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ORIGINAL RESEARCH

Pilot Study of a Modified DOPS Scale for Insulin Pump and CGM Installation Training in Chinese Medical Students During Endocrinology Rotations

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Background: Direct Observation of Procedural Skills (DOPS) is a clinical assessment tool that enables trainers to observe medical students' procedural abilities in real-time clinical settings. It assesses students' knowledge application, decision-making, and skill proficiency during clinical tasks.

Methods: This study modifies the DOPS to evaluate the operation of insulin pumps (PUMP) and continuous glucose monitoring systems (CGMS) in diabetes management. Key elements of the modified DOPS include 1) Knowledge Assessment: Evaluating understanding of PUMP and CGMS, including interpreting CGMS data for insulin adjustments; 2) Operational Skills: Assessing correct PUMP needle insertion, programming, and adjustments; 3) Patient Safety: Ensuring safe and aseptic procedures; 4) Feedback: Providing constructive feedback to help students improve their skills.

Results: Training through DOPS led to significant improvements in all domains, overall performance scores, and reduced execution time for each domain. Correlations between domains showed that PUMP indication scores were linked to all other domains and execution times, including re-evaluation. Communication skills and seeking assistance were crucial factors influencing other domains. Multilinear regression analysis revealed that while DOPS-CGMS (R square 1.0) fully explained performance scores, DOPS-PUMP (R square 0.984) indicated that additional personal qualities significantly impacted students' PUMP operation performance.

Conclusion: This customized DOPS form offers insights into students' abilities in managing diabetes with PUMP and CGMS, while emphasizing the need for training on both technical skills and interpersonal skills in future educational models.

Keywords: diabetes mellitus, direct observation of procedure of skills, insulin pump, continuous glucose monitor system

Introduction

The insulin pump (PUMP) and the continuous glucose monitoring system (CGMS) are essential advancements in modern diabetes mellitus (DM) care, designed to optimize blood glucose regulation. The PUMP delivers precise doses of insulin, mimicking natural insulin release, while the CGMS provides continuously real-time data on glucose levels, enabling timely adjustments. Together, these technologies empower patients with diabetes to maintain stable glucose control effectively, each contributing uniquely to comprehensive diabetes management.[1]

The PUMP continuously infuses insulin to regulate blood glucose by mimicking natural insulin secretion. It delivers both basal and bolus doses, helping maintain stable glucose levels and reducing the discomfort of frequent injections. Key components include the pump unit, insulin reservoir, and tubing with an infusion set. The insulin reservoir stores the insulin, while the pump unit features a display and controls for setting basal rates and pre-meal doses. This system

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minimizes hypoglycemia and reduces the discomfort of multiple injections by ensuring stable, continuous insulin delivery.

The CGMS is a minimally invasive technology designed to track blood glucose levels in real time. It uses microelectrodes embedded in the subcutaneous tissue to detect electrical signals from glucose oxidation in the interstitial fluid, providing an indirect measurement of glucose levels. CGMS continuously monitors glucose, enabling the detection of hypoglycemia and hyperglycemia, offering timely alerts, and helping patients understand their glucose fluctuation patterns. Together, the insulin pump and CGMS offer a comprehensive solution for managing diabetes, ensuring more stable and consistent control throughout the day.

Training medical students in the use of PUMP and CGMS requires a well-rounded approach, combining technical skills with empathy and patient communication. A comprehensive evaluation tool should focus on 1) Medical Knowledge: Students must grasp diabetes management principles, including indications, contraindications, and complications, and apply this knowledge to clinical scenarios. 2) Operational Skills: Students should be proficient in operating and troubleshooting insulin pumps and CGMS, ensuring effective diabetes care. 3) Humanistic Care: This assesses students' communication, empathy, and professionalism, observed through interactions with patients and role-playing scenarios. 4) Evaluation and Feedback: Real-time observation of students' skills enables immediate, constructive feedback, helping students refine their abilities and boost their confidence in clinical practice. This approach ensures a balanced development of both technical and interpersonal skills in diabetes care.[2,3]

Skill training in the medical field faces several challenges, particularly the gap between theoretical knowledge and practical application. While medical students may have strong theoretical foundations, they often lack hands-on experience, especially with complex tools like insulin pumps and CGMS. Moreover, such procedures require both technical expertise and strong interpersonal skills, including effective patient communication and empathy. Limited time and resources in clinical settings further complicate training. To address these challenges, structured programs that combine technical skills with humanistic care, along with consistent feedback, are essential for effective learning and improvement.

Several methods have been explored to enhance medical student training in DM management. Research indicates that hands-on experience with diabetes management tools improves students' understanding of the condition and enhances their ability to educate patients. These approaches offer valuable opportunities for students to develop both their clinical skills and their communication abilities, ensuring a more comprehensive training experience for effective diabetes care. Training tools include virtual simulations,[4] simulation-based learning,[5] and case-based learning,[6] which provide risk-free environments for practicing and patient communication.

