The Teaching of Clinical Skills and the Applicability of a Simplified Guide to Physical Examination in Undergraduate Medical Training

O Ensino de Habilidades Clínicas e a Aplicabilidade de um Guia Simplificado de Exame Físico na Graduação de Medicina

Salomão Georges Kahwage Neto[I]
Tiago Kiyoshi Kitabayashi Braga[I]
Márcia Bitar Portella[I]
Régis Bruni Andriolo[I]

KEYWORDS

- Physical Examination.
- Medical Education.
- Guide.
- Undergraduate Medical Education.

ABSTRACT

Introduction: *Despite technological advances, anamnesis and physical examination remain the most important and effective diagnostic tools in a clinical case. However, many students complete their medical degree lacking these essential skills. The unstandardized character of the physical examination is considered one of the major hurdles in the teaching-learning of this practice.* **Objective:** *To evaluate the clinical skills of medical students and the applicability of a simplified physical examination guide for the improvement of these skills.* **Methods:** *This was an analytical and quantitative-approach study, which compared before-and-after information among general medicine student interns from January to February 2014. The students were trained with the simplified guide for a 3-week period. The students had their clinical examination evaluated in 13 items: vital signs, oral cavity examination, ophthalmoscopy, otoscopy, thyroid examination, cardiovascular, pulmonary, abdominal examination, lymph nodes, anthropometric measurements, ankle-brachial index (ABI), neurological examination, examination of the breast (female patients) or testicles (male patients). The result of each part of the examination was classified into three categories: complete assessment, partial assessment and absent assessment.* **Results:** *A total of 31 students participated. Significant improvement was found in almost all items in relation to the complete evaluation after training with the guide: cardiovascular system (3.23% versus 74.19%, before and after training, respectively, $p < 0.01$), pulmonary system (22.58% versus 90.32%, $p < 0.01$), abdomen (22.58% versus 74.19%, $p = 0.01$), vital signs (16.13% versus 100%, $p < 0.01$), palpation of lymph nodes (6.45% versus 77.42%, $p < 0.01$), neurological examination (0% versus 22.58%, $p = 0.02$), thyroid palpation (0% versus 61.29%, $p < 0.01$), examination of oral cavity (6.45% versus 67.74%, $p < 0.01$), anthropometric measurements (0% versus 45.16%, $p < 0.01$), breast examination (0% versus 36.84%, $p = 0.02$), ophthalmoscopy (0% versus 32.26%, $p < 0.01$), otoscopy (0% versus 64.52%, $p < 0.01$); evaluation of the ankle-brachial index (0% versus 83.87%, $p < 0.01$), examination of the testicles (0% versus 8.33%, $p = 1.0$). A 280.7% increase was also observed in the students' median score after training (1.92 versus 7.31 points, $P < 0.001$). There was no significant correlation between student performance and time on the medical course ($R2 = 0.1242$; $P = 0.0515$).* **Conclusions:** *There is a large deficit in teaching clinical skills during undergraduate medical courses. As an effective solution, a simplified sequential clinical examination guide can serve as training for medical students.*

[I] *University of the State of Pará, Belém, PA, Brazil.*

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PALAVRAS-CHAVE

- Exame Físico.
- Educação Médica.
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- Educação de Graduação em Medicina.

