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Continuing professional development for primary care physicians: a pre-post analysis of a focused abdominal point-of-care ultrasound pilot training

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Abstract

Introduction Abdominal pain is a leading cause of primary care visits and emergency department admissions. The recent surge in the implementation of point-of-care ultrasound into primary care underscores the necessity for specialized training to enhance the expertise of primary care physicians and foster a positive attitude toward its routine use in clinical activities.

Methods This prospective cohort study, conducted between March and August 2023 at Ben Gurion University, introduced an integrative abdominal ultrasound program for 48 participating primary care physicians with no prior formal experience in abdominal ultrasound. Physicians' knowledge, practical skills, and attitudes towards abdominal ultrasound integration were evaluated using a pre/post-course clips-based pathology test, a hands-on exam immediately following the course, and a survey conducted ten weeks later.

Results Post-course evaluations showed an improvement in primary care physicians' proficiency with hands-on skills, increasing from 26 to 69% ($p < 0.001$), with increased comfort using abdominal ultrasound (from 0 to 42%, $p < 0.001$) and enhanced understanding of its capabilities and limitations (from 0 to 58%, $p < 0.001$). Pattern recognition skills, assessed through clips, presented a notable rise from an average of 26% to 69% ($p < 0.001$). Ten weeks following the training, an increase in its utilization was observed; weekly usage rose from zero to 44%, and the proportion not using it declined from 94 to 19% ($p < 0.001$, $p < 0.001$, respectively).

Conclusions An integrative two-day training program increases the application of abdominal bedside ultrasound in clinical settings, demonstrating the effectiveness of combining practical training with flexible, theoretical learning.

Keywords On-the-Job Training, Ultrasonography, Primary Care, Medical Education

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Introduction

Abdominal pain is a common complaint in primary care and accounts for the fifth most frequent reason for primary care visits [1–3] and 10% of all emergency department admissions [1, 3–5]. In roughly one-third of abdominal pain cases treated in community settings, the exact cause of the abdominal pain remains unidentified, underscoring the diagnostic challenges encountered by primary care physicians (PCP) [4].

The assessment of abdominal pain is based on patient history and physical examination, focusing on distinguishing acute from chronic symptoms [5–7]. The conventional approach to abdominal examination often falls short of accurately diagnosing various conditions, including renal and hepatobiliary morbidities as well as ascites [5–7]. This challenge underscores the need for more reliable diagnostic tools in clinical settings. While computed tomography (CT) remains the gold standard for diagnosing various abdominal issues, its limited immediate availability poses a significant challenge, particularly in community and rural healthcare settings [4, 8]. In this context, the emergence of abdominal ultrasound (AUS) presents a promising alternative.

AUS offers a portable, accessible, and user-friendly option for bedside diagnosis. Its effectiveness in identifying a spectrum of abdominal conditions has been increasingly recognized [9]. Notably, AUS has demonstrated efficacy in diagnosing acute conditions such as cholecystitis and renal colic and in identifying critical signs like free fluid [10]. This suggests its potential as a valuable tool in enhancing diagnostic accuracy and patient care in various medical settings.

Previous studies indicate that physicians consider point-of-care ultrasound (POCUS) user-friendly and time-efficient with short training periods, prompting organizations such as the American Academy of Family Physicians to include it in residency curriculum guidelines for primary care [11, 12]. However, as of 2014–2019, POCUS teaching programs remain insufficient, with only 53% of family medicine residencies incorporating POCUS curricula [13], while others reported PCPs'reluctance to adopt the modality [8]. The limited research on establishing and evaluating the effectiveness of focused AUS techniques in community settings underscores the need for more comprehensive training to integrate them into initial patient encounters [14, 15].

This prospective cohort study implemented a streamlined, innovative AUS training program, previously proven effective in lung ultrasound, to support continuous professional development among primary care physicians [16]. The curriculum was structured using Peyton's Four-Step Approach, a well-established instructional method for teaching POCUS [17–21] along with a recognized six-step framework for acquiring procedural skills [22]. Peyton's method consists of: 1) Demonstration—where the instructor performs the skill at a normal pace without commentary; 2) Deconstruction—the instructor repeats the procedure while explaining all necessary sub-steps; 3) Comprehension—the student guides the instructor through the steps to reinforce understanding; and 4) Performance—the student independently executes the skill. Our evaluation of the course's effectiveness focused on two key aspects: first, the enhancement of participants' hands-on skills and competence in identifying abdominal pathologies using POCUS, and second, the shifts in primary care physicians' attitudes toward integrating AUS into their daily practice.

Methods

This prospective cohort feasibility study was cunducted at Ben Gurion University Medical Simulation Center, southren Israel, and with the approval of the university's ethics board committee (reference number 15–2022). The sessions were led by an ICU physician with 15 years of POCUS experience and a radiologist specializing in abdominal ultrasound, supported by teaching assistants with at least three years of experience. Data gathering was carried out from March to August 2023. This prospective cohort feasibility study followed the DoCTRINE guidelines to report innovations in education [23].

