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Descriptive Account

‘Dealing’ With Incidence, Prevalence, and Odds Concepts in Undergraduate Epidemiology

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Abstract

Concepts and associated statistical formulae of incidence, prevalence, and odds/odds ratios are core knowledge in epidemiology yet can be confusing for students. The purpose of this project was to develop, validate, and share one possible pedagogical technique using playing cards that could be employed to improve undergraduate understanding of foundational concepts in incidence, prevalence, and odds ratios. Baseline undergraduate student knowledge was first assessed with pre-lesson comprehension surveys; following the lesson, post-lesson comprehension surveys and lesson efficacy evaluations were given. Less than half of the students could accurately define incidence, prevalence, or odds ratios prior to the lesson, and less than a quarter could compute these values from a given data set. The percent of students able to accurately define incidence, prevalence, and odds ratios increased from pre to post (all $p \leq 0.01$). Scores assessing student ability to calculate incidence, prevalence, and odds ratios from a given data set increased from pre to post (all $p \leq 0.009$). Students responded positively to the pedagogical approach as indicated on a post-lesson efficacy evaluation. These results suggest that the model described here may be one plausible and novel teaching technique for improving undergraduate functional knowledge of incidence, prevalence, and odds/odds ratios.

Keywords: diseases; odds ratios; playing cards; simulation

Introduction

Both authors of this paper teach undergraduate courses which include epidemiology as a primary (if not main) component, and both repeatedly find that the majority of undergraduates use terms/concepts related to incidence, prevalence, and odds interchangeably and nebulously. To adduce as evidence, in spring 2008, DSS directly asked students in one of his junior/senior level human diseases courses the following question during an unannounced pop quiz: “What is the difference between incidence and prevalence?” Points were awarded solely for participation (attendance) so students were free to answer as they felt. Of the 23 respondents, only 6 (26%) were able to define ‘prevalence’ with the most frequent descriptor being ‘how common’ something was; further, only 3 (13%) were able to define ‘incidence’ with ‘rate’ being the most common descriptor. One student had a textbook-perfect definition for both, whereas another student had the correct definitions with the wrong terms. Four students (17%) defined incidence by the definition for prevalence and 6 (26%) confused ‘incidence’ with ‘instance.’ This impromptu survey is representative of the knowledge base that both of us typically encounter at the beginning of our courses.

The purpose of this descriptive account is to share a novel technique developed and refined in our classes to help undergraduate students correctly understand core concepts and formulae for incidence, prevalence, and odds/odds ratios. We decided to ‘deal’ with this topic using a standard deck of playing cards as our focus. Playing cards are an ideal teaching medium on several fronts, given the facts that they are readily manipulated, familiar and carry a positive connotation to most students, are cheap and take up little storage space.

Methods

Defining Key Concepts

Definitions of 'incidence' and 'prevalence' vary in sophistication. Because this is an introductory lesson for many students at the tertiary level, we are opting for more rudimentary definitions (Crichton, 2000). Computationally, prevalence describes the presence of a condition in a population for a given time period. Prevalence is a snapshot of the total burden of disease (both new and existing cases) in a population. Expressed as a ratio, prevalence is:

$$\frac{\text{Number of existing cases at a particular time}}{\text{Total Number of individuals in population at this point in time}}$$

Multiplying this ratio by 100 gives a percentage. Incidence is computationally defined as the instance of new cases of a condition in a population for a given time period. Expressed as a ratio, incidence is:

$$\frac{\text{Number of new cases of the condition a specified time period}}{\text{Total Number of individuals in population during this time period}}$$

Rates are usually expressed as percentages over a specified time period.

The distinction between incidence and prevalence is both necessary and important when diseases of contrasting properties are considered conceptually. Diabetes and influenza provide a strong comparative example. Diabetes is a chronic, non-infectious and currently non-curable disease, but which is only fatal after a long period. By contrast, influenza is an acute, infectious disease which quickly resolves (either in health or death). Based on these characteristics, we would expect that diabetes has a relatively low incidence but relatively high prevalence compared to influenza; in other words, there are few new cases each year of diabetes, but those cases persist and accumulate within the population. Conversely, we would expect influenza to have a relatively high incidence but low prevalence; in other words, cases are frequent but not persistent.