Direct Observation of Procedural Skills (DOPS) is an assessment method introduced in the 1990s to evaluate medical students' clinical competencies. By observing students perform specific procedures, such as using medical devices or administering treatments, educators assess both technical skills and communication abilities in real-time. DOPS provides immediate feedback to improve student performance, making it a valuable tool in medical training for ensuring readiness in practical tasks. DOPS has been implemented across various medical disciplines, with significant research conducted on its effectiveness in improving clinical skills in fields such as surgery,[7] and other procedure training.[8,9]

While it helps refine technical skills and improve clinical performance, assessing both competence and confidences, traditional DOPS has limitations, such as increasing student stress, evaluator bias, and logistical challenges in busy clinical settings.[10] To address these challenges, improvements have been made in recent years to expand its advantages emphasizing real-time, direct observation and objective feedback. By prioritizing immediate evaluation and constructive comments, students can refine their techniques and develop better clinical proficiency in a more efficient manner.[7,9,11] In this study, the DOPS was modified to include the PUMP and CGMS assessments of medical students in the Department of Endocrinology.

Methods

Participants and Setting

Two DOPS assessments were administered before and after training to all 64 residents in the Department of Endocrinology at Pudong Hospital, affiliated with Fudan University, during the period from June 2023 to

June 2024. During the initial DOPS assessment, the trainees were informed of these assessments as part of their rotations. Under the supervision of their rotation tutors, the students were guided to pre-designated patients with appropriate indications to perform the PUMP and CGM procedures. Their performance was then evaluated, and feedback was provided by the tutors. The modified DOPS was used as a self-evaluation tool during the rotation period preceding the second assessment. After the initial evaluation and feedback from their rotation tutors on task performance, the students were encouraged to reflect on their results and practice the tasks voluntarily during their daily activities, preparing for the second assessment.

Instrument Development

The instrument, developed based on international DOPS standard, incorporates the specific characteristics of diabetic patients, as well as the protocols and scoring systems for PUMP and CGMS procedures. It assesses students' competencies in diabetes management, evaluating both clinical knowledge and technical skills. A bilingual Chinese-English version is also provided. The current questionnaire has been preliminarily tested on small samples, demonstrating effectiveness. The following five domains were included in each DOPS form of PUMP and CGMS assessment: 1) indications for wearing an insulin PUMP and continuous glucose monitoring and execution time; 2) communication skills, which evaluate the students' capacity to communicate with and obtain essential patient information, as well as their empathy and humanism. Communication time will also be included as an assessment criterion. 3) Skill proficiency: This item evaluates the student's actual operative ability in the insertion of a PUMP and CGMS and fundamental medical concepts, such as the requirement for sterility and precautions for MRI when wearing PUMP and CGMS. 4) Ability to seek assistance: This item assesses a student's collaborative abilities when faced with a challenge. 5) Overall performance: The supervisor provides a comprehensive and general assessment of the score based on the student's overall performance on the examination, which is indicative of the student's clinical competence. Tables 1 and 2 show the five domains that comprise the DOPS examination for the PUMP and CGMS, respectively.

The Setting of the DOPS-PUMP and DOPS-CGMS Examination

Two DOPS examinations were conducted at the start and end of rotation. Students will be provided with information regarding the DOPS examination form and encouraged to consult with their supervisors regarding the appropriate warnings and indications for the use of the CGMS and PUMP. The teachers who supervised the two examinations were identical; however, the patients were distinct and had varying disease conditions. The student completed the entire process of installing the insulin PUMP and CGMS, communicated with the patients, and conducted an interview with the patients at the bedside during the DOPS examination.

The supervisor evaluated the performance of the students and the procedure time during the interviews and installation. The student receives necessary feedback from the supervisor during the operation. Students will be informed of the performance and disadvantages of each item in their initial examination, as well as the field that requires improvement following the initial examination. Participants were able to engage in active practice after the initial examination. At the end of his rotation in the Department of Endocrinology, the student will be administered an additional DOPS examination, and the results will be recorded in their rotation record. Table 3 shows the details of each patient who was interviewed.

Statistical Analyses

All statistical analyses were performed using SPSS (version 25, USA) and Prism (GraphPad, version 10.0) software. The Kolmogorov–Smirnov test was used to assess the normal distribution of the data. The five domains, including score and time, using the DOPS-PUMP/CGMS scale were compared using a parametric or non-parametric method-based paired test. Spearman correlation coefficient was used to examine the interrelationships between each item. Multilinear regression analyses were performed to determine the critical traits that contributed to the overall performance score, assessed using DOPS. Statistical significance was set at $p < 0.05$.

Table 1 The Modified DOPS-PUMP Form for Assessment of Trainees Interviewed with the Patients with Diabetes Mellitus (DM)

