## Parasitological Laboratory Diagnosis of Operculated Eggs: A Competency-Based Model By Microbiology Postgraduate Learners at Armed Forces College of Medicine

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### ABSTRACT

**Background:** In parasitology, investigating the diagnostic stages is the most cost-effective, yet it requires sufficient training. This competency was compulsory in the master's degree in microbiology necessitating test requisition form at the workplace to help correct diagnosis.

**Patients and Methods:** Brainstorming sessions were the initial step to defining their learning requirements. Then a student-centered learning process was used to trigger cognitive motivation, personal development, and learner satisfaction. Each competency was analyzed into milestones that reflect specific outcomes and objectives framed into entrustable professional activities (EPAs). To guarantying reaching the required milestone of competence continuous monitoring and evaluation guided by regulations of specific KPIs were performed. The time frame of the activity was within the duration specified for the required EPAs weight. Constructive feedback using questionnaires and measurements of the outcome tools was done.

**Results:** No average or poor responses by the teachers or the learners as regards all the different analytic elements in the evaluation forms. Despite having a sufficient level of proficiency, the chosen good responses of some parameters reflected that not all students were on the same level of learning achievements. The limited time restrained the development of the tool.

**Conclusion:** The incorporation of technology into the educational process restricted the traditional teacher-centered role. The Excel spreadsheets were innovated in detail to reflect provisional diagnoses. Students' perception of the experience was adequately positive to recommend extending the use of the tool to other courses. Also, teachers' responses were very positive encouraging the continuation of the experience.

**Key Words:** Competency, constructive feedback, educative tool, entrustable professional activity, excel spreadsheets, medical education, microbiology, operculated eggs in the stool, parasitology, post-graduate students.

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#### **INTRODUCTION**

The trails to learning no longer lead routinely to traditional institutions of higher education. In its place, they lead most directly to learning chances in which competencies are defined clearly with multiple transfer decisions<sup>[11]</sup>. Competency-based medical education (CBME) targets consistent levels to pledge that all learners have a sufficient level of ability after training<sup>[21]</sup>; the paradigm shift will eventually redefine the roles of faculty, institutions, and accreditors<sup>[11]</sup>. In CBME, stress has shifted towards outcomes, graduate capabilities at the workplace, and learner-centeredness with a focus on sustained indication of professionalism calling for changing methods of teaching and assessment<sup>[3]</sup>.

Entrustable professional activities (EPAs) are units of qualified practice, defined as tasks or responsibilities to be commended to the unsupervised performance by a trainee once he/she has attained sufficient specific competence. EPAs are independently executable, observable, and quantifiable in their process and outcome, and therefore, suitable for entrustment choices. Sequencing EPAs of increasing difficulty, risk, or complexity can serve as a mainstay for graduate medical education<sup>[4]</sup>.

EPAs are descriptors of work and usually require multiple competencies of an integrative nature. An EPA must be described at a sufficient level of detail. This is to set trainee prospects and guide the supervisor's assessment and entrustment choices. Indicators are phases in the expansion of specific competencies. Entrustment decisions involve clinical skills and capabilities as well as general facets of competence, such as understanding one's boundaries and knowing when to ask for help. Making entrustment verdicts for unverified practice requires observed expertise, usually on multiple events<sup>[4]</sup>.

In the context of parasitology laboratory training, the importance of setting in determining the type of parasite that the patient may have acquired should be unveiled as part of taking a detailed history. It remains noteworthy along years of practice and turnout in infectious diseases/ microbiology teaching conferences how often the shreds of evidence to the definitive judgment were present in the clinical history or, unfortunately, should have been present had an in-depth clinical history been taken. The clinical history is designed to discover epidemiologic risk factors that are important for guiding testing<sup>[5]</sup>. In addition, specific questions concerning past medical history, previous residence, travel, outdoor activities, family, food, and drinking water should be addressed<sup>[6]</sup>.

If the history did not include the location of prior citizenship, then parasite examination of the stool may not have been achieved, as the individual may have been asymptomatic. Although there are no accepted general guidelines in these cases, routine parasitology inspections of O&P may be a proper option<sup>[7]</sup>. Eggs are often important to diagnose parasitic helminths because of their distinctive morphological structures. Mostly a concentration technique will be needed to approach a definitive diagnosis to avoid overlooking parasites that are present in a minor number. It is also of utmost importance for the parasitologist to measure objects in the microscopic field which is requiring a skilled parasitologist<sup>[8]</sup>.

The student-centered education process with instructive quality has become a basic part of the informative process all over the world, increasing student contribution, and adding a new measurement to monitoring educational brilliance and student gratification<sup>[9]</sup>.