Goals of the curriculum

The study aimed to assess the practicality and effectiveness of training PCPs to perform and interpret essential AUS scans through an 11-h ultrasound course using the Venue Go™ POCUS device. The primary objective was to evaluate the impact of the course on PCPs'perceptions of its real-world utility, while the secondary goal was to assess their ability to distinguish normal from pathological POCUS images and perform AUS scans proficiently.

Target population of learners

48 attending and resident PCPs affiliated with Israel's largest Health Maintenance Organizations (HMOs), Maccabi and Clalit, serving over 75% of the nation's population [24] participated in an abdominal POCUS training program. Before this training, the participating PCPs had not received any abdominal POCUS training. Their involvement in the study was voluntary, contingent upon providing written informed consent. The performance outcomes were kept confidential and not shared with any supervisory entities, precluding any influence on PCP's professional assessment.

Outcome-based learning objectives

The AUS program had four key learning objectives, evaluated immediately after the course and 10 weeks later (Fig. 1). First, it aimed to develop PCPs'proficiency in performing high-quality AUS exams for clinical decision-making. Second, it focused on interpreting AUS clips to differentiate normal from pathological conditions like hydronephrosis, nephrolithiasis, renal cysts, gallbladder stones, cholecystitis, choledocholithiasis, biliary obstruction, and abdominal aortic aneurysm/dissection. Third, it aimed to enhance diagnostic competence in abdominal pathologies. Finally, the program assessed the impact on PCPs'confidence and willingness to incorporate AUS into their practice.

Curriculum implementation

Instructional setting and resources for curriculum delivery

To prepare for the practical workshops, the participants received eight recorded lectures, totaling five hours. Two lectures addressed POCUS principles and technology, while six others focused on its use in diagnosing abdominal pathologies. (Appendix S1 presents the course syllabus). The hands-on sessions were conducted in small groups of five PCPs, utilizing the 3D Simbionix US Mentor Systems (Ultrasound Mentor | Simbionix, Fig. 2 [25]) and live-patient models using the Venue Go™ by Ge Healthcare.

Description of instructional method

Preparatory lectures

Before the hands-on workshops, the PCPs engaged with two pre-recorded lectures, cumulatively lasting 1.1 h, covering the "Introduction to Ultrasound" and "Principles of Ultrasound Technology" (Appendix S1).

Hands-on practice

Following the lectures, PCPs had six hours of guided hands-on training led by an intensive care physician with 15 years of experience in clinical POCUS (divided into two sections of three hours each, Fig. 1). PCPs practiced image acquisition utilizing standard ultrasound devices (Venue Go™ by Ge Healthcare) on healthy models. The PCPs were instructed in executing subtle transducer movements and mastering three fundamental techniques