US National statistics on both diabetes and influenza highlight differences in incidence and prevalence and confirm these assumptions. According to the Centers for Disease Control (CDC, 2008), the prevalence of diabetes in Americans <20 years of age was 0.2% in 2007. In other words, 0.2 individuals out of every 100 (or 2 individuals out of every 1000) have diabetes. By contrast, the incidence (number of new cases) of diabetes for the same time period was 0.02% (~2 new cases for every 10,000 individuals). Thus, for diabetes, prevalence is higher than incidence. According to the National Institutes of Allergy and Infectious Disease, the incidence of influenza in the US per year is 36% (Anonymous, 2008). Because influenza resolves within 3-7 days on average, this is also the prevalence for influenza per year. However, if one were to take a snapshot of the US at any given time point during the year (for example, the first week in October), the prevalence of influenza would be well below 36% of the US population. Influenza infections would already be resolved in some individuals, while others would have yet to acquire the disease that year. Calculating prevalence would only account for those currently suffering from the disease. Defining the time period encompassed by the measure is clearly important. Finally, the situation with influenza is more complicated as infections vary based on month of the year.

Odds ratios are an extension of prevalence calculations and help highlight risk or susceptibility factors (Crichton, 2001). To calculate an odds ratio, it is necessary to first know the odds of a particular event for two separate groups. Within a group, the odds are the probability of an event happening divided by the probability of the event not happening. Assume a population of males and females and a disease X. In the female group disease X is found in 33 of 100 patients, whereas in the male group disease X is found in 20 of 100 patients. The odds of disease X occurring in a female sample is 0.49 (=33/67 because 33/100 have the disease and 67/100 do not) and for the male sample 0.25 (=20/80). Odds ratios are calculated simply by dividing the odds in group 1 by the odds in group 2; a number greater than 1 indicates the event is more likely to occur in group 1 than in group 2, whereas a number less than 1 indicates the event is less likely to occur in group 1 than in group 2. In our fictitious example, the odds for females was 0.49 and for males 0.25, so 0.49/0.25 = 1.96. Women have almost twice the odds of having the disease (2:1) compared to men. Gender-specific patterns such as these are common for several diseases such as multiple sclerosis, where women are 2x as likely as men to have MS (Jones, 2008).

Pedagogical Approach

The entire approach presented here encompassed two, 50-minute class periods. Three core comprehension goals were identified: (1) Students will individually be able to define ‘incidence’ and ‘prevalence’ in writing; (2) Given a basic data set, students will individually be able to calculate incidence, prevalence, and odds ratios; and (3) Students will individually be able to name at least 1 disease that fits each of the following 3 criteria pairs: high incidence/low prevalence, low incidence/low prevalence, and low incidence/high prevalence.

Day 1: The schedule for Day 1 was to conduct a pre-learning survey and to introduce incidence and prevalence. A pre-comprehension survey was distributed to students. The instructor collected the surveys and used them as a basis to construct whole-class, anonymous student-based responses to each survey item. Definitions of incidence and prevalence were first garnered from student responses, and then refined by the instructor using the whiteboard. Emphasis was placed on describing incidence and prevalence in terms of narrative as well as numerator/denominator. This interchange was used to segue into Card Activity A.

In Card Activity A, the instructor produced a normal deck of playing cards and asked students to describe the normal deck in terms of suits, cards/suit, numbers, and face cards. The deck was splayed on a central table, and each student selected one card. Table 1 presents one possible outcome of this procedure given 25 students each selecting 1 card from a 52-card deck which will be used to illustrate Card Activity A.

Table 1 *Example outcome of card distribution procedure for Card Activity A. Each individual student in a class of 25 total students selects 1 card randomly from a 52-card deck. Columns represent card values. Suits are not considered; hence, up to 4 students may draw a card of any given value.*

Card	**A**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**J**	**Q**	**K**
Occurrence	3	2	3	2	2	1	1	2	1	1	1	4	2

The instructor called out one number (in this case, ‘5’) as being indicative of a fictitious disease state; additionally, students were instructed to assume that people with ‘5’ have had ‘5’ their entire lives (in other words, no one recently contracted ‘5’). A quick class survey revealed how many students had ‘5’. In the example presented by Table 1, 2 out of 25 students drew a ‘5’ from the deck. The instructor asked the class how they would calculate the percentage of students who had ‘5’ and then asked if this was a question of incidence or prevalence (answer: prevalence). Using the example in Table 1 again, the prevalence of ‘5’ would be 8% (or [2/25]×100).