#### Aim of the study

The study aimed to present a collaborative competencybased microbiology postgraduate medical education approach for the laboratory diagnosis of parasitic infections with operculated eggs in the stool. Consequently, a series of EPAs were decided by the mentors with continuous feedback to reach the designation level triggered by the learner-centered educational tool.

#### **PATIENTS AND METHODS:**

#### Setting:

The study was conducted in the Parasitology Department at Armed Forces College of Medicine (AFCM).

### Steps included:

#### **1-Brainstorming sessions:**

To define needs valuation and achieve the required competency<sup>[10]</sup>.

## 2- Required competency identification:

Methodology, task file of committee members, and vision of guidelines propagation after approvals are mandatory<sup>[11]</sup>.

## 3- Training objective according to Garcia et al. 2018<sup>[7]</sup>:

To enable 1<sup>st</sup> part postgraduates of Master's degree in microbiology to be competent at the diagnosis of operculated eggs by O&P examination and create a simple tool for aiding the diagnosis of stool samples with the proper contentment and recommendations of further accurate analysis based on:

A. Geographical area of origin or as a visitor or consumption of imported food staff as a source of infection

#### B. Occupation

C. Evidence of infection or exposure to infection as well as complaint and clinical presentation via:

a. Patient questionnaires.

b. Necessary communication with the referring physician as an interdisciplinary approach to patient management.

D. Other lab findings and investigations.

#### 4- Simulation and role-play:

A multitask to imagine being professionals and to show the guidelines for the diagnosis of operculated eggs in the stool<sup>[12]</sup>.

#### 5- Requirements:

Starting from anonymous and based on the clinical sheet from the patient and the size of the recovered operculated egg after sample examination. Flow charts were built according to guidelines. Introducing the data to Excel sheets was initiated and continuously upgraded.

#### 6- Training weight:

Equivalent to  $\frac{1}{2}$  credit hour training from all the required EPAs weight.

#### 7- Learning needs:

Were decided under required knowledge, intellectual, professional, practical, and attitudinal skills leading to expertise.

## By the end of the activity, 1<sup>st</sup> part microbiology postgraduate should be able to:

## Knowledge (K):

K1- Enumerate parasitic infections where the patient passes operculated eggs in the stool (individual).

K2-Recognize different sizes of operculated eggs found in the stool sample for differential diagnosis (individual) with the associated clinical manifestations.

## Intellectual skills (I):

I1- Relate such infections to the history of residence or visiting endemic areas, occupation, and modes of infection (individual and teamwork).

I2- Correlate the different sizes of the operculated eggs with the main complaint and clinical presentation (individual and in teamwork).

I3- Suggest different lab methods for diagnosis.

### Professional and practical skills (P):

P1- Construct a working flow chart of operculated egg identification to comment on it in the stool analysis report (teamwork).

P2- Recommend further investigations for final diagnosis in the stool analysis report (individual and teamwork).

P3- Set the guidelines for laboratory diagnosis of patients passing operculated eggs in the stool (teamwork).

P4- Apply the diagnostic tool and guidelines to identify the given unknown samples under the microscope in individuals and without assistance (individual).

#### Attitude and professionalism (A):

A1- Suggest methods of dissemination of these guidelines (teamwork).

A2- Acknowledge teamwork and interdisciplinary approach to the management of patients passing operculated eggs.

A3- Reflect on his performance and the performance of his peers for further improvement of teamwork workshops.

A4- Fulfill the structured interviews objectively for further improvement of the tool.

#### 8- Key performance indicators (KPI)

KPI1- Checked individual and group task files and mentors' feedback.

KPI2- The Excel tool with required data for the provisional diagnosis, as approved by the mentors.

KPI3- The results of assessing the input data necessary for the diagnosis with the optimal recommendations needed.

Checklist and grading rubrics were designed and evaluated for the improvement of their skills and attitude. Also, the recommended resources were provided.

#### Checklist items for KPI3:

1- Discussion and evaluation of case scenarios provided (2 points)

2- Introducing the data to the excel sheet (2 points)

3- Multiple re-evaluations sessions to optimize the clinical sheets data from the different case histories (2 points)

4- Diagnosing different operculated eggs of different parasites (2 points)

5- Extra recommended investigations for different parasitic infections under the recommendations heading (2 points)

Postgraduate trainees were continuously evaluated and were asked to repeat the skills to reach the required level of competence to be entrusted.

## 9- Feedback and measurements of satisfaction and outcomes:

Through evaluation forms and structured interviews with the students and staff members figuring out the conclusions and results in upgraded flowcharts.

#### A satisfaction assessment:

Was done based on methodical interactions and agreements between the following parameters. The teachers 'questionnaires had the same structure as the students<sup>[13]</sup> and that was followed by statistical analysis.