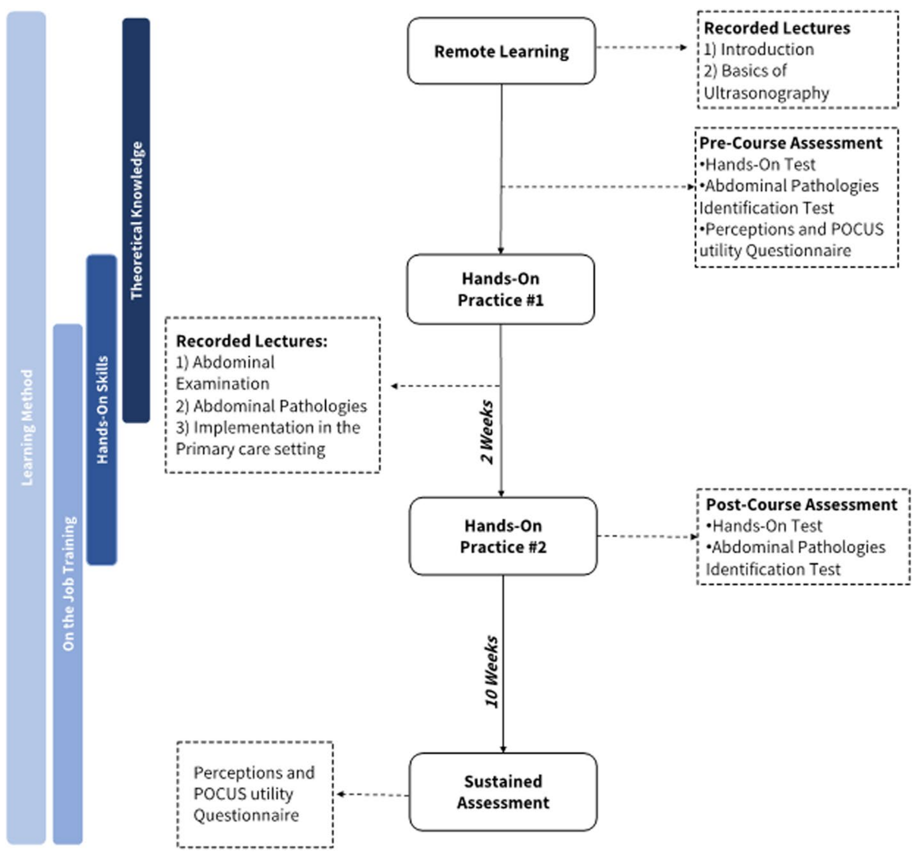

Fig. 1 Training Timeline. This chart outlines the abdominal ultrasound training sequence, starting with pre-course assessments, the first hands-on practice, a 2-week in-clinic practice and recorded lectures phase, post-course assessment during the second hands-on practice, and a final evaluation after ten weeks

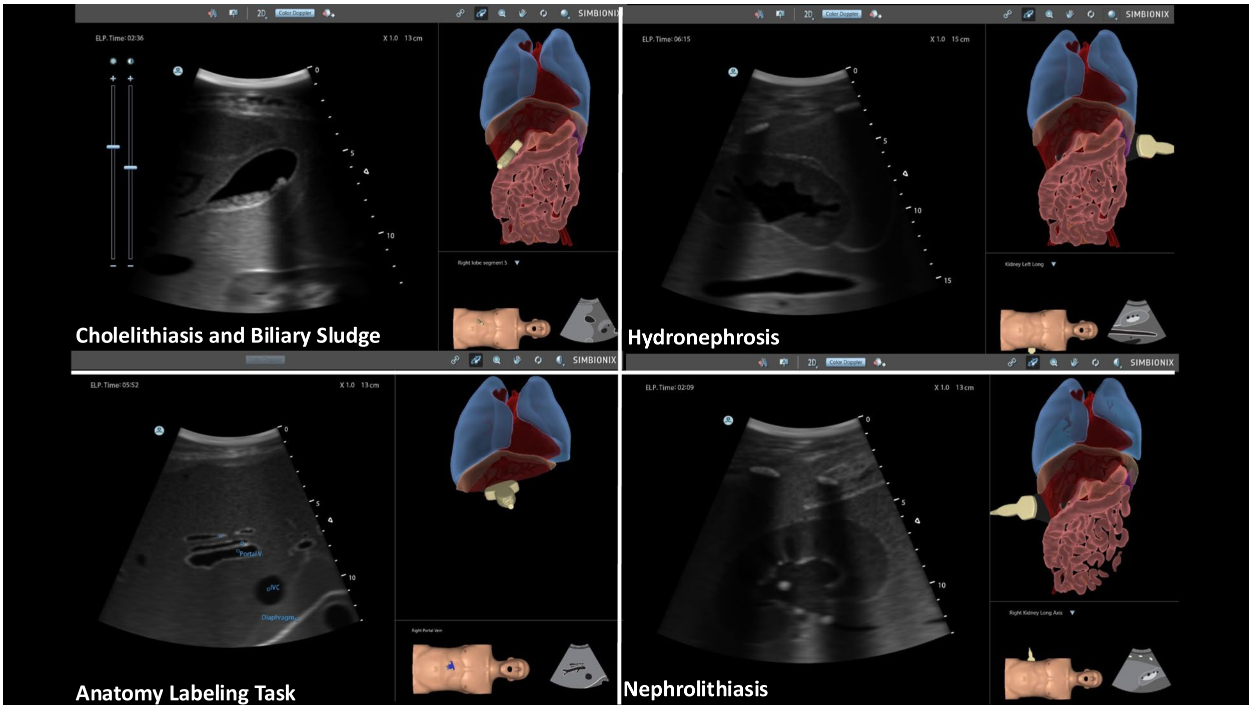

Fig. 2 Ultrasound Mentor | Simbionix, Abdominal Module. This figure presents a series of ultrasound images alongside corresponding 3D anatomical models. Top left: Gallstones and gallbladder sludge depicted in an ultrasound image with a visual guide to the gallbladder anatomy. Top right: Hydronephrosis shown in ultrasound with a 3D model illustrating renal pelvis dilation. Bottom left: Anatomy labeling task featuring an ultrasound image of the portal vein (Port.V), inferior vena cava (IVC), and diaphragm, accompanied by a 3D anatomical representation. Bottom right: Kidney stones identified in an ultrasound image with a corresponding 3D kidney model, highlighting the location of the scan in real life

(alignment, rotation, and tilt) to optimize image quality for each view.