RESUMO

Introdução: *Apesar dos avanços tecnológicos, a anamnese e o exame físico permanecem as ferramentas diagnósticas mais importantes e eficazes diante de um caso clínico. No entanto, muitos alunos concluem o curso médico com deficiências nessas habilidades essenciais. A falta de padronização do exame físico é considerada uma das principais dificuldades no ensino-aprendizagem.* **Objetivo:** *Avaliar as habilidades clínicas dos estudantes do internato de Medicina e a aplicabilidade de um guia simplificado de exame físico para o aperfeiçoamento dessas habilidades.* **Métodos:** *O estudo foi analítico, quantitativo do tipo comparativo antes e depois, realizado com alunos de Medicina em estágio de Clínica Médica no período de janeiro a fevereiro de 2014. Os estudantes foram treinados com o guia simplificado por um período de três semanas. Os alunos tiveram seu exame clínico avaliado em 13 itens: sinais vitais, exame da cavidade oral, fundoscopia, otoscopia, exame da tireoide, exame cardiovascular, pulmonar, abdominal, linfonodos, medidas antropométricas, índice tornozelo-braquial (ITB), exame neurológico, exame das mamas (pacientes mulheres) ou dos testículos (pacientes homens). O resultado da avaliação de cada item foi classificado em três categorias: avaliação completa, avaliação parcial e avaliação ausente.* **Resultados:** *Ao todo, participaram 31 estudantes. Observou-se melhora significativa de quase todos os itens em relação à avaliação completa após a capacitação com o guia: sistema cardiovascular (3,23% versus 74,19%, antes e depois do treinamento, respectivamente, $p < 0,01$); sistema pulmonar (22,58% versus 90,32%, $p < 0,01$); abdome (22,58% versus 74,19%, $p = 0,01$); sinais vitais (16,13% versus 100%, $p < 0,01$); palpação de linfonodos (6,45% versus 77,42%, $p < 0,01$); exame neurológico (0% versus 22,58%, $p = 0,02$); palpação da tireoide (0% versus 61,29%, $p < 0,01$); exame da cavidade oral (6,45% versus 67,74%, $p < 0,01$); medidas antropométricas (0% versus 45,16%, $p < 0,01$); exame das mamas (0% versus 36,84%, $p = 0,02$); fundoscopia (0% versus 32,26%, $p < 0,01$); otoscopia (0% versus 64,52%, $p < 0,01$); avaliação do índice tornozelo-braquial (0% versus 83,87%, $p < 0,01$); exame dos testículos (0% versus 8,33%, $p = 1,0$). Foi possível observar também um aumento de 280,7% na pontuação mediana do desempenho dos alunos após o treinamento (1,92 versus 7,31 pontos, $P < 0,001$). Notou-se ausência de correlação significativa entre o desempenho dos alunos e o tempo de permanência no curso ($R2 = 0,1242$; $P = 0,0515$).* **Conclusões:** *Há um déficit grande no ensino de habilidades clínicas durante a graduação de Medicina. Como uma solução eficaz, um guia simplificado sequencial de exame clínico pode servir no treinamento de estudantes de Medicina*

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INTRODUCTION

Physical examination is an essential practice for guiding diagnosis and therapeutics[1]. However, even internal medicine residents demonstrate significant deficiencies in clinical skills, considered important during the program[2]. A study by Mavis revealed that students spent only 20% of the time they are expected to on training in physical examination skills. Evidence has shown that the remaining time was used to review text books and handouts[3].

Due to the undeniable findings of these deficiencies, physical examination training demonstrates increasingly deplorable statistics, due to the sole reason that it has become less and less of a daily practice. Accordingly, while in 1960, 75% of the clinical teaching was performed at the bedside, in 1978 this percentage had fallen to 16%[4]. As a result, the physical examination has continued to decline, especially in view of its disuse among students and physicians, which in practice translates into reduced familiarity with clinical symptoms and the usefulness of semiology, leading to increasing dependence on laboratory tests and scans[5,6].

Despite technological advances, the skills to take a patient's medical history, to perform a physical examination and to communicate with the patient remain the most important and effective diagnostic tools in any clinical case. However, many students complete the medical degree deficient in essential skills[7]. This finding reinforces the need for, during undergraduate medical training, educators to turn their attention to the evaluation of clinical competence, characterized as a set

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of knowledge, technical and communication skills, empathy, propaedeutic and clinical reasoning[8]. If carefully integrated with new technologies, the physical examination will continue to be critical to medical practice.

In a clinical environment, many students are frustrated by the difficulty they experience in remembering previously acquired knowledge and by being incapable of applying such knowledge to the clinical case in question. Teachers, on the other hand, are often surprised by the students, who seem to have retained so little. The problem may lie in the separation between clinical learning and the environment in which it is applied[9].

Perhaps due to the lack of a basic physical examination guide with a simple and practical sequence, medical students fail to apply prior knowledge in practice, neglecting important semiologic points. Many doctors, for example, do not measure the abdominal circumference on routine visits. This is an important piece of information for assessing cardiovascular risk in the patient; when this measurement is over 94 cm in males and over 80 cm in females, there is an increased risk of metabolic and cardiovascular complications[10]. Another neglected piece of clinical data is the ankle-brachial index, which allows the diagnosis of peripheral arterial disease and is also a prognostic factor for cardiovascular mortality events[11,12].

In practice, there is no routine physical examination with a standard sequence for exploring the various systems. There are many models for performing the physical examination with advantages and disadvantages, most with an extensive and complex *checklist*. The preparation of a simplified guide with a structured sequence physical examination can serve as a model for the medical student. It is the systematic repetition that can shape the student into a skilled physician in physical examination.

Therefore, the objective of this study was to evaluate the clinical skills of medical students and the applicability of a simplified physical examination guide for the improvement of these skills.