Domains of DOPS-PUMP	Contents
Trainee could provide an explanation of the following indications and precautions: Time (including Feedback from trainer)	1. Determine the indication for wearing insulin PUMP: Is the patient diagnosed with type 1, LADA diabetes, or type 2 diabetes with substantial blood glucose fluctuations? 2. Does the patient experience recurrent severe hypoglycemia (HAAF) recently? 3. Does the patient present hypoglycemia episode at night? 4. Does the patient present a dawn phenomenon recently? 5. Does the patient present Somogyi phenomenon recently? 6. Does the patient present an inexplicable increase in blood glucose levels (to define out the presence of primary aldosterone, Cushing's syndrome, or pituitary tumors)? 7. Is the patient's skin suitable for an insulin PUMP, such as local skin inflammation or an excessively thin patient? 8. Inform the patient of methods of insulin-intensive therapy. 9. Inform the patient of the benefits of wearing an insulin PUMP.
Medical interview skills Time (including Feedback from trainer)	1. Introduce yourself and other staff to the patient in a way that makes them feel comfortable 2. Respect the patient, ascertain the patient's primary health problems, communicate in plain language, and encourage the patient to ask questions. 3. Appropriate questions and counseling to elicit adequate information, summarize the major complaint and the history of the current disease. 4. Have an appropriate response to the patient's body language (For example, if the patient complains about an unpleasant or painful spot in his body, the trainee should immediately do a physical examination (PE) and then proceed with the medial interview.) 5. Create a family tree for the patient, including each relative (the age starts to suffer from diabetes, health, major illness, and cause of death). 6. In patients suspected of having type 1 diabetes or latent autoimmune diabetes in adults (LADA), obtain a medical history to rule out thyroid disease or other autoimmune diseases and perform a PE for thyroid. Inquire about any autoimmune disease symptoms, such as joint pain or stiffness. 7. Macrovascular problems such as myocardial infarction, chest discomfort, and orthopnea; stroke, and Transient Ischemic Attack (TIA) are also possible. 8. Microvascular complications: blurred vision, foamy urine, etc. 9. Diabetic neuropathy's history includes changes in superficial and deep feeling, including numbness and discomfort in the lower limbs, as well as skin color.
Skill proficiency Time (including Feedback from trainer)	1. Be proficient in opening the package 2. Be proficient in connecting the pipeline 3. Be proficient in injecting insulin into the reservoir 4. Accurately find the injection site 5. Be proficient in sterile disinfection 6. Be proficient in installing the insulin PUMP for the patient 7. Be proficient in explaining the time of high-dose injection to the patient 8. Explain the precautions to the patient (such as removing it from the connector during MRI examination, taking a bath, etc.) 9. Be proficient in adjusting the basal rate
Organized and seek assistance when needed.	1. Panic occurs when equipment is disorganized, and do not seek the assistance when encountering challenges. Score 1–3. Although the operation protocol is accurate, and seek assistance when encountering challenges, it affected the smoothness of the whole procedure. Score 4–6. 2. The operation protocol is accurate; when encountering challenges, seek assistance at the appropriate moment, prioritize the patient's comfort, respond to their inquiries, and establish trust with the patient. Score 7–9.
Overall clinical competence Overall time:	1. Above all, the mention is unsatisfying. 2. Above all, the mention is satisfactory. 3. Above all, excellent in the mention

Table 2 The Modified DOPS-CGMS Form for Assessment of Trainees Interviewed with the Diabetes Mellitus (DM) Patients

Domains of DOPS-CGMS	Contents
Trainee could provide an explanation of the following indications and precautions: Time (including Feedback)	1. Determine the indication for wearing insulin PUMP: Is the patient diagnosed with type 1, LADA diabetes, or type 2 diabetes with substantial blood glucose fluctuations? 2. Does the patient experience recurrent severe hypoglycemia (HAAF) recently? 3. Does the patient present hypoglycemia episode at night? 4. Does the patient present a dawn phenomenon recently? 5. Does the patient present Somogyi phenomenon recently? 6. Does the patient present an inexplicable increase in blood glucose levels (to define out the presence of primary aldosterone, Cushing's syndrome, or pituitary tumors)? 7. Is the patient's skin suitable for a CGMS, such as local skin inflammation or an excessively thin patient? 8. Inform the patient of methods of insulin-intensive therapy. 9. Inform the patient of the benefits of wearing a CGMS.
Medical interview skills **Time (including Feedback from trainer)**	1. Introduce yourself and other staff to the patient in a way that makes them feel comfortable 2. Respect the patient, ascertain the patient's primary health problems, communicate in plain language, and encourage the patient to ask questions. 3. Appropriate questions and counseling to elicit adequate information, summarize the major complaint and the history of the current disease. 4. Have an appropriate response to the patient's body language (For example, the trainee must perform a physical examination (PE) immediately upon the patient's complaint of an unpleasant or painful spot on their body, and subsequently proceed with the medial interview.) 5. Create a family tree for the patient, including each relative (the age starts to suffer from diabetes, health, major illness, and cause of death). 6. In patients suspected of having type 1 diabetes or latent autoimmune diabetes in adults (LADA), obtain a medical history to rule out thyroid disease or other autoimmune diseases and perform a PE for thyroid. Inquire about any autoimmune disease symptoms, such as joint pain or stiffness. 7. Macrovascular problems such as myocardial infarction, chest discomfort, and orthopnea; stroke, and Transient Ischemic Attack (TIA) are also possible. 8. Microvascular complications: blurred vision, foamy urine, etc. 9. Diabetic neuropathy's history includes changes in superficial and deep feeling, including numbness and discomfort in the lower limbs, as well as skin color.
Skill proficiency Time (including Feedback from trainer)	1. Carefully unpack the package. 2. Carefully calibrate the receiver. 3. Carefully open the reusable blood glucose receptor injector. 4. Determine the installation site on the arm of the patient. 5. Expertly execute aseptic disinfection. 6. Insert blood glucose receptors with precision and inject them. 7. Adjust the receiver to receive the signal. 8. Enter the corrected blood glucose value with precision. 9. Make sure the patient is at comfort while wearing the CGMS and take the initiative to clarify whether it is permissible to cleanse while wearing it, or to address any other inquiries the patient may have.

