"Teaching Physics to Radiology residents: Implementation and Outcomes of interactive lecture approach with monthly summative evaluation."

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Learning objectives

We present a fresh educational approach to teach physics to radiology residents that has replaced the traditional didactic structure used in previous years introduced recently in our department. The hypothesis is that consecutive 3 to 4 day interactive physics lectures followed immediately by a summative written evaluation will facilitate greater retention of core physics concepts and will bring better understanding. We present both the implementation of this newer technique and the initial outcome.
Background

Asound foundation in radiologic physics is essential for understanding the basics of imaging technology in radiology. Medical certification authorities around the globe have made physics a compulsory part of radiology curriculum. The College of Physicians and Surgeons Pakistan (CPSP) affirming the importance of this subject has mandated Radiologic Physics an essential part of Intermediate module (IM) exam, for which a resident becomes eligible at the end of his second year of radiology residency.

Teaching physics to radiology residents in an effective way is a major challenge as most residents perceive physics as boring and irrelevant or simply as a hurdle to be crossed and forgotten. Like most training programs, our institution had a didactic curriculum taught by a medical physicist in a traditional lecture format followed by end of the year written physics exam. The exam results and resident feedback suggested that a change was needed as the exam scores and the resident satisfaction level were both sub optimal. On reviewing literature we found interesting articles by Dr William Hendee, editor of Medical Physics, who has urged academic institutions to alter the historical function of medical physicists, shifting their role from "sage on the stage" to "guide on the side"[1,2,3,4]. Another article by Shankar et al suggested good initial outcomes from their change from didactic lecture by medical physicist to a resident-led Physics curriculum format with integration of the RSNA/ AAPM physics modules. [5]

Our department hence developed and implemented a newer interactive approach with immediate written evaluation that has replaced the traditional didactic lecture structure used in previous years in our department.

Previously two physics didactic lectures were delivered in one month by a medical physicist two weeks apart, followed by end of the year written exam. A change in teaching schedule was made with 3 to 4 physics lectures on consecutive days. Residents were given the topics to be covered prior to the lectures and lectures were given in an interactive format with residents participating in the discussion rather than only listening to the lecture. This was followed by a prompt summative written evaluation the very next day.

We hypothesized that these changes will facilitate greater retention of core physics concepts, will bring better understanding and lead to improved performances in the physics portion of the Intermediate Module (IM) exam. We present both the implementation of this newer technique and the initial results. The purpose of this study is to evaluate the early outcomes of these changes in our physics curriculum.
Findings and procedure details

Implementation of new curriculum:-

A questionnaire (Appendix I) was designed to obtain feedback from residents regarding their opinions about the current curriculum and didactic teaching methodology. Based on this feedback, a new and modified teaching curriculum was developed for teaching physics in our radiology department which basically comprised of two changes. First was to replace the didactic approach of lecture delivery by an interactive approach. The second change was to replace previous teaching schedule of annual written physics exam at the conclusion of a yearlong module of fortnightly lectures by a two year curriculum of short modules comprising consecutive three to four day interactive lectures followed immediately by a written exam. These changes were implemented by joint efforts of senior faculty radiologist and medical physicist in our department after approval from residency program director and post graduate medical education department. Each of these lectures comprised of small group discussion in an interactive manner with medical physicist acting as facilitator and audience comprising all residents in the residency program. An open discussion forum was allowed for continuous interaction between facilitator and participants. A compulsory in training exam was taken at the end of these short modules. After introduction of this new curriculum a post-implementation survey was conducted to obtain feedback from all the participants. (Appendix II).

Quantitative and qualitative measurement of outcome:-

Response rate of 100% was obtained for both pre and post implementation surveys. Average physics test scores at end of first month of new curriculum were compared with preimplementation scores of previous exams which showed improvement of approximately 16% in average test scores. Surveys and comparative analysis was approved by Institutional Review Board of Shifa International Hospital, Islamabad.

Results:

The post-implementation survey demonstrated that 46% of respondents 'disagree', while another 15% of residents 'strongly disagree' with the opinion that previous didactic approach to teaching physics should be continued (Figure 1). When asked to directly compare the two curricula in terms of implementation, 85% of residents thought that the new curriculum should be implemented in the future and replace the previous one (Figure 2). In terms of resident perception about the new approach to teaching physics, 54% respondents thought that the new interactive lecture approach with immediate summative evaluation was 'extremely effective' and 38% thought of it as 'moderately effective' (Figure 3). Average physics scores of residents in tests taken before and after implementation of new curriculum were calculated and compared which showed statistically significant
increases in average scores after implementation of new curriculum. When asked whether the newly implemented physics curriculum seems a better option to meeting both academic and professional needs of the residents, 61% 'strongly agree' to its continuation while another 7% 'agree' with the suggestion (Figure 4).
Figure 3. Response of residents in pre-implementation survey to question ‘Do you think that teaching methodology of didactic lectures with annual exam is preparing you optimally for your exams?’

Fig. 1

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Figure 4. Pie chart of number of residents responding to question ‘Which one of the following physics teaching curriculum would you be like to be implemented in the future- didactic lecture with annual exam or interactive lecture with immediate summative evaluation’

Fig. 2

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Figure 5. Graph of resident response to question about their perception of impact of new curriculum

Fig. 3

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Figure 6. Chart depicting response of residents to question regarding their opinion about new interactive lecture based physics curriculum as a better option to meet requirements of radiologic physics education.

Fig. 4

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**PRE-IMPLEMENTATION QUESTIONNAIRE**

Regarding radiological physics curriculum and teaching, please select a single option from the following:

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Do not know</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you think physics should be included in teaching curriculum of radiology residency</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you think your working knowledge of physics is helpful in tackling daily professional problems (daily call/work related)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you think you have adequate knowledge of physics to cover exam syllabus without the support or assistance from a physics teaching program</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you think that the teaching methodology of didactic lectures with annual exams is preparing you optimally for your exams</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 1**

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## Appendix II

### POST-IMPLEMENTATION QUESTIONNAIRE

Regarding radiological physics curriculum and teaching, please select a single option from the following:

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Do not know</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you want the previous radiologic physics curriculum comprising of twice a month lecture with annual exams to be reimplemented?</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Do you think that the new interactive lecture methodology is a better option for meeting your requirements of gaining knowledge of Physics for academic and professional purposes</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Do you think a resident led approach can yield better outcomes than a physicist led session</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>How do you rate the current interactive session teaching with immediate summative evaluation as compared to previous lecture based approach</td>
<td>□</td>
<td></td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Which of the following physics teaching programs would you like to be implemented in the future</td>
<td>□</td>
<td></td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>• Didactic lecture with annual exam</td>
<td>□</td>
<td></td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>• Interactive lecture with immediate summative evaluation</td>
<td>□</td>
<td></td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

### Table 2

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Conclusion

Compared to our prior didactic lecture-based physics curriculum with annual exam, the change to an interactive lecture-based approach with immediate monthly evaluation has been both effective and well received in the initial analysis.
**Personal information**

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References