METHOD

This was an analytical, quantitative study comparing before and after data. The work, once approved by the Research Ethics Committee of the University of the State of Pará (CEP-Uepa), was conducted at the Jean Bitar Hospital Complex (CHJB), one of the UEPA teaching hospitals in the city of Belém. The sample included students of both sexes, who were regularly enrolled interns from the UEPA medicine course and were taking the Internal Medicine module in the hospital setting, from January to February 2014. The patients to be examined were ones who had been admitted to the internal medicine ward. All participants, students and patients examined, signed a Declaration of Free and Informed Consent.

The simplified physical examination guide sequence was structured to minimise the examiner's movement and limit the patient's need to stand up, allowing the exploration of areas of the body that are part of different organ systems. This is one of many possible roadmaps that allow the performance of a complete physical examination.

The research was performed in two stages: at the beginning of the internal medicine internship without the physical examination guide, and at the end of the training period, after training with the guide.

In the first instance, students who had just begun the internal medicine internship recorded physical examination data in the medical records without having undergone any training with the guide. The students were accompanied by the resident doctor responsible for the bed to observe whether the examination was performed. The physical examination data recorded on each patient's chart were subsequently reviewed by means of an evaluation form which analyzed which of the 13 semiologic aspects had been examined by the student doctor: vital signs, oral cavity examination, ophthalmoscopy, otoscopy, thyroid examination, cardiovascular examination, pulmonary examination, abdominal examination, lymph nodes examination, anthropometric measurements, ankle-brachial index (ABI), neurological examination, examination of the breast (female patients) or testicles (male patients).

The examination of each semiologic domain was classified as a "complete assessment", "partial assessment" or "absent assessment".

The recording of vital signs was considered complete if blood pressure, temperature, pulse rate and respiratory rate were annotated. Cardiovascular examination was considered complete if cardiac auscultation, peripheral pulse palpation and ankle-brachial index were recorded. In the case of pulmonary examination, complete assessment required description of auscultation and thoracic palpation or percussion; for the abdominal examination, the required data were those related to the inspection, percussion, auscultation and palpation of the abdomen. The neurological examination was considered complete if it included the description of gait, pupillary examination, ocular movements, muscular strength and peripheral reflexes. In relation to the anthropometric measurements, weight, height, body mass index (BMI) and waist circumference were required to constitute full assessment.

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The examination of the lymph nodes was considered complete when inspection and palpation of the main ganglionic chains: head and neck, axillary, epitrochlear and inguinal, had been performed. When palpable, the examiner should have described the following characteristics: location, size, consistency, fixation to the skin and deep planes, sensitivity and skin changes (flushing, temperature, fistulas, scars). A complete thyroid examination, meanwhile, should contain the following mandatory information on palpation: volume, consistency, mobility, surface, and tremors.

As regards the examination of the oral cavity, a light source (torch) and tongue depressors were provided for performance of the examination. The complete description should contain information on the findings of inspection of the lips, oral mucosa, gums, teeth, palate, tongue and pharynx. For the ophthalmoscopy, an ophthalmoscope was provided and the examination was considered complete if the fundus of the eye inspection had been recorded with description of the optic disc, AV crosses, retinal lesions and macula area. For otoscopy, an otoscope with a speculum was made available and the exam was considered complete when records had been taken of findings of the auditory canal and tympanic membrane.

For the examination of the breast, the examining physician should report findings of the inspection and palpation of each breast with the patient lying down. Examination of the testicles should include inspection of the scrotum (contours and skin) and palpation of each testicle (pain, nodule, and consistency). The ABI should report systolic pressure (SPV) obtained in the right leg, the systolic pressure (SPV) obtained in the right arm and SPV right leg/SPV right arm values.

These criteria were established as a basis for indirect evaluation of the quality of the examination performed. Any exams that failed to fulfill all the criteria for completeness were classified as "partial assessments". Semiologic descriptions that were presented as "no particularities" or "nothing noteworthy" were considered incomplete. It was also considered "absent evaluation" when the physical examination areas were not clearly marked if they were considered as "complete", "partial" or "absent", that is, the data were not available, due to poor completion, in the evaluation form.

Following this first stage, the students underwent training with the aid of a simplified physical examination guide, lasting approximately 30 minutes. Initially, the sequence was performed by the instructor and then by the student, who continued to receive daily training from the instructor in the guide sequence throughout the three-week internship period.

After the three weeks of training with the guide, the students were evaluated with the same checklist applied on the first day.

Regarding the information about the physical examination findings, the variables were categorized, with three possibilities (complete examination, partial examination and absent examination). Therefore, each of these possibilities was treated as a dichotomous variable. The effectiveness of the educational intervention, with the aim of improving the quality of the aspects of clinical assessment, was assessed by comparing the two data sets obtained before and after the intervention, for each item of clinical assessment. To this end the McNemar statistical test was applied for paired samples.

