Teaching a Multidisciplinary Approach to Cancer Treatment during Surgical Clerkship via an Interactive Board Game

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BACKGROUND: Although educators agree that the approach to cancer management must be multidisciplinary, medical students usually observe cancer patients through the eyes of a single specialist at any given time.

METHODS: In order to teach third-year medical students that cancer management is multidisciplinary, we developed the Oncology Game, an interactive, computer-assisted board game built on the principles of self-directed learning and student-student interaction. Eight "patients" with different histologic types of cancer are distributed randomly to 4 students, who play in teams of 2. The object is for the team to obtain the best treatment for its patients by advancing them via a roll of dice through surgical, medical, and radiation oncology clinics in the order most logical for the patients particular cancer type. To test improvement in cognitive skills as a function of play, 16 students participated in a tournament taking parallel pretests and posttests before and after each round of play.

RESULTS: Students demonstrated a statistically significant change in the total number of questions answered correctly each time they played the Oncology Game (F = 4.16, P = 0.018; Pretest Round 1: 8.88 ± 0.58; Posttest Round 1: 9.63 ± 0.42; Pretest Round 2: 10.75 ± 0.62; Posttest Round 2: 11.5 ± 0.85). Post hoc pairwise comparison revealed a significant improvement in student performance after playing two rounds of the Oncology Game. Based on the postgame survey, students felt they improved their understanding of oncologic principles (4.56 ± 0.13), knowledge of malignancies (4.50 ± 0.13), and appreciation for the multidisciplinary nature of cancer management (4.56 ± 0.13).


Traditional medical education, parcelled into discipline-based clinical clerkships, too often promotes student misconceptions that disease processes are the domain of a single specialty. The fact is that many arenas of medicine require the cooperative efforts of several specialists. The management of patients with cancer is one such example. When a student observes a patient with cancer in a traditional third-year student clerkship, it is usually through the eyes of a single specialist. To broaden this view, our purpose was to develop a problem-based learning educational tool that would teach a multidisciplinary approach to oncology, while promoting self-directed learning and student-student interaction. Our hypothesis was that a game format, with its interactive nature, would increase students' appreciation of the multidisciplinary nature of oncologic problems as well as their knowledge of general oncologic principles, while promoting a teamwork approach to solving clinical problems. Accordingly, we developed the Oncology Game, an interactive, computer-assisted board game.

METHODS

Development of the Game

Sixteen patient scenarios were developed to demonstrate the multidisciplinary aspects of oncology patient management. Treatment plans for all cases include a combination of at least two of three cancer specialties: medical oncology, radiation oncology, and surgical oncology. Cases were designed specifically to reflect classic disease presentations and introductory principles of oncologic management at the third-year medical student level. Treatment protocols are based on a variety of published guidelines including the National Cancer Institute web site, the Society of Surgical Oncology Practice Guidelines, and textbooks. Each case includes a brief history and physical examination, as well as laboratory and radiology results where appropriate. Based on the presentation of the disease process, a clinic sequence is formulated.

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A computer program, written with the Java Development Kit, was created to perform the database and logic functions-storing information to maintain the correct clinic sequence and to record patient progress through the game. System requirements included a personal computer with a 90 MHz processor or higher with at least 24 MB of RAM and a VGA or better monitor. JAVA must be installed on the computer and requires 30 MB of free disk space. The computer should be running Windows version 3.1 or later and have a mouse or other pointing device.

Playing the game, one-way repeated measures analysis of variance (ANOVA) utilizing Student-Newman-Keuls test, for post hoc pairwise comparisons, when appropriate. Comparisons between scores on the tests were divided into three groups: All cases, CASES I, and CASES II. Linear regression analysis was used to determine the correlation between the number of questions answered correctly and the number of games played. A Likert scale (1 to 5) was used to assess the students’ impressions of the impact of playing the game on (1) their understanding of oncologic principles, (2) their knowledge of malignancies and complications of cancer, and (3) their appreciation for the multidisciplinary nature of cancer management. A P value of 0.05 was considered significant. All results are reported as mean ± SEM, unless stated otherwise.