(*Continued*)

Table 2 (Continued).

Domains of DOPS-CGMS	Contents
Organized and seek assistance when needed.	1. Panic occurs when equipment is disorganized, and do not seek the assistance when encountering challenges. Score 1–3. 2. Although the operation protocol is accurate, and seek assistance when encountering challenges, it affected the smoothness of the whole procedure. Score 4–6. 3. The operation protocol is accurate; when encountering challenges, seek assistance at the appropriate moment, prioritize the patient's comfort, respond to their inquiries, and establish trust with the patient. Score 7–9.
Overall clinical competence Overall time:	1. Above all, the mention is unsatisfying. 2. Above all, the mention is satisfactory. 3. Above all, excellent in the mention

Table 3 The Characteristics of the Patients Involved in This DOPS-PUMP/-CGMS Study

	Initial Evaluation						Re-Evaluation After Training					
PUMP	**Patients' Gender**		**Initial Visits**		**Patients' Condition**		**Patients' Gender**		**Initial Visits**		**Patients' Condition**	
	M	**31**	**Yes**	**5**	**S**	**32**	**M**	**34**	**Yes**	**1**	**S**	**33**
	F	**33**	**No**	**59**	**C**	**32**	**F**	**30**	**No**	**63**	**C**	**31**
CGMS	**Patients' gender**		**Initial visits**		**Patients' Condition**		**Patients' gender**		**Initial visits**		**Patients' Condition**	
	M	34	**Yes**	1	**S**	37	**M**	29	**Yes**	1	**S**	29
	F	30	**No**	63	**C**	27	**F**	35	**No**	63	**C**	35

Abbreviations: M, male; F, female; S, Simple case; C, Complicated case.

Result

The Comparisons on the Progress of Scores and Time When Assessing 5 Domains of DOPS

The DOPS forms were disseminated to all 64 students before the examination, which lasted approximately 1 month. The response rate was 100%. As anticipated, the scores for each domain on the DOPS form substantially increased when the evaluation of PUMP/CGMS indication, communication skills, PUMP/CGMS skill proficiency, seeking assistance, overall performance scores, and time use was conducted ($p<0.0001$) (Figures 1 and 2).

The Factors Associated with the 5 Domains Scores Before and After Training in PUMP and CGMS

The Spearman correlation analyses on the five domains of the PUMP evaluation revealed that the initial PUMP indication evaluation score was significantly associated with the scores of the other four domains and negatively correlated with the time used in indication evaluation, skill processing, and completion time of the whole evaluation. The initial communication skill score was significantly correlated with the performance of seeking assistance and played a significant role in overall performance and time use, as well as influencing the time used to process the operation of PUMP and CGMS. The performance in seeking assistance also influenced the time used in the completion time, in addition to the overall performance score, which skill proficiency score also made a significant contribution. Intriguingly, the outcome of the