Furthermore, the overall quality scores of the evaluation were obtained using the sum of points assigned to each item of the clinical assessment analyzed (1.0 point for "complete", 0.5 points for "partial", zero points for "absent"). This sum was divided by 1.3. Thus, each student had a minimum global score of zero points and a maximum of ten points, which score is therefore considered as a continuous variable. The global scores were compared before and after the training. The Kolmogorov-Smirnov test was initially applied to verify the normality of the variable. When the distribution found was normal, the paired t-test was then applied; when it was a non-normal distribution, the Wilcoxon test was applied.

Additionally, the possible association between the course year of undergraduate medical training and the global score obtained after the training was evaluated. This analysis was performed by the Pearson correlation test. For all analyses, $p < 0.05$ was considered.

RESULTS

In all, 31 students were evaluated, of which 19 examined female patients and 12 examined male patients.

In the period that preceded the training of the students, the most frequently performed examinations were the cardiovascular system (100%), pulmonary system (100%), abdomen (100%) and vital signs (83.87%), followed by palpation of lymph nodes (35.48%), neurological examination (25.81%), thyroid palpation (16.13%), oral cavity examination (12.90%), anthropometric measurements (9.68%) and breast (5.26 %). Ophthalmoscopy, otoscopy, examination of the testicles and assessment of ABI were ignored by all students (Graph 1). After the training, the most frequently performed examinations, in descending order, were the cardiovascular system (100%), pulmonary system (100%), abdomen (100%), vital signs (100%), palpation of lymph nodes (100%), oral cavity examination (96.77%), neurological examination (93.55%), an-

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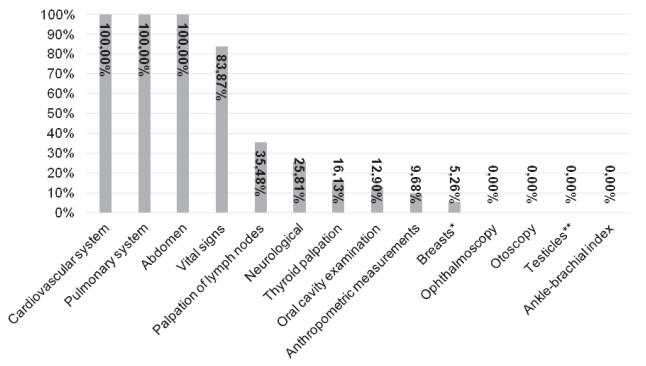
kle-brachial index (90.32%), otoscopy (74.19%), anthropometric measurements (70.97%), breast (68.42%), thyroid palpation (67.74%), ophthalmoscopy (35.48%), and, finally, testicular examination (25%) (Graph 2).

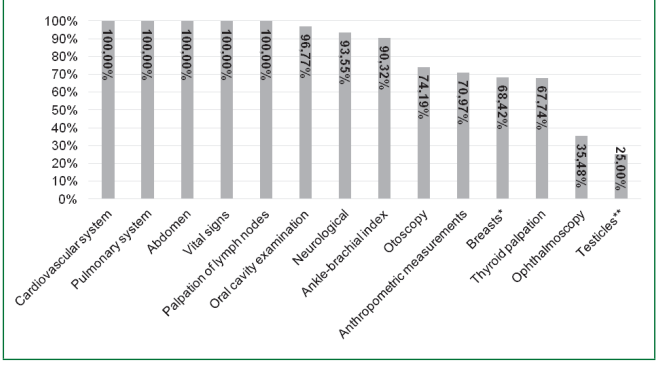
The percentage of students who performed a complete assessment of vital signs increased significantly, from 16.13%, prior to the training, to 100%, after the training, with a relative risk (RR) of 6.2 (P <0,01). Such an increase in the quality of the assessment resulted in the significant and desired reduction of assessments considered partial (P <0,01) and absent (P = 0,06), as observed in Table 2.

Graph 1
Relative frequency of clinical assessment items performed by students, either partially or completely, before training (N = 31)



*Source: Data collected from the study (CHJB/2014). * N = 19. ** N = 12.*

Graph 2
Relative frequency of clinical assessment items performed by students, either partially or completely, after training (N = 31)



*Source: Data collected from the study (CHJB/2014). * N = 19. ** N = 12.*

Table 1
Relative frequency of clinical assessment items performed by students, either partially or completely, before and after training

Semiologic domain	Before (N = 31) %	After (N = 31) %
Cardiovascular system	100	100
Pulmonary system	100	100
Abdomen	100	100
Vital signs	83.87	100
Palpation of lymph nodes	35,48	100
Neurological	25,81	93,55
Thyroid palpation	16,13	67,74
Oral cavity examination	12,90	96,77
Anthropometric measurements	9,68	70,97
Breast examination*	5,26	68,42
Ophthalmoscopy	0	35,48
Otoscopy	0	74,19
Testicular examination**	0	25
Ankle-brachial index	0	90,32