AUS pathology lectures

Following the first hands-on workshop, participants were instructed to review six recorded lectures focused on POCUS's application for diagnosing abdominal pathologies before the second workshop (Lecture Syllabi-Appendix S1, lecture recordings would be available upon request). Lecture topics were as follows: Abdominal examination and diagnosis using AUS and AUS scan per organ: liver, gallbladder, pancreas, spleen, kidneys, bladder, and abdominal aorta.

On-the-job training

PCPs were encouraged to integrate ultrasound image acquisition into their routine clinical activities between training sessions. This practice was voluntary, with no set requirement for practice hours. An inclusion criterion of the study ensured all PCPs had access to a device for individual practice in the clinic, but the independent practice was not tracked.

Methods to evaluate achievement of outcome-based learning objectives

Pre-course assessment

An assessment was conducted before the course to gauge the proficiency and perceptions of PCPs regarding POCUS. A subset of 13 (27%) PCPs, randomly chosen, participated in a hands-on technical evaluation in abdominal POCUS using human models. Each participant was asked to demonstrate three AUS views on a human model. A POCUS expert, blinded to whether the demonstration was pre or post-course**,** reviewed these demonstrations, classifying them as correct or incorrect (Appendix S2). Additionally, to evaluate the PCPs'perceptions and usage of POCUS, a Likert scale questionnaire of 11 statements adapted from a previously validated study (Cronbach's alpha =0.84) was administered [26]. (Appendix S3) An eight-question AUS pathology identification test was also designed to assess the PCPs'skill in distinguishing between normal and pathological AUS images (Appendix S5) [26]. The clips-based assessments were uploaded to a cloud with an appropriate blinded coding system for both pre- and post-course evaluations.

Immediate post-course physiology and pathology assessment

PCPs underwent two examinations after the training. The abdominal pathology identification test mirrored the pre-course assessment (Appendix S5), evaluating their capacity to differentiate between normal and pathological AUS scans. As in the pre-course assessment, evaluators were blinded to whether the test originated from the pre- or post-course, with all clips uploaded to a cloud platform using a coded system. The second test involved a hands-on ultrasound examination of human models, assessed by a POCUS expert**,** blinded to the pre/post status who categorized the results as either correct or incorrect (criteria outlined in Appendix S2).

Ten-week post-course PCP's perceptions of abdominal POCUS questionnaire

All physicians who participated in the 2023 POCUS courses received an identical 11-statement questionnaire, mirroring the pre-course assessment (Appendix S3, S4). Participants rated their agreement with each statement on a Likert scale of 0 to 4 or 5. The questionnaire assessed physicians'views on integrating abdominal POCUS into practice, focusing on its potential to improve diagnosis speed, accuracy, decision-making, and patient care. Administered online 10 weeks after course completion, it evaluated the course's lasting impact on ultrasound use and perceptions.

Statistical analysis

Descriptive statistics were calculated to summarize the sample characteristics. The McNemar test, paired t-test, and Wilcoxon signed-rank test were utilized to compare pre-and post-tests and questionnaire results. The analysis covered the entire participant cohort, with no missing data. The Shapiro–Wilk test was employed to evaluate the normality of the variable distributions. Variables with skewed distributions were reported as medians (IQR), while normally distributed variables were shown as means (SD). To further assess the magnitude of changes, we calculated effect sizes: Cohen's d for continuous variables, odds ratios for dichotomous data, and rank-biserial correlations (r) for ordinal items. The reliability of the questionnaires was assessed using Cronbach's alpha ($\alpha = 0.895$). A priori power analysis assumed $\alpha = 0.05$, with 80% of participants not using AUS before the course and 30% after, based on prior research and teaching experience with AUS in professional development programs. This analysis indicated that a sample of 30 participants would provide 80% power to detect a 40% change in AUS utilization from pre- to post-course. Furthermore, prior analysis with a group of primary care physicians evaluating lung ultrasound using similar teaching methods demonstrated that a sample size of 50 participants was sufficient to capture the training effect [16]. The study was sufficiently powered based on these parameters. All statistical analyses were conducted at a significance level of $\alpha = 0.05$ (two-sided) using R Studio 4.4.0.

Results

The training included 48 resident and attending primary care physicians (PCPs), with a balanced representation from Israel's two leading Health Maintenance Organizations: Maccabi (54%) and Clalit (46%). The participants had an average age of 40.52 (SD 9.45) years, demonstrated a well-distributed sex representation, and included 69% Attending Physicians and 31% Resident Physicians. While the hands-on test was conducted on a random sample of participants due to logistical constraints, complete data were collected for all other measures in both pre- and post-course assessments. Comprehensive details of these baseline characteristics are presented in Table 1.

Abdominal POCUS physiology and pathology assessment

Hands-On AUS proficiency assessment

The hands-on proficiency of PCPs in AUS was evaluated at pre- (T1) and post- (T2). At T1, a subset of 13 (27%) randomly selected participants demonstrated minimal competency with a mean score of 8% (SD 15%). Following the course (T2), an improvement was observed with a mean score of 74% (SD 29%) ($p < 0.001$, Cohen's d = 3.66 [2.04, 5.26]).