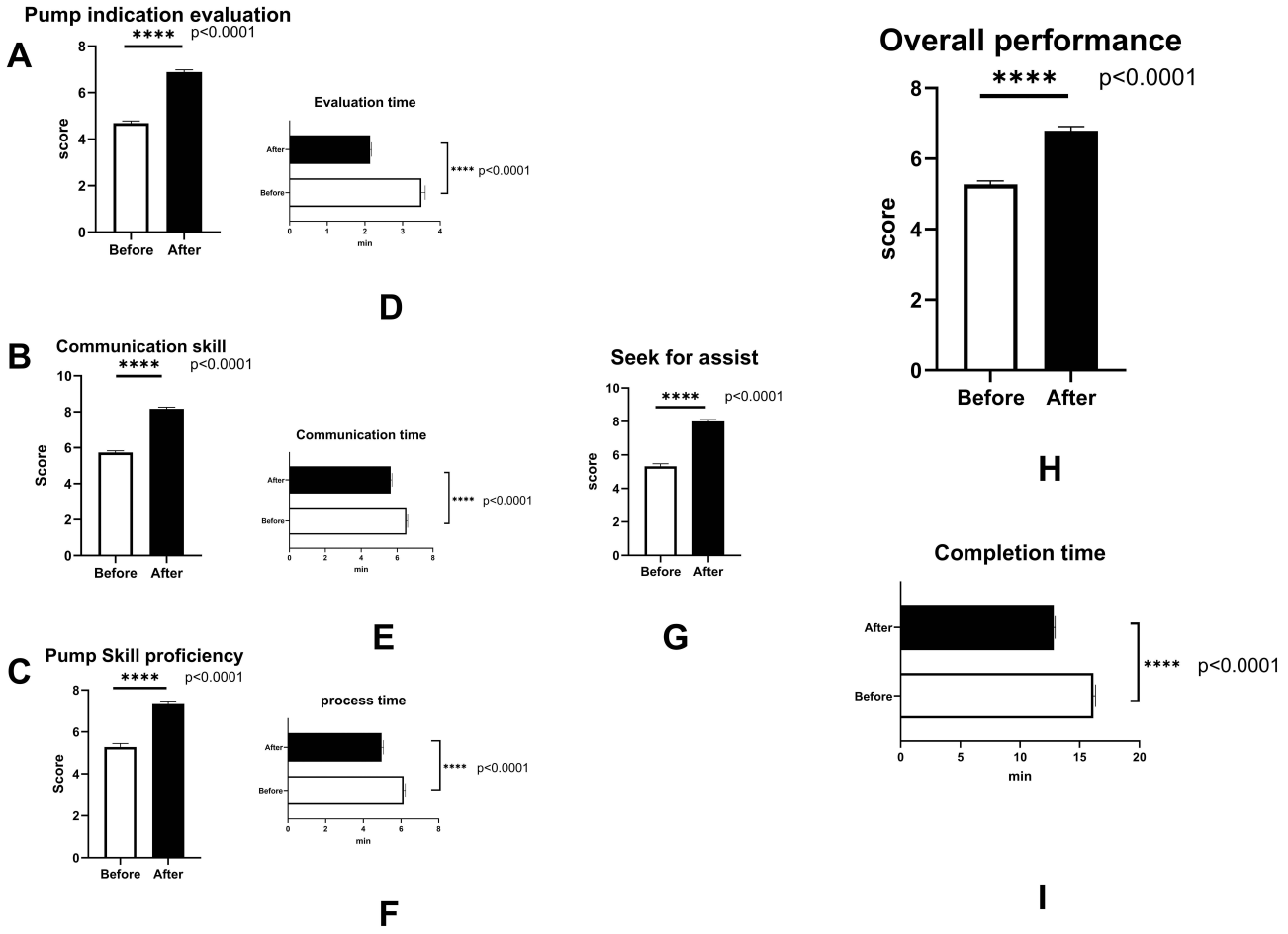

Figure 1 Increased scores on the DOPS in 5 domains including PUMP indication evaluation (**A**), communication skill (**B**), PUMP skill proficiency (**C**), Seek for assist (**G**), and overall performance (**H**), with improvement on PUMP evaluation time (**D**), communication time (**E**), process time (**F**), and completion time (**I**) after DOPS training.
Note: ****$p<0.0001$.

initial assessment was associated with the time used in the final evaluation, particularly PUMP indication evaluation performance.

In the re-examination at the end of the rotation, the performance of communication skills was associated with the performance of PUMP skill proficiency, whereas seeking the fore-assist score was significantly negatively related to communication time. In addition, the time used in the communication and processing evaluation was significantly associated with the completion time of the entire re-examination. The details of the DOPS-PUMP evaluation correlation analyses are presented in Tables 4 and 5.

In contrast, in two turns of the CGMS examinations, distinct interrelationships existed within the DOPS-PUMP study. While the performance score for the other four domains was only positively correlated with the overall performance score, the communication skill evaluation was significantly related to time use, and the completion time had a significantly negative relationship with seeking assistance. In a reexamination session, a substantial correlation was observed between the overall performance score and the other four domains. In particular, the reexamination score of the CGMS indication was positively correlated with time in the initial evaluation of the CGMS indication (Table 6).

The Multilinear Regression Analyses on the Major Components Contributed to the Progress on the Increased Overall Score

Thereafter, in multilinear regression analyses for each scale, include both the performance score and time used in each scale, and the details of the patients included in this study. Interestingly, despite the significant contribution from the scale

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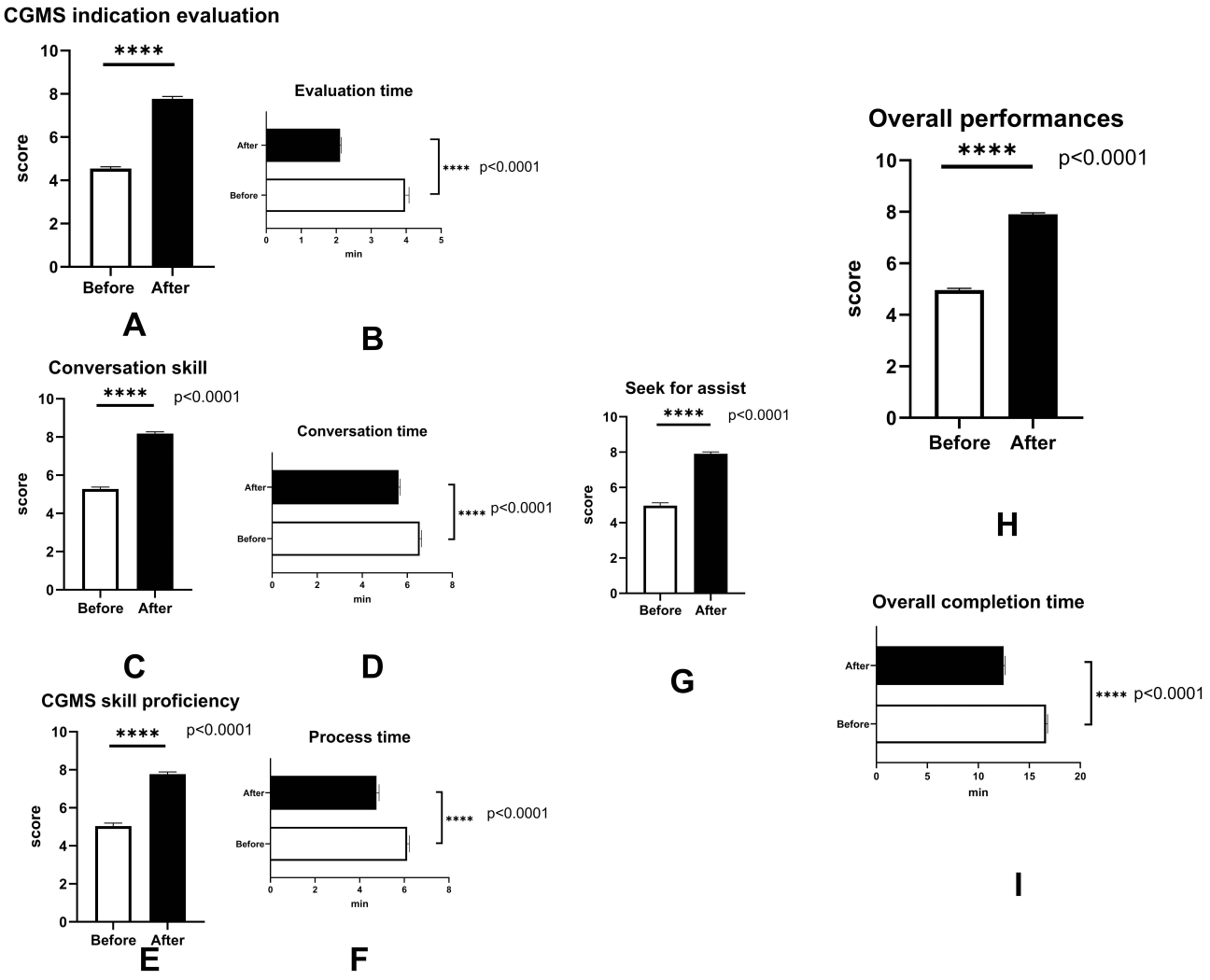