*Source: Data collected from the study (CHJB/2014). * N = 19. ** N = 12.*

Desired and statistically significant results were observed in relation to analysis of the complete clinical assessments, of the cardiovascular system (3.23% versus 74.19%; RR = 23; P < 0.01), pulmonary (22.58% versus 90.32%, RR = 4; P <0.01), abdomen (22.58% versus 74.19%; RR = 3.29; P = 0.01), neurological (0% versus 22.58%; RR = not estimable; P = 0.02), lymph nodes (6.45% versus 77.42%; RR = 12; P < 0.01), thyroid (0% versus 61.29%; RR = not estimable; P <0.01), oral cavity (6.45% versus 67.74%; RR = 10.5; P <0.01), ophthalmoscopy (0% versus 32.26%, RR = not estimable; P < 0.01), otoscopy (0% versus 64.52%; RR = not estimable; P < 0.01), breast (0% versus 36.84%; RR = not estimable; P = 0.02), anthropometric measurements (0% *versus* 45.16%; RR = not estimable; P <0.01) and ankle-brachial index (0% *versus* 83.87%; RR = not estimable, P <0.01).

The only exception to the complete assessment comparisons was observed in the testicular exams, with a total absence of complete assessment prior to student training and a discrete increase to 8.33% after the training. Such a difference was considered insignificant according to statistical analysis (P = 1.0).

The comparison between the individual global performances before (median = 1.92, maximum value: 5.38, minimum value: 1.15) and after (median = 7.31; maximum value: 10.0; minimum value: 4.23) of the training period showed a statistically significant difference (p <0.01), as observed in Table 3.

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Table 2
Comparisons of the percentages of assessments of semiologic domains considered complete, partial and absent, before and after training (N = 31)

Domains evaluated	Quality	% Before (N = 31)	% After (N = 31)	RR	P
Vital signs	Complete	16.13	100.00	6.20	< 0.01
	Partial	67.74	0.00	42.00	< 0.01
	Absent	16.13	0.00	10.00	0.06
Palpation of lymph nodes	Complete	6.45	77.42	12.00	< 0.01
	Partial	29.03	22.58	0.78	0.79
	Absent	64.52	0.00	40.00	< 0.01
Thyroid palpation	Complete	0.00	61.29	not estimable	< 0.01
	Partial	16.13	6.45	0.40	0.45
	Absent	83.87	32.26	0.38	< 0.01
Cardiovascular system	Complete	3.23	74.19	23.00	< 0.01
	Partial	96.77	25.81	0.27	< 0.01
	Absent	0.00	0.00	not estimable	1.00
Pulmonary system	Complete	22.58	90.32	4.00	< 0.01
	Partial	77.42	9.68	0.13	< 0.01
	Absent	0.00	0.00	not estimable	1.00
Abdomen	Complete	22.58	74.19	3.29	0.01
	Partial	77.42	25.81	0.33	< 0.01
	Absent	0.00	0.00	not estimable	1.00
Neurologic	Complete	0.00	22.58	not estimable	0.02
	Partial	25.81	70.97	2.75	< 0.01
	Absent	74.19	6.45	0.09	< 0.01
Neurological Oral cavity examination	Complete	6.45	67.74	10.50	< 0.01
	Partial	6.45	29.03	4.50	0.07
	Absent	87.10	3.23	0.04	< 0.01
Ophthalmoscopy	Complete	0.00	32.26	not estimable	<0.01
	Partial	0.00	3.23	not estimable	1.00
	Absent	100.00	64.52	0.65	< 0.01
Otoscopy	Complete	0.00	64.52	not estimable	< 0.01
	Partial	0.00	9.68	not estimable	0.25
	Absent	100.00	25.81***	0.26	< 0.01
Breast*	Complete	0.00	36.84	not estimable	0.02
	Partial	5.26	31.58	6.00	0.13
	Absent	94.74	31.58***	0.33	< 0.01
Testicles**	Complete	0.00	8.33	not estimable	1.00
	Partial	0.00	16.67	not estimable	0.50
	Absent	100.00	75.00	0.75	0.25
Anthropometric measurements	Complete	0.00	45.16	not estimable	< 0.01
	Partial	9.68	25.81	2.67	0.22
	Absent	90.32	29.03***	0.32	< 0.01
Ankle-brachial index	Complete	0.00	83.87	not estimable	< 0.01
	Partial	0.00	6.45	not estimable	0.50
	Absent	100.00	9.68	0.10	< 0.01