Clips-based assessment

PCPs took a pre-course 8-item abdominal identification test based on AUS clips (Fig. 3). Comparing pre (T1) and post (T2) performance reveals substantial skill enhancements (Table 2). Ability to identify transducer placement on patient images improved significantly: recognizing Morrison's pouch placement increased from 35 to 83% *($p < 0.001$, OR = 12.5 [2.96, 52.77])*, and positioning for

Table 1 Background characteristics

Variable	Statistic
Health Maintenance Organization, n (%)	
Clalit	22/48 (46%)
Maccabi	26/48 (54%)
Sex, Female, n (%)	23/48 (48%)
Age, Mean (SD)	40.52 (9.45)
Experience, n (%)	
Attending Physician	33/48 (69%)
Resident Physician	15/48 (31%)

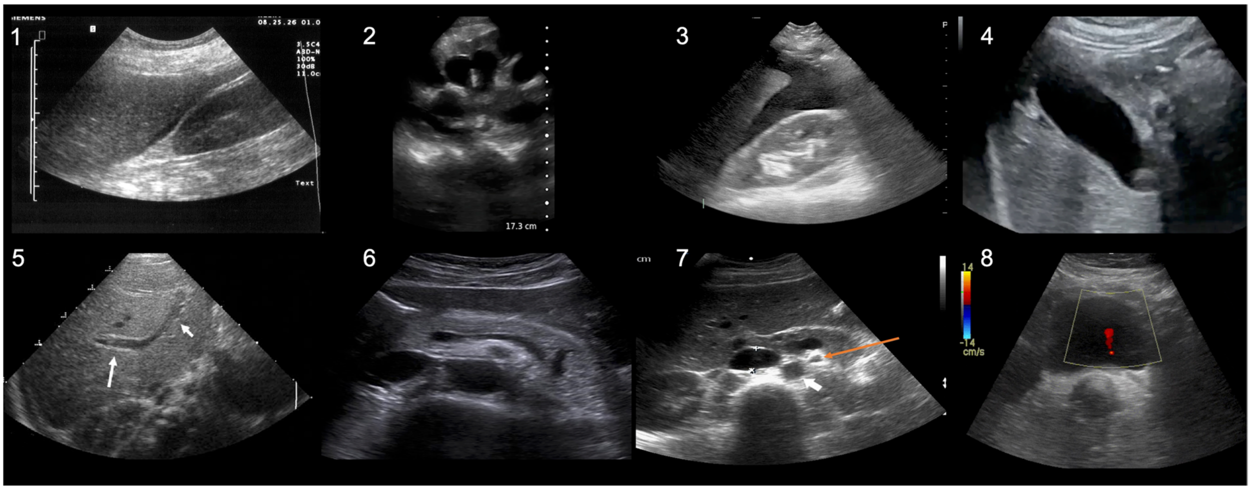

Fig. 3 Presents a series of ultrasound images presented in the US Clips-Based Assessment: Item 1 shows the transducer placed in a position to visualize "Morison's pouch"; Item 2 displays an ultrasound image of a dilated renal pelvis and calyces; Item 3 illustrates an ultrasound indicative of the presence of free fluid in the abdomen (FAST positive); Item 4 depicts the gallbladder with a thickened wall; Item 5 reveals an expanded Wirsung duct; Item 6 provides a subxiphoid view capturing the inferior vena cava, abdominal aorta, portal, splanchnic veins, and superior mesenteric artery; Item 7 focuses on non-pathologic view of the abdominal aorta (white arrow) and superior mesenteric artery alone (orange arrow); and Item 8 shows the bladder with its physiologic appearance

Table 2 Ultrasound clips based assessment

Ultrasound Clip (correct)		Time T1	Time T2	p[1]	Effect Size (95% CI)
Anatomical-Theoretical Transducer Placement, n (%)	"Morison's pouch"	17/48 (35%)	40/48 (83%)	< 0.001	OR = 12.5 (2.96, 52.77)
	Abdominal Vasculature: IVC, aorta, portal, and splanchnic veins, and the SMA	12/48 (25%)	30/48 (63%)	< 0.001	OR = 4.6 (1.75, 12.1)
Hydronephrosis, n (%)		18/48 (38%)	41/48 (85%)	< 0.001	OR = 8.67 (2.62, 28.63)
FAST positive, n (%)		14/48 (29%)	38/48 (79%)	< 0.001	OR = ∞ (NA, ∞)
Cholecystitis, n (%)		14/48 (29%)	38/48 (79%)	< 0.001	OR = 9 (2.73, 29.67)
Wirsung duct expansion, n (%)		15/48 (31%)	32/48 (67%)	0.002	OR = 3.83 (1.56, 9.41)
Superior Mesenteric Artery, n (%)		11/48 (23%)	37/48 (77%)	< 0.001	OR = 27 (3.67, 198.7)
Normal Bladdder (no pathology), n (%)		16/48 (33%)	41/48 (85%)	< 0.001	OR = 13.5 (3.21, 56.77)
Total Score,Mean (SD)		26% (15%)	69% (14%)	< 0.001	Cohen's d = 2.24 [1.7, 2.76]