Figure 2 Increased scores on the DOPS in 5 domains including CGMS indication evaluation (**A**), communication skill (**B**), CGMS skill proficiency (**C**), Seek for assist (**G**), and overall performance (**H**), with improvement on CGMS evaluation time (**D**), communication time (**E**), process time (**F**), and completion time (**I**) after DOPS training.
Note: ****$p<0.0001$.

of performance score and time use, whereas the patient information of this study was excluded from the calculation, dissimilar results with the CGMS evaluation were found; the R square for PUMP did not completely contribute to the scores and time use of the five domains. Details of the multilinear regression are presented in Tables 7 and 8.

Table 4 The Correlation Between 5 Domains Scores and Other Elements Before Training in DOPS-PUMP Evaluation

Before			**After**	
	Score	**Time**	**Score**	**Time**
PUMP indication evaluation	Communication skill r=0.522**	Evaluation time r=−0.442**		Process time r=0.267*
	Process skill proficiency r=0.478**	Process time r= −0.270*		Completion time r=0.495**
	Seek for assist r= 0.452**	Completion time r= −0.356**		
	Overall performance r= 0.692**			

(*Continued*)

Table 4 (Continued).

Before			After	
	Score	**Time**	**Score**	**Time**
Communication skill	Seek for assist r= 0.490**	Evaluation time r=−0.373**		
	Overall performancer=0.752**	Process time r= 0.466**		
		Completion time r=−0.303*		
Process Skill proficiency	Overall performance r=0.746**			Communication time r= 0.283*
				Completion time r=0.263*
Seek for assist	Overall performance r=0.731**	Completion time r=−0.364**		Completion time r= 0.308*
Overall performance				Completion time r=0.360**

Note: **p<0.01; *p<0.05; PUMP: Insulin PUMP.

Table 5 The Correlational Relationship Between 5 Domains Scores and Other Elements After Training in DOPS-PUMP Evaluation

	After			**After**	
	Score	**Time**		**Score**	**Time**
PUMP Indication Evaluation			**Evaluation Time**		
Communication skill	Process Skill proficiency r= 0.283*		**Communication time**		Completion time r=0.445**
Process Skill proficiency			**Process time**		Completion time r=0.706**
Seek for assist		Communication time r= −0.281*			
Overall performance			**Completion time**		

Note: **p<0.01; *p<0.05. PUMP: insulin PUMP.

Table 6 The Correlational Relationship Between 5 Domains and Other Elements Before and After Training in DOPS-CGMS Evaluation

Before			After		
	Score	**Time**		**Score**	**Time**
CGMS indication evaluation	Overall performance r= 0.413**		**CGMS indication evaluation**	Overall performance r= 0.425**	Initial evaluation time r= 281*
Communication skill	Overall performance r=0.350**	Communication Time r=−0.273*	**Communication skill**	Overall performance r=0.529**	
Process Skill proficiency	Overall performance r=0.637**		**Process Skill proficiency**	Overall performance r=0.546**	
Seek for assist	Overall performance r=0.482**	Completion time r= −0.364**	**Seek for assist**	Overall performance r=0.543**	
Overall performance			**Overall performance**		

Note: **p<0.01; *p<0.05;
Abbreviations: CGMS, continuous glucose monitor system.

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Table 7 Multiple Linear Regression Analysis of Factors Influencing the Overall Performance Score Before and After Training (DOPS-PUMP)

Variables (Before)	Overall Performance Score (Before) R^2=0.984 F=917.804 p<0.0001				
	B	SE	β	T	*p*
Constants	−0.178	0.104		−1.718	0.091
PUMP indication evaluation	0.284	0.024	0.273	11.629	<0.0001
Seek for assist	0.253	0.014	0.379	18.711	<0.0001
Skill proficiency	0.222	0.012	0.366	18.838	<0.0001
Communication skill	0.279	0.025	0.259	11.141	<0.0001
Variables (After)	**Overall performance score (After) R^2=0.107 F=7.420 p=0.008**				
	B	**SE**	**β**	**t**	***P***
Constants	4.863	0.717		6.782	<0.0001
PUMP indication evaluation (initial)	0.411	0.151	0.327	2.724	0.008

Abbreviations: B, unstandardized coefficient; SE, standard error; β, standardized coefficient.