*Source: Data collected from the study (CHJB/2014). * N = 19. ** N = 12. *** Of the cases of "absent assessment", one was considered absent due to the unavailability of information in the evaluation form. P values obtained by means of the McNemar statistical test. RR: Relative risk.*

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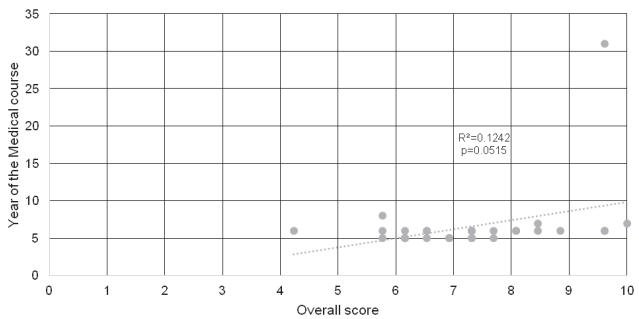
Table 3
Comparison of the medians of the individual global performances between the two evaluation periods, before and after the training period

Overall score before (min. and max. median) N = 31	Overall score after (min. and max. median) N = 31	Difference between medians	P
1.92 (1.15-5.38)	7.31 (4.23-10.0)	5.38	< 0.01

Source: Data collected from the study (CHJB/2014). Min = minimum value. Max = maximum value. P values obtained by the Wilcoxon statistical test.

The improved performance, according to the overall scores in the individual clinical assessments, showed a weak correlation (R2 = 0.14242, p = 0.0515) with the year of the medicine course, as shown in Graph 3.

Graphic 3
Correlation between the medicine course year and the individual global performance in the clinical assessment, after training



Source: Data collected from the study (CHJB/2014). P value obtained by the Pearson statistical test.

DISCUSSION

The failure among physicians to perform clinical assessments or adequate physical examinations has become a generalized phenomenon, observed worldwide over recent decades[13,14]. This problem is so common and well reported in medical education services around the world, that one author who researches this area, Chad Cook, a specialist in musculoskeletal disorders, refers to clinical examination as "the lost art"[15].

The present study demonstrates the low level of appreciation for the physical examination prior to the training (Tables 1 and 2). Although some segments of the clinical examination were recorded in 100% of the cases (cardiovascular, pulmonary and abdominal exams), many medical records were incomplete, as shown in Table 2.

The scenario encountered before the training could be compared to findings of other studies. A multicenter study by Barrios *et al.*[16], in 1995, for example, demonstrated that the physical examination had already been neglected in large university centers even when patients presented complaints that justified the examination. Ten years later, the same authors analyzed the physical examinations performed by doctoral students and residents of the Internal Medicine Service of a university hospital and observed that examinations of the cardiovascular system, pulmonary system and abdomen were prioritized in relation to the others, and recorded in the following percentages of cases, respectively: 94.1%, 95.8% and 91.66%. However, despite these records, a complete examination had rarely been performed. These data are exemplified in the cases of the pulmonary system assessment (complete in only 10% of cases) and cardiovascular system assessment (46.6%). In addition, of the total patient sample, in only 11.6% of the cases a description of the neurological examination was presented in the hospitalization notes (14/120 patients)[13]. These data are similar to those of the present study, in which, as shown in Table 1, the cardiovascular system, pulmonary system and abdomen examinations were recorded in 100% of the patients prior to training with the guide; however, Table 2 shows that only 3.23%, 22.58% and 22.58% of the patients were subjected to complete assessments for cardiovascular, pulmonary and abdominal systems, respectively. Furthermore, the neurological assessment was performed in 25.81% of the patients, all of which were partial examinations, before training with the guide.

In another study, the authors used a clinical score based on physical examination data at the time of medical care and according to the patient's information. This clinical score was constructed based on questions addressed to the patient regarding the following medical procedures: (1) blood pressure measurement; (2) heart auscultation; (3) pulmonary auscultation; (4) palpation of the abdomen; (5) after being shown a stethoscope and a tensiometer, whether such devices had been used during the physical examination. Hence the clinical score could vary from 0 to 5 points, where a score of zero was attributed to medical consultation without apparent clinical investigation, and 5 to that in which the physical examination was supposedly more adequate. The clinical score registered a mean of 3.1 (± 2.1), and 23.9% (34/142) of the cases with a score of zero. Of the 142 patients included in this study, 50 (35.2%) reported that their blood pressure had not been measured, and 50 (35.2%) reported not having had the thorax auscultated and almost half (47.2%; n = 67) reported no abdomen examination[17].

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Further supporting the results of the present study, Silva and Rezende[18], in 2008, observed that 65% of medical students who had already undergone medical semiology in adults, were self-assessed as not having the necessary ability to perform a physical examination, and 18.5 % reported not noticing significant semiologic signs.

