than geographical and structural factors, when determining why certain clinics have ultrasound.

Of the clinics with ultrasound, 80% reported having the curvilinear probe available, which is consistent

with the fact that examinations of the gallbladder and aorta were the most prevalent. In 2015, abdominal pain was the third most frequent diagnosis in Norwegian out-of-hours service [12] and the usefulness of abdominal ultrasound compared with the physical exam alone is unquestionable. In the future, one might argue that there is a role for abdominal ultrasound examinations beyond that of the gallbladder and aorta as evaluation for appendicitis or small bowel obstruction has shown excellent results in the hands of emergency clinicians [13]. Only 17% of clinics had access to the phased array probe, suggesting that cardiac ultrasound examinations are rarely performed and is probably beyond the current scope of casualty clinic POCUS.

The reimbursement data show a steady increase in the number of ultrasound examinations per year; however, the percentage of physicians using ultrasound is low, only 6.5% performed at least one examination in 2015. The non-access clinics cited lack of trained physicians as the most frequent factor as to why they did not have ultrasound available. Other studies indicate that inadequate teaching and supervision is a major barrier for widespread ultrasound implementation [14,15].

According to the 'theory of diffusion of innovation', demographic factors such as gender should be irrelevant when it comes to adoption of innovations [16]. In this study however, we found that male physicians used ultrasound more than their female colleagues. Other studies have also shown this, suggesting that male physicians are more likely to be early adopters of ultrasound [9,17]. Noteworthy, one study found that females felt they required more training compared to males to start using POCUS [18]. Similar examples can be found elsewhere in the adoption of technology [19].

Ultrasound examinations were associated with increased consultation length and use of laboratory services. This may indicate that ultrasound is used in more complex cases requiring broader workup and diagnostic evaluation. However, it is important to emphasize that the two groups contain different spectra of diagnoses as the non-ultrasound group includes presentations where ultrasound would not be appropriate (i.e. psychiatric disorders). The groups are, therefore, not directly comparable.

In this study, we were limited to data from reimbursement claims to estimate the frequency of ultrasound examinations. Whilst the financial incentive makes it likely that almost all of the performed examinations eligible for reimbursement were registered, non-eligible examinations such as focused

echocardiography, lung ultrasound and others were not included in the analysis, thus underestimating the total ultrasound examinations performed. Some of the initial increase seen in Figure 1 might be attributed to the introduction and familiarity of ultrasound reimbursement rather than an actual increase in the number of examinations. However, the steady increase seen towards the end of the study period strongly suggests increased use of POCUS in the casualty clinics. None of the datasets contained information regarding admission rates, outpatient referrals or medication prescription, which would have allowed us to analyse the downstream effects of ultrasound use.

The use of POCUS in Norwegian casualty clinics or emergency primary health care in general has not been well studied and more research is needed before any conclusive statement regarding its utility can be agreed upon. Given the body of evidence supporting POCUS in emergency medicine the data from this study suggests that ultrasound is underutilized in Norwegian out-of-hours services. Recently, ultrasound training was implemented in medical school curriculum in one Norwegian university [20] so it is likely that the next generation of doctors will be more familiar and eager to adapt POCUS.

Disclosure statement

This study was exempted from ethical approval and the authors report no conflicts of interest. The authors report no conflicts of interest.

Funding

The study was funded by the National Centre for Emergency Primary Health Care, Uni Research Health, Uni Research AS, Bergen, Norway.

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