Table 8 Multiple Linear Regression Analysis of Factors Influencing the Overall Performance Score Before and After Training (DOPS-CGMS)

Variables (Before)	Overall Performance Score (Before) R^2=1.000				
	B	SE	β	T	*p*
Constants	<0.0001	0.000		0.000	1
Skill proficiency	0.250	0.000	0.590	181,642,911.2	<0.0001
Seek for assist	0.250	0.000	0.569	177,274,081.0	<0.0001
Communication skill	0.253	0.000	0.361	111,022,811.2	<0.0001
CGMS indication evaluation	0.250	0.000	0.321	99,021,616.46	<0.0001
Variables (After)	**Overall performance score (After) R^2=1.000**				
	B	**SE**	β	**T**	***P***
Constants	<0.0001	0.000		0.000	1.000
Skill proficiency	0.25	0.000	0.524	189,344,219.2	<0.0001
Communication skill	0.25	0.000	0.416	149,877,476.5	<0.0001
CGMS indication evaluation	0.25	0.000	0.498	179,294,828.8	<0.0001
Seek for assist	0.25	0.000	0.476	17,015,026.6	<0.0001

Abbreviations: B, unstandardized coefficient; SE, standard error; β, standardized coefficient.

Discussion

The DOPS examination is a novel educational tool that is beneficial for evaluating the resourcefulness and operative ability of medical students in real-world healthcare environments.[12] It may also enable students to immediately address discrete non-specialty problems in a clinical practice setting by applying their theoretical learning, intuition, and ability to deal with them. In this instrument major, students were assessed for their capacity for reflective thinking, communication, independent reasoning, operations, cooperation, and comprehension. Despite the incorporation of numerous innovative teaching paradigms in the clinical setting for rotation students, such as the Mini-CEX, which was implemented in previous investigated rotation residents,[13] the assessment of endocrinology operations has not received significant attention. Consequently, in this pilot study, the DOPS scale was implemented to evaluate students' skills in the

implementation of insulin PUMP and CGMS devices, which are two essential and frequently utilized devices for the management of blood glucose in patients with diabetes (Figure 3).

In the initial section of the self-contrast analysis, the performance scores and time use of the students in the five domains were found to experience substantial improvement following training following the initial examination. This indicates that feedback on their performance had a noticeable beneficial effect on all aspects of a student's DOPS ability, thereby demonstrating the effectiveness of the DOPS paradigm in enhancing students' operative skills. In subsequent correlational analyses, the results of PUMP and CGMS demonstrated significant disparities in the interrelationships between performance scores and time use. The items of evaluation of indications for PUMP/CGMS and communication, as well as seeking assistance, played a significant role. The supervisor's feedback during the evaluation time significantly influenced performance in the final re-examination, indicating that the supervisor's feedback was essential. This phenomenon has been documented and illustrated in numerous prior investigations.[14–16]

An intriguing interrelationship existed between the five domains, their scores, and time use. For example, the performance of the evaluation of insulin PUMP indications was significantly associated with process skill proficiency and seeking assistance. Additionally, there was a significant relationship between communication skills and seeking assistance scores, indicating that students' understanding of the mechanism of PUMP and independent thinking was intimately associated with PUMP operation proficiency. However, the cooperative characteristics of medical students are