Neurological examination may have had a low percentage of complete assessments (22.58%) even after the training (Table 2) due to "neurophobia", which is a phenomenon in which medical students often perceive neurology as the specialty, which makes them less willing to deal with neurological conditions[19]. The complexity of the clinical examination is one of the main reasons why many students find neurology difficult[20]. Studies show that medical students generally perform poorer in neurological examinations than in other fields of clinical assessment[21].

The completion rate for palpation of the lymph nodes improved substantially following the training: 100% of the students examined the lymph nodes after the training, 77.42% fully. It is likely that the simplified study guide, which lists the ganglion chains to be evaluated by students in each body segment, helped significantly in achieving this improvement because it enabled students to remember which chains should be examined, in a simple and sequential manner.

There was also significant improvement in the rate of ophthalmological examinations performed after the intervention. However, still only 35.48% of the students conducted the exam, either completely or partially (Graph 2), even though an ophthalmoscope was available. This demonstrates the great challenge involved in teaching direct ophthalmoscopy at undergraduate level. The medical literature has already found that most clinicians and students lack the confidence and ability to perform ophthalmoscopy[22]. One study showed that the students had an average confidence level of below 2, on a scale of 1 to 5 (1 being the least confident) [23] to perform an ophthalmologic examination. Change is therefore required in this context, because it is necessary for the clinician to know how to perform direct ophthalmoscopy and how to interpret it. Thus, there is a need for students to have more exposure to ophthalmology clinics[22]. One study created a teaching ophthalmoscope in which a third person could observe the student's vision of the fundus of the eye during the examination[24]. Another lower cost option would be to have more specific skills training sessions for the ophthalmological exam, using less expensive materials[23].

Significant improvement was also observed in relation to the performance of otoscopy after the intervention, with the rate of complete assessments reaching 64.52% (Table 2). Prior to the training with the guide, none of the students performed otoscopy, which demonstrates that the teaching of otoscopy is also very poor during graduation. Jones *et al*[25], for example, identified that only 5% of the evaluated medical students felt they could perform an appropriate otoscopy examination in children. Another study showed that only 38.5% of the primary care physicians of the San Antonio Military Health System used an otoscope to diagnose acute otitis media[26].

The rate of complete thyroid examinations rose from 0% to 61.29%. Clinical assessment of this gland is poorly performed in medical practice, so much so that Wu *et al*[27], in 2007, found a self-confidence level of 2.8 (1 to 5 scale, 1 being the lowest confidence level) among medical students as regards the detection of a thyroid nodule. However, with simple interventions, this scenario is likely to change, as seen in the present study and in the work of Haring *et al*[28], in 2014. These authors noted that following systematic training of clinical skills and physical examination in real patients, 75% of medical students performed thyroid examination. And 75% of those executed the exam properly.

Regarding breast examination, it was reported that only 5.26% of the students performed this exam, and even so only partially, before the intervention with the guide. After the training, this rate increased to 68.42%, but there was still a low percentage of assessments considered complete (36.84%). This is probably due to cultural barriers, as it is an intimate part the woman's body. Wang *et al*[29], in 2015, demonstrated in a questionnaire survey that the acceptability of breast examination by male physicians is low among medical students and physicians themselves, with 35.03% and 59.66% deeming it acceptable, respectively. Haring *et al*[28] presented more worrying data regarding breast examination: in their study, one hundred medical students underwent eight weeks of systematic training in clinical skills, followed by an additional eight weeks of training with actual patients. In the end, it was observed that only nine students performed breast palpation.

The testicular examination was the only item that was not associated to any educational and statistical difference considered relevant, probably due to cultural norms, a perceived low distribution of related diseases in the general population and associated to the students' indifference towards the importance of this type of assessment in the current phase of their training. To overcome this barrier aginst the clinical assessment of the genitals, more far-reaching measures may be needed, such as an integrated teaching program on female and male genital examination (using trained teachers and simulated patients in a supervised clinical teaching setting), since

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during undergraduate training, there are few opportunities to practice this type of examination[30].

The oral cavity examination was performed in 96.77% of the patients after the training, a result in line with a study by Haring *et al*[28] in 2014, which showed that 100% of the students performed examination of the oral cavity and pharynx following educational intervention. However, Haring *et al*[28] noted that only 9% of these students performed the exam adequately. In the present study, 67.74% of the assessments were considered complete (Table 2). This discrepancy may be due to differences in the criteria adopted for determining whether the examination was adequate.