#### Included items:

#### 1- General satisfaction with this experience:

a. This experience is motivating

b. This experience is useful to learn concepts

c. This experience is useful to develop competencies

#### 2- Reflections on the development of competencies:

a. This experience allows me to become more aware of my learning process

b. This experience helps me to develop my competencies

c. This experience helps me to assess my competency achievement

## 3- Regarding the assignment:

- a. The content is easy to follow
- b. The competencies to tag are clear
- c. It is easy to design and develop each post

#### 4. Related to the assessment process:

a. The frequency of feedback is correct

b. The feedback helps me to carry out subsequent assignments

c. The peer comments help me to carry out subsequent assignments

d. The tags guide me in subsequent assignments

## 5. The feedback received in my inbox helps me:

- a. Approach the next assignment
- b. Enhance my commitment to the task
- c. Include criteria to evaluate my progress
- d. Include criteria to keep working on my competencies

## 6. Do you recommend this experience?

- a. For use in the same course
- b. For use in other courses

# 7. Rate your overall level of satisfaction with this experience.

## Descriptive data analysis

Based on the investigative nature of the study, the data gathered using the questionnaires were analyzed through descriptive statistical analysis to reach conclusions. Interpretations were drawn from the comments provided by respondents, about the categories for each part of the questionnaires about the experience of students and teachers' opinions of the learning tool.

## **RESULTS:**

Triggered by the learner-centered educational achievement, excel spreadsheets were chosen by the students to be used as their diagnostic aid in fulfilling the competency. They created their interpretative reports using programmed excel spreadsheets to help them analyze the input data like age, travel history, dietary history, symptoms, morphology, size of the egg in stool, and geographical distribution to output a reliable provisional diagnosis.



**Fig. 1:** Conduction of a provisional diagnosis using excel sheet. (A): click on travel history, (B): data of dietary history, (C): Egg size as measured by micrometry, (D): Correlating all data entry to a provisional diagnosis as one button click. Notice: All items were dragged into the clinical sheet for operculated eggs in the stool. The answers were revealed by the sheet in bold while other parasites were excluded and remarked by the word "NO" not matching the selected items in the clinical sheet.



Fig. 2: Qualitative assessment of the targeted parameters of evaluation for teachers' responses.



Fig. 3: Qualitative assessment of the targeted parameters of evaluation for students' responses.

#### DISCUSSION

The most commonly performed examination in the parasitology laboratory is the complete investigation of O&P which consists of a direct wet mount, concentration, and permanent-stained smear. A clinical microbiologist should work with the medical staff to frame the test demand forms, at their workplace and help diagnose the patient. They should work to aid clinicians in the clinical scenario met<sup>[7]</sup> **Garcia** *et al.* **2018**). This competency is due to their progress in the parasitology course encountered as a subsidiary in their master's degree.

Our study started with brainstorming assemblies with the learners to define their provisions. As the student-centered learning process with educational superiority has become a basic part of the educational process all over the world, increasing student participation, when not only the academic staff participate, adds a new dimension to monitoring educational excellence and learner satisfaction. This issue bangs the ideas about the relationship between cognitive incentive, personal growth, and student satisfaction with post-graduate higher education<sup>[9]</sup>.

That helped in defining the required competency which reached the goal of proper identification through the tool provoked by the learners. Milestones of each competency were investigated to reflect specific outcomes needed and that was achieved through crucial objectives being accomplished as previously explained by<sup>[11]</sup>. These objectives were frame-worked to translate EPAs. To enable this translation, addressing the concern that competency frameworks would exclude being too hypothetical to be useful for training and assessment in daily the students' practice as suggested formerly by<sup>[14]</sup>.

Learning needs are the best trigger for reflecting on capabilities and deficiencies required by each learner gathering the requirements requested to define consequences. Competencies should be transparent. Outcomes hold no anonymity, excluding those that are verified only by specialized judgment ignoring students' impact as stated previously by<sup>[15]</sup>. Consequently, the objectives were specific to the definite target of finding eggs of helminths in stool, considering important items which are essential for diagnosis required for students at their workplace. As competency-based models eventually rely on measurable assessment, so if a proposed competency cannot be described definitely and subsequently measured, it probably is not a competency. Given these essential features, all revelries sharing in the learning experience; should be able to understand with precision the outcomes of the learning experience<sup>[15]</sup>.

The learners were left to be triggered to find the suitable tool that can help them achieve and gain the competency. Hereby they chose the Excel spreadsheets. Formerly, the Excel spreadsheet-based patient reports proved to display an ability to rapidly and easily prepare the kind of patient data investigation<sup>[16]</sup>. As previously indicated by earlier studies, further quality enhancement is primarily connected with, increasing flexibility and individualization of the educational process offering more opportunities for practiceoriented learning, more active information support covering the advantages of novelties introduced, opportunities for self-development, extra-curricular and leisure activities for learners<sup>[17]</sup>. The use of Excel software in pathology and clinical chemistry applications is not new<sup>[18,16]</sup> however, it is as regards medical parasitology. Being easy to use and most im-portantly, deliver clinically useful information to physicians that are either not obtainable at all or not easily accessible in most parasitology laboratories.