Abbreviations: *IVC* Inferior Vena Cava, *FAST* Focused Assessment With Sonography in Trauma, *SMA* Superior Mesenteric Artery

[1] McNemar test, Paired t-test

abdominal vasculature—including inferior vena cava, abdominal aorta, mesenteric vessels—rose from 25 to 63% *($p < 0.001$, OR = 4.6 [1.75, 12.1])*. Recognizing a physiologic bladder increased from 33 to 85% *($p < 0.001$, OR = 13.5 [3.21, 56.77])*, and hydronephrosis identification improved from 38 to 85% *($p < 0.001$, OR = 8.67 [2.62, 28.63])*. Recognition of a Focused Assessment with Sonography in Trauma (FAST) positive ultrasound image rose from 29 to 79% *($p < 0.001$, OR = ∞)*, while cholecystitis identification improved from 29 to 79% *($p < 0.001$, OR = 9 [2.73, 29.67])*. Recognition of Wirsung duct expansion increased from 31 to 67% *($p = 0.002$, OR = 3.83 [1.56, 9.41])*. Superior mesenteric artery identification rose from 23 to 77% *($p < 0.001$, OR = 27 [3.67, 198.7])*. Overall scores increased from a mean of 26% to 69% *($p < 0.001$, Cohen's d = 2.24 [1.7, 2.76])*.

Perceptions of abdominal POCUS among PCPs

Forty-eight participants (100%) answered both pre- and post-questionnaires (Fig. 4). Ten weeks after the abdominal POCUS course, PCPs significantly increased their use of AUS: usage at least four times per month rose from 6 to 79%, and non-users decreased from 94 to 19% ($p < 0.001$, $r = 0.95$ [0.9, 0.97]). PCPs reported enhanced