RESULTS

A total of 16 students (8 teams) played the Oncology Game over a 3-week period. Pretests, posttests and a post, game attitudes survey were given to all 16 students. After Round 1, comparison of the totals of correctly answered questions (n = 8) on the first set of cases (CASES I) did improve, but did not reach statistical significance (Pretest Round 1: 4.86 ± 0.42; Posttest Round 1: 5.63 ± 0.26; P = 0.14).

Eight students (four teams) advanced to the second round and played using the second set of cases (CASES II); pretests and posttests were again administered. For the students who participated in both rounds, and therefore saw all 16 cases, the change in total number of questions answered correctly was statistically significant (F = 4.16, P = 0.018; Pretest Round 1: 8.88 ± 0.58; Posttest Round 1: 9.63 ± 0.42; Pretest Round 2: 10.75 ± 0.62; Posttest Round 2: 11.5 ± 0.85; Figure 1).

Post hoc pairwise comparison revealed a significant improvement in student performance after playing two rounds of the Oncology Game. There was a positive relationship of total questions answered correctly versus number of times the game was played by linear regression analysis (Figure 2). The correlation coefficient for the least squares linear regression is 0.526 with a significance of P <0.001. Based on the postgame survey, students felt they improved their understanding of oncologic principles (4.56 ± 0.13), knowledge of malignancies (4.50 ± 0.13), and appreciation for the multidisciplinary nature of cancer management (4.56 ± 0.13; Figure 3).

### TABLE

<table>
<thead>
<tr>
<th>Malignancies Used in the Oncology Game</th>
<th>Cases I</th>
<th>Cases II</th>
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<tr>
<td>Colon</td>
<td>Cervical</td>
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<td>Melanoma</td>
<td>Leiomysarcoma</td>
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<td>Testicular</td>
<td>Hodgkin's lymphoma</td>
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<td>Breast-cancer- ductal</td>
<td>Breast cancer-infiltrating</td>
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<td>carcinoma in situ</td>
<td>invasive ductal</td>
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<td>Esophageal</td>
<td>Ovarian</td>
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<td>Anal-squamous tell</td>
<td>Head and neck-squamous tell</td>
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<td>inflammatory breast cancer</td>
<td>Prostate</td>
<td></td>
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<tr>
<td>Lung, non-small tell</td>
<td>Lung, small tell</td>
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Statistical Analysis

'Oncology Game was played as a single elimination tournament with the winning team advancing after each round. Eight teams voluntarily participated in the tournament over a 3-week period. Dinner was provided, and the team winning in the final match received a gift certificate for textbooks of their choice. Students playing the Oncology Game were given pretests and posttests consisting of 16 true/false questions about each of the malignancies listed in Table. Pairs of true/false questions about a particular malignancy were divided between two numbered tests. Tests were randomly distributed so that before the game student 1 would receive test 1 and student 2 would receive test 2, and then after the game, student 1 would take test 2 and Student 2 would take test 1.

Statistical analysis was performed using a paired t test after Round 1, and for students who played more than one game.
Figure 1. Pretest and posttest results by round for the eight students who played two games. There is a significant increase in the total number of questions answered correctly after each round ($F = 4.16, P = 0.018$; one-way repeated measures ANOVA). Post hoc pairwise comparison between tests was significant for Pretest Round 1 and Posttest Round 2 ($P < 0.05$, Student-Newman-Keuls test).

**Linear regression of Total correct answers versus number of games played**

![Graph showing linear regression](image)

Figure 2 Relationship between total number of questions answered correctly and number of games played; each point represents one student ($n = 40$). The correlation coefficient is 0.526, $P < 0.001$.

**COMMENTS**

Improved test scores and postgame survey results demonstrate that third-year medical students can learn about basic oncology principles and gain an appreciation for oncology as a multidisciplinary field of medicine through an interactive, computer-assisted board game. One limitation of our study was the absence of a control group. Thus, it can be argued that “practice makes perfect” in playing the game and answering the test questions. However, improvement in game playing and test scores does require an increased knowledge base and skillful coordination of multiple subspecialties in directing the proper care for a patient. This was our goal. Me Oncology Game provides the infrastructure for small group interactivity by stimulating intellectual discussion of oncologic principles.