In the study, learners were continuously monitored and evaluated guided by regulations of specific KPIs targeting the specified track for the outcomes. Steps of activity were enclosed considering a time frame within the activity duration specified for the required EPAs weight.

Monitoring meticulously the whole process through constructive feedback and measurements of the outcome tools was done for the general satisfaction and the overall progress of the whole experience. As the most effective method of assessing the quality of medical education is through a selection of qualitative assessments, usually as part of a program evaluation. Common qualitative assessments include capacities of students' and teachers' contribution, outcome measures such as assessment results, and as here, qualitative assessments such as interviews and questionnaires of students and teachers<sup>[19]</sup>. Results showed no average or poor responses were provided by the teachers or the students as regards all the different analytic elements in the evaluation forms. The students encouraged the idea and found it motivating and touching their needs. The only regard was to the time limit which needed to be increased to enable the handling and perfection.

Emphasizing the formative measurement of feedback in the teaching and learning process, and primarily its role in assessment should be always well-thought-out<sup>[20]</sup>. The results obtained confirm the ideas of<sup>[21]</sup>, who fortified the value that feedback is cherished by all the participants (both teachers and students) as a key element that helps to improve the teaching and learning process, and, more specifically, to develop relevant aptitudes.

In our study, no average or poor responses have been provided by the teachers or the students as regards all the different analytic elements in the evaluation forms. The excellent-very good response reflected that the detailed nature of the topic after learning its content was well digested urging the students to construct a flow chart, here in the present study the excel spreadsheets were chosen, and to search for a mind map to simplify the diagnosis and help them study and practice to reach a milestone of achieving the competence.

As regards the student's responses as excellentgood, they reflect the students' enthusiasm when a suitable encouraging environment and studentcentered learning are applied, they can excel. The chosen good responses of some parameters reflect that not all students were on the same level of learning attainments which is a norm in population disparity<sup>[22]</sup>. Also, they reflect the nature of this selected topic content in being a little bit difficult for the students to study, and may be that was the impulse of the students' selection for this topic in their tool application. The time limit was an important factor limiting the peer review from the other students who had studied that course or who are going to study it. They were only supervised by their staff members.

Though each milestone included criteria for evaluation of the tool application with continuous feedback to readjust, the response for the parameter of As regards the teachers' responses, the chosen good responses, in some indicators were due to the lack of time to re-evaluate, assess, apply to other areas and get familiar with the tool used. The experience was tightly bound to a little period according to the schedule of the students as post-graduates studying a subsidiary specialty and this is to be applied comparatively for the main parasitology specialty, though many hidden skills were achieved indirectly to get this tool being attained.

As regards, the parameter of easy is used as being quick and of good quality, the good responses may be interpreted due to, the wide differentials within the other topics, like the protozoal infections, which may be found by some teachers to be arduous and confusing for students although the trial should be executed on the real basis to assume true findings as the student's accomplishments could never be predictable<sup>[23]</sup>. In addition, not all the staff were present all the time during the skill milestone preparation as according to the work nature of the faculty some are only parttimers.

As approved by Gikar et al.[24], it is often considered that student active learning needs to be merged appropriately into education and learning procedures. In this research, microbiology postgraduate students made it clear that they have no problem with the use of technology, but they also value its incorporation into the educational process triggered by student-centered education. Also, the teachers provide a great welcome to concise their teacher-centered role and allow the student to innovate their perspective for diagnosing, to study parasitology. Students' perception of the experience was adequately positive to recommend extending it to other courses especially in acquiring new competencies in diagnostic parasitology with other parasitic groups as responded by them with their excellent feedback. Also, teachers' responses were very positive encouraging the continuation of the experience.

#### **CONCLUSION AND RECOMMENDATIONS**

Our conclusions admitted that the whole experience has met the expectations, as it has shown students satisfaction with their chosen interactive tool that focuses on the academic material and helped them mind map it to accomplish their professional skill and subsequently competence. Hopefully, future makeup with more students' ideas and trials will refine and add to innovate an information system with the ability to use this tool or others as an educative and diagnostic means for rapid and easy parasitological diagnosis. It is recommended to extend the use of the tool to other topics of the medical parasitology diagnostics, and other laboratory courses and to involve peer evaluation over a longer study duration with a continuous focus on solving any obstacles faced considering the modification in the schedule of the students making each addition a capstone achievement with a bonus.

#### **CONFLICT OF INTEREST**

There are no conflicts of interest.

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