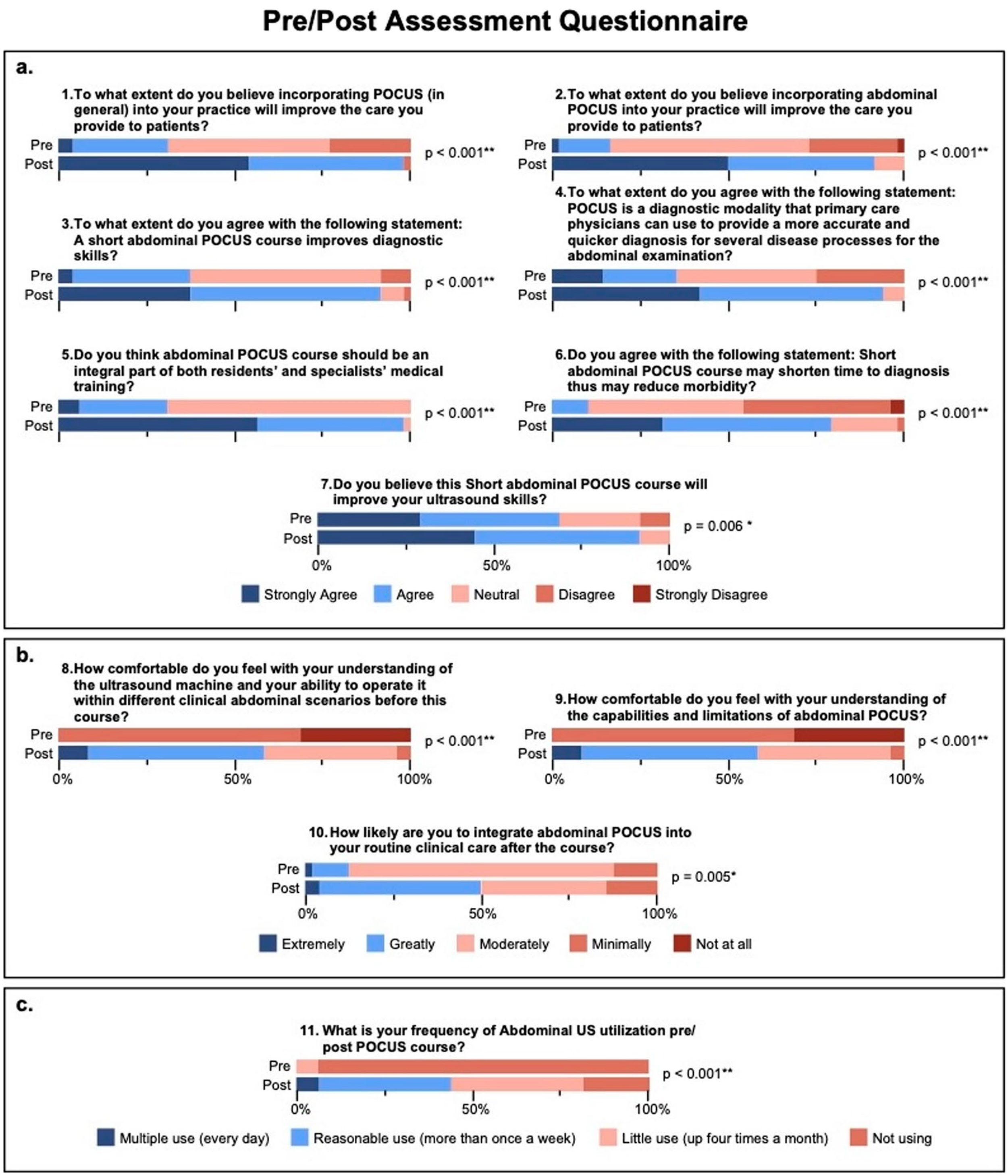

Fig. 4 Primary Care Physicians' Perceptions Of Point Of Care Ultrasound portrays the outcomes of pre- and post-assessment questionnaires administered to primary care physicians regarding their perspectives and involvement with abdominal point-of-care ultrasound (POCUS). Subsection (**a**) exhibits a statistically significant positive change in primary care physicians' attitudes toward the integration of POCUS into their clinical practice. Subsection (**b**) demonstrates an improvement in their confidence and comprehension of POCUS, while subsection (**c**) indicates a notable increase in the frequency of abdominal ultrasound utilization. The statistical significance of these pre- to post-training changes is supported by *p*-values, and detailed percentage data can be found in Appendix S6

comfort with abdominal POCUS; those feeling “Not at all” comfortable decreased from 52% to 2.1%, and 82% felt “Moderately” or “Greatly” comfortable post-course ($p < 0.001$, $r = 0.93$ [0.87, 0.96]). Recognition of abdominal POCUS’s diagnostic potential improved, with 79% selecting “Greatly” or “Extremely” post-course ($p < 0.001$, $r = 0.98$ [0.96, 0.99]), and intent to integrate POCUS into daily practice increased from 6.3% to 56% ($p < 0.001$, $r = 0.53$ [0.26, 0.72]). Beliefs about POCUS’s diagnostic speed and accuracy improved, with 92% marking “Agree” or “Strongly Agree” post-course ($p < 0.001$, $r = 0.85$ [0.73, 0.92]). Belief in its role in mortality prevention rose, with “Agree” or “Strongly Agree” responses increasing from 36 to 94% ($p < 0.001$, $r = 1$ [1, 1]).

Discussion

To the best of our knowledge, this study represents one of the first documentations of the perceived sustained impact of a brief AUS program for PCPs. The curriculum demonstrated notable improvements in PCPs’ AUS skills. Additionally, PCPs reported a more positive perspective regarding the integration and importance of AUS in their clinical practice. While further research is needed to assess long-term skill retention through objective testing, these findings suggest that AUS training may contribute to enhancing primary care practice.

Teaching procedural skills like AUS presents unique challenges in healthcare education due to the need for specialized knowledge, effective communication, and hands-on technical skills [27–29]. Given these challenges and the time constraints faced by primary care physicians (PCPs) [30], a comprehensive, time-efficient pedagogical strategy was developed. The curriculum follows Peyton’s Four-Step Approach, a well-established method for teaching POCUS [17–21] alongside a six-step competency framework for procedural skills [22]. The first two steps of Peyton’s approach (Demonstration, Deconstruction) [21] were adapted to a remote format using pre-recorded lectures and step-by-step AUS scanning demonstrations, allowing the hands-on training (step three) to focus on practical experience with real-time instructor feedback. Additionally, healthy human models were used to enhance communication skills to help PCPs manage complex examination elements, such as the sonographic Murphy sign, which may cause discomfort. The training was divided into two sessions over two weeks, incorporating on-the-job practice where PCPs applied AUS in real clinical settings, following the recognized six-step approach [22]. To maximize efficiency and minimize disruption to PCPs’ daily routines, the program was designed to encourage the integration of AUS into everyday practice by addressing common pathologies they are likely to encounter. The study demonstrated significant improvement in technical skills and pathology recognition among participants, providing strong evidence of the advantages of this curriculum; moreover, all participants completed the course and showed measurable progress in their abilities.