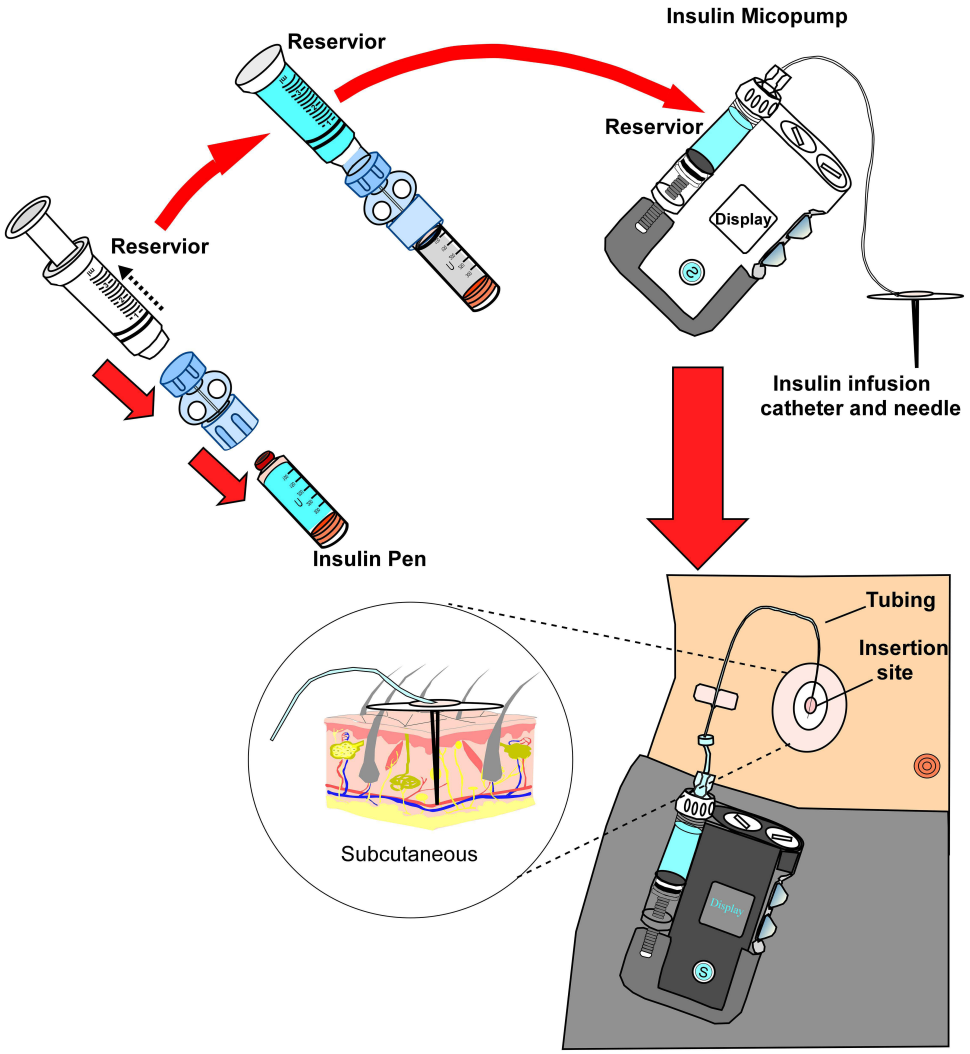

Figure 3 The illustration concisely displays the processing of installing of an insulin PUMP in a diabetic patient. The components of insulin PUMP are annotated in the illustration.

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essential to their everyday duties.[17] Additionally, their excellent communication abilities may help them effectively seek assistance from other individuals or professionals to achieve their goals.

These five domains of DOPS are particularly significant in contemporary medicine as there is an increasing demand for medical professionals to participate in active collaboration and communication.[18] Excellent communication traits or language expression abilities may help them to smoothly and effectively seek assistance from other individuals, professionals, or teams to achieve their appeals.[19] Another benefit for a medical student in DOPS evaluation to enhance their communication skills is to lessen the mutual impedance of the doctor and the patients, promote the smoothness and proficiency of the subsequent process, where basic ability, artistry communication skills, and, more importantly, a doctor's empathy play a significant role.[20–22] DOPS examinations provide medical students with the opportunity to enhance their communication and collaborative skills. The present research demonstrated a distinct positive correlation between skill proficiency and communication time. In particular, the student was able to acquire improved knowledge of the patient's condition, and the mutual impedance between the doctor and patient was reduced as a result of the comprehensive interviews. The overall completion time was also influenced by the operation proficiency of the PUMP or CGMS, which suggests that medical students' hands-on ability is essential for clinical operations.

The results of regression analyses virtually alert us to the discrepancy in PUMP and CGMS evaluation that the proportion of an individual's inner property may be accountable to increase, accompanied by an increase in the degree of complication and difficulty of their current operating task. The regression calculation excluded the possibilities of the implications from the patient's selection and background information (Table 3). This surprising consequence advised us that the evaluation of implications from the student's traits or self-feedback for the operation-related assessments could be utilized as an additional evaluation project, and enhancement of a student's mental strength based on the variation scores assessed by corresponding students will help them accomplish medical-related problems in their daily work.[23]

Limitation

The evaluation of self-reflection or interview skills can be improved by further refining the scale into the forms of this study. Furthermore, the scale should incorporate feedback content and timeframes, as well as the recommendations of trainers. However, it is essential to incorporate the new practical instrument into future research to assess the various characteristics of students and subsequently aid them in the completion of their clinical duties.

Conclusion

In the current pilot study, utilized modified DOPS methods in the field of endocrinology can assist students in enhancing their hands-on skills in the management of patient blood glucose using PUMP and CGMS. This investigation demonstrated that the DOPS is a practical and comprehensive instrument for assessing the clinical qualities of students in the endocrinology department, as well as for facilitating the enhancement of their clinical skills.

Data Sharing Statement

All data generated or analyzed during this study are included in this published article.

Ethical Statement

The study, including the application of PUMP, CGMS treatments, and access to or utilization of the raw data, obtained ethical approval from the Ethics Committee of Shanghai Pudong Hospital (Shanghai, China, wz.010). The guidelines were outlined, and the procedures were conducted in accordance with the Declaration of Helsinki. All participants were informed and volunteered provided informed consent prior to participating in the study. Informed written consent was obtained from the patients for the publication of this study. All the data used in this study were anonymized before use.

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Author Contributions

All authors made significant contributions to this work, including the conception of the study, study design, execution, data acquisition, analysis, and interpretation of data. All participants actively participated in drafting, revising, and critically reviewing the manuscript. The final version of the manuscript was approved by all authors. They collectively agreed to the journal to which the article was submitted and were willing to take full responsibility for all aspects of the work.

Consent for Publication

Not applicable.

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Disclosure

The authors declare that there are no potential conflicts of interest in this work.

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