Games have been used throughout history for both recreation and education. Archeological finds have revealed evidence of games as far back as 3,500 BC.5 Many of the first educational games were designed for military purposes, and one of the first publications about this, Rules of a New War Game for the Use of Military Schools, appeared in 1797. In fact, modern-day chess is related to ancient war games thought to teach military strategy.7 The theory of gaming as a formal teaching tool was introduced nearly 80 years ago.6 At the turn of the century, numerous publications appeared about the use of gaming in child education. Since this time, there has been an increasing interest in the use of games in higher education. Not all games designed for education are good educational games, however. Avedon and Sutton-Smith7 define "good" games as those that help the learner to learn.

An extensive review of the medical literature for examination of games used in medical education was remarkable for the paucity of such literature. The few examples found for physicians in training included the Lactation Game geared toward obstetric housestaff and the Dermatology Game geared toward medical students.9,10 More examples of games used as educational tools were found in the nursing literature, including the HIV Challenge.11 Perhaps the limited use of games in medical education in general stems from concern that dealing with serious medical problems in a fun, game-based setting will cause students to take such issues lightly. Obviously this is of particular concern with an educational tool about oncology. We made a deliberate effort to emphasize the importance of patient respect with small details throughout the game. For instance, students had to refer to their patients by their proper names; it was not acceptable to refer to a patient as "the lady with breast cancer." In fact, students were required to pay close attention to patient preferences in terms of their own treatment decisions, even when discordant with medical recommendations. Ignoring these points could, and often did, result in losing the game, driving home these points.

To our knowledge, none of the published games utilized computer software in conjunction with a traditional board game format, as did the Oncology Game. Although nu-
merous publications discuss computer-assisted learning tools in the medical setting, most computer programs involve the solitary participation of a single student using a quiz-like format or a clinical simulation. In contradistinction, the board game concept facilitates small group study and interactivity among students. Students learn from each other, and learn how to work with and trust their colleagues to solve clinical problems. The interactive board game, supported by the database of the computer program, provides structure for an engaging, stimulating intellectual environment.

One of the benefits of a game as an educational tool is the range of skills it van encompass. If a game has the appropriate mixture of chance and skill, persons of somewhat different abilities van play together, and success will depend in part, but not entirely, upon their relative skill. Indeed students of different academic caliber played the Oncology Game. The game combined chance (roll of dice) and skill (choosing the correct treatment sequence) to provide a competitive, but not intimidating, environment.

It is important to emphasize that the Oncology Game is an interactive board game, not a computer game. In its earliest version, in fact, the Oncology Game was played without computer assistance, using written text for patient scenarios and individual answer cards as responses for each possible clinic move. This manual version of the game was an arduous task to set up. The number of permutation of possible clinic sequences rendered the answer cards unwieldy. We soon realized that a computer program would make the game more playable. Hence, the computer is merely an adjunct to the board game that tracks clinic sequences and stores the database of responses.

Although it is possible for a student to learn something by merely reviewing the cases independently, the must valuable aspects of the game stem from the interaction and cooperation between peers, with open discussion and exchange of medical knowledge. It was not uncommon for teammates to have heated discussions about the role of pre-versus postoperative chemotherapy for one of their hypothetical patients, or to debate an answer to a Waiting Room question. An unexpected, intangible benefit of the Oncology Game was the sense of collegiality it fostered among teammates.

The Oncology Game was not designed to provide exhaustive explanations of all the treatment plans for every stage of a malignancy. The game is intended to stimulate students to further their learning process even after the game’s conclusion. Interestingly, the average score on CASES I on the second round pretest increased before the second game (data not shown). This suggests that students may have reviewed the topics they had encountered after Round 1.

Educational games diminish the role of a teacher as judge and jury, enabling students to see the consequences of their own actions. Students understand more clearly the relationship between their own devises and the outcome. Playing any type of game is an attention-focusing process. Perhaps the most important feature of educational games may be that students enjoy themselves more while they are playing than when they are not; whatever they learn (whether it be as much as usual or less), is learned with enjoyment.

We have demonstrated that the Oncology Game van teach students that cancer treatment is multidisciplinary, and van improve students’ factual knowledge about cancer. It is a practical, inexpensive teaching adjunct that tomes at a time when faculty time and financial support for educational activities are at a premium. The greatest utility of the Oncology Game may lie in the educational framework it provides: active participation, student-student interactivity, and self-directed learning. We believe that similar game-based learning is applicable to other areas of medicine requiring a multidisciplinary approach.

REFERENCES