Our findings align with previous studies showing that PCPs perceive POCUS as a user-friendly, efficient, and clinically valuable tool [31, 32]. For instance, Andersen et al. (2019) reported significant improvements in ultrasound proficiency among general practitioners following a structured training course, with a sustained increase in POCUS use in clinical practice [33]. Similarly, Steinmetz et al. (2020) found that a short, intensive ultrasound course significantly enhanced physicians’diagnostic accuracy and confidence in abdominal ultrasound applications [34]. Our study builds upon these findings by integrating both hands-on and theoretical components in a two-day course while also assessing long-term changes in clinical use. However, few studies have highlighted the importance of mastering fundamental ultrasound skills—such as image acquisition, interpretation, and clinical correlation— to enhance POCUS acceptance and positive perceptions [35]. Expanding on this approach, the integrative training model included e-learning for theoretical knowledge, lab simulations for hands-on skills designed to reduce resistance to change [36] and support continuous professional development. Our group demonstrated previously that applying similar principles led to increased lung ultrasound use among PCPs [16]. In this study, we observed a sustained rise in AUS utilization, with 80% of participants using it weekly and recognizing its clinical benefits. These improvements persisted ten weeks post-training, suggesting that this integrative approach could be replicable across other areas of continuous professional development [34, 35].

To sustain the positive perspectives and continued use of AUS among PCPs, ongoing support is essential to prevent skill degradation. Although post-course proficiency in abdominal diagnoses is typically high, it may decline without regular tutoring and practice [37, 38]. A 2019 review suggested that improper use of POCUS can lead to diagnostic errors [33]. False-positive findings in abdominal examinations have been reported to range from 0.5% to 9.9%, highlighting the need for continuous oversight and education [39, 40], whereas the higher rates (~ 20%) were seen in studies screening asymptomatic patients [41–43]. However, advancements in technology raise the question of whether the equipment used at the time contributed to the high false-positive rates and if there is a need to reconsider the role of POCUS in screening. To mitigate these challenges, integrating artificial intelligence and telemedicine could potentially enhance accuracy and support ongoing learning, especially in remote settings [44–49].

Limitations

This study has several limitations. Although the small cohort size is appropriate for this field, its single-center design may limit the generalizability of the findings. The unmonitored use of ultrasound devices may have influenced the results, as variations in usage could affect outcomes. The 10-week follow-up period may be insufficient to assess long-term skill retention fully; however, it provided an opportunity to closely monitor participants' progress and perspectives. Testing on healthy models may not fully reflect the challenges encountered with actual patients. Prior informal ultrasound experience and increased general awareness of POCUS could have influenced results, though a pre-course sample assessment showed minimal baseline knowledge. Furthermore, as a pilot study utilizing a pre/post design, there was no separate control arm, which may limit direct comparisons but still provides valuable insights into training effectiveness. Despite these limitations, the study represents a significant advancement in understanding the efficacy of our training program and its potential to enhance primary care physicians' skills and confidence in using AUS in clinical practice.

Conclusions

This two-day continuous professional development program, employing an integrative approach that combines hands-on sessions, recorded video lectures, and practice-based support, enhanced primary care physicians' skills and sustained perceptions regarding AUS. This approach, which minimizes out-of-office time, offers a future blueprint for primary care physician skill development. Future studies should incorporate longer follow-up periods to assess the durability of training effects and evaluate patient-centered outcomes to better understand the clinical impact of primary care physicians' ultrasound training.

Abbreviations

PCP	Primary Care Physician
CT	Computed Tomography
AUS	Abdominal Ultrasound
POCUS	Point-of-Care Ultrasound
HMO	Health Maintenance Organization
FAST	Focused Assessment with Sonography in Trauma
DoCTRINE	Defined Criteria to Report Innovations in Education
SD	Standard Deviation
IQR	Interquartile Range
IRB	Institutional Review Board
TM	Trademark
US	Ultrasound

Supplementary Information

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Supplementary Material 1.

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Authors' contributions

Authors'contributions I.B.S- Writing – Conceptualization, Methodology, Formal Analysis, Investigation, Writing—original draft K.I– Investigation, Writing—original draft M.S—Writing – Conceptualization, Methodology, Investigation, Writing—original draft A.A.H—Writing – review & editing O.K—Resources, Project administration, Writing – review & editing Y.G – Project administration O.W – Resources, Project administration L.F—Project administration, Supervision.

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Data availability

The datasets are available from the corresponding author upon reasonable request and subject to IRB approval.

Declarations

Ethics approval and consent to participate

The study was approved by the Ethical Review Board at Ben Gurion University (approval number: 15–2022). The research was performed in accordance with the Declaration of Helsinki, and all methods were carried out in accordance with relevant guidelines and regulations. All participants involved in the study were adults 18 years old and older. Written consent was obtained from the participants. The researcher ensured that participants were fully informed about the study's purpose, procedures, and their rights as participants.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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