The ankle-brachial index (ABI) measurement increased from 0% to a rate of 83.87% complete assessments following the training. The deficiency in knowledge about ABI among physicians has already been shown in other studies. In the study by Wyatt *et al*[31], in 2010, it was shown that among 29 internal medicine residents, only 4% correctly measured ABI, 10% correctly calculated it, and 45% correctly interpreted it. However, after an educational session with a specialist, there was a noticeable improvement: 50% of the residents measured it correctly, 75% calculated it correctly and 88% interpreted it adequately. Therefore, a simple intervention, like the simplified guide, can greatly improve the performance of ABI measurement.

The rate of anthropometric measurements also improved after the training. However, a complete assessment was still only achieved by 45.16%, a relatively low percentage, considering that BMI and waist circumference are simple measurements to perform. Perhaps the students' perceived low degree of usefulness of these measurements during hospitalization and the displacement of the patients from their bed to scales to measure height and weight were factors that undermined the performance of this assessment.

As Graph 3 demonstrates, no correlation was found between the students' current year of undergraduate course and the overall score after the intervention. This may have occurred because there was only one course year difference between most the students (fifth year and sixth year of medicine degree); therefore, this time difference may not be as significant for the physical examination. Furthermore, the small number of study participants, 31 in total, may have influenced this outcome.

To solve the current problem in the medical training process, which fails to prioritize the ability to perform routine and complete clinical examination, focusing on teacher preparation and awareness in relation to this competency at undergraduate degree level is the most highly recommended strategy[32,33]. In addition, the authors of the present study suggest that training with the simplified guide for PhD students and early stage interns in the presence of a teacher is another simple and probably very effective strategy. Establishing an integrated program with the discipline of Semiology to accompany the students until the end of the course could be an initiative of easy implementation. But it is valid to reinforce the need to test, in addition to face-to-face instructions and printed materials, other resources, such as electronics, which may include the internet and applications[34,35].

Highlighting the efficacy of the simplified physical examination guide, students in the present study clearly improved their clinical semiotics, with a 280.7% increase in the median student performance score after the training (1.92 versus 7.31 points), as shown in Table 3. In this sense, a standard physical examination sequence that contemplates all the systems has been shown to be effective for almost all the clinical assessment items analyzed.

The teaching of clinical skills, especially clinical assessments, physical examinations or other situations of health care practice, may be influenced by different teaching styles, differences in the teaching staff of an institution, local administrative characteristics, degree of individualization and characteristics of the patient and the assesor[36,37]. Despite these influences, in addition to certain subjective factors, objective instruments, in a checklist format, are extremely promising and recommendable for future studies in this area, as a viable means for the teaching-learning process of clinical assessments[38].

In addition to the use in the training of undergraduate medical students, the proposed instrument could also be used in continuing medical education actions in various health services, presumably making them more efficient and responsible in the use of diagnostic technologies, especially in low income areas[39].

It is interesting to note that, in the present study, the students exercised the activities independently, without the presence of a teacher, at the exact moment of the assessments[40]. Unlike the Structured Clinical Examinations and Objectives, the simplified clinical assessment guide was applied in circumstances consistent with the actual demands of the health service in which the study was conducted (Jean Bitar Hospital Complex). Since 1975, the methodology of Structured Clinical Examinations and Objectives has incorporated a wide variety of activities in very different cases, scenarios and situations, but all of them in simulation conditions, including with the participation of actors, when necessary[41]. This point was emphasized by Weller *et al*[42], in 2014, in the article *Can I leave the theater? A key to more reliable workplace-based assessments*. In this study, the authors emphasize that assessment methods in situ-

ations of greater student independence, in real situations, can be a reliable means of evaluation, without burdening the routine of both teaching and service staff.

One evident limitation of this study is that the simplified guide was only applied for only three weeks. For a better analysis and deeper intervention, it would require a longer experimental period. But this study already demonstrates the effectiveness of this tool and serves as the basis for future studies. In addition, other interventions may be needed in conjunction with the simplified guide, especially for items that reported a relatively low overall rating.

CONCLUSION

There is a large deficit in teaching clinical skills during medical graduation. As an effective solution, a simplified sequential clinical examination guide can serve as training for medical students.

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CONTRIBUTION OF AUTHORS

Salomão Neto – idealization of the work and the simplified guide, interpretation of the results. Tiago Braga – bibliographic research, data editing and composition of the article. Márcia Portella – orientation, editing and coordination of the research. Regis Andriolo – orientation, editing and coordination of the research.

CONFLICT OF INTERESTS

We declare that there is no conflict of interest between the authors of this article.

MAILING ADDRESS

Salomão Neto
Centro Hospitalar Jean Bitar
Rua Cônego Jerônimo Pimentel, 543
Umarizal – Belém
CEP 66055-000 – PA
E-mail: matheus98@oi.com.br