Then a new scenario was introduced for Card Activity A: Assume a new infectious disease which infects permanently, but does not kill or maim, has just infiltrated campus (represented in this instance by ‘jacks’). Students were asked how to calculate what percentage of the class had the disease (same as above) and whether this was incidence or prevalence (answer: both). Returning to Table 1 as an example, only 1 out of 25 students drew a jack so the prevalence would be 4% (or [1/25]x100). Students were then asked to assume one year had transpired and now people with ‘queens’ had the disease in addition to those with jacks. Using the outcome presented in Table 1, the total number of students who drew a jack or a queen was 5 (1 jack + 4 queens). Students again calculated incidence and prevalence for Year 2, and the differences in these two concepts between the two years were discussed. In the Table 1 example, prevalence for Year 2 would be 20% (or [5/25]x100) but incidence would represent only new cases (the queens) and would be calculated as 17% (or [4/24x100; as the Jack already has the disease, the Jack is not at risk for it in Year 2). The activity was continued for a third round (Year 3), now with ‘kings’ also having the disease state. From Table 1, the total number of students who drew jack or queen or king was 7 (1 jack + 4 queens + 2 kings) so Year 3 prevalence would represent the total pool of individuals with disease and would be 28% (or [7/25]x100) whereas incidence would represent only individuals contracting the disease in year 3 and would be 10 % (or [2/20]x100; for Year 3, we start with the value 25 and subtract the 1 Jack and 4 Queens from previous years, as neither Jacks nor Queens are at risk for the disease in Year 3).

Card Activity B was conducted next and was an extension of Card Activity A. Whereas Card Activity A assumed a single population, Card Activity B assumed multiple, discrete populations. In this exercise, the class of 25 students was asked to divide themselves into six separate, self-selected groups which could (were encouraged to) vary in size. Each group represented distinct populations, and each group got their own complete deck of playing cards. A group leader shuffled the deck and doled one card to each group member. Table 2 represents one possible outcome of this procedure given 25 students assembled into 6 total groups of varying size each given a separate deck, which will be used to illustrate Card Activity B.

Table 2 *Example outcome of card distribution procedure for Card Activity B. The class of 25 students is asked to form 6 groups, which can vary in size but must have at least 2 members. Each of the 6 groups is given its own deck of cards. Each individual within the group draws 1 card at random. ‘Hearts’ represented the disease state.*

Group	Number of Students in Group	Cards Drawn by Students in Group	Within-Group Prevalence of ‘Hearts’
Group 1	3	8♣, 10♥, J♥	66% or 2/3
Group 2	5	2♣, 3♦, 6♥, J♠, J♥	40% or 2/5
Group 3	8	A♣, 4♣, 5♠, 7♣, J♣, Q♠,Q♥, K♣	12.5% or 1/8
Group 4	3	A♠, 3♦, Q♠	0% or 0/3
Group 5	4	2♥, 3♣, 9♣, Q♦	25% or 1/4
Group 6	2	5♦, 7♥	50% or 1/2

For Card Activity B the disease state was represented by ‘hearts’. Within their groups, students were asked to calculate the prevalence of hearts in their group, and to report prevalence as both a percentage and fraction on the whiteboard. Calculations for the groups in Table 2 are shown in Table 2. When all groups had reported, the instructor asked the class what the correct manner was for calculating prevalence for the entire class (all populations together) assuming all individuals count equally. Wait time and probing questions were used to refine student responses. Students usually arrive at 2 possible methods: averaging out all percentages across groups, or combining the numerators and then combining the denominators across groups and recalculating an overall percentage (the latter is correct). Students are encouraged to calculate prevalence using both methods. Using Table 2, if the former method is used, the prevalence is calculated as 32.25% ([66+40+12.5+0+25+50]/6); if the latter method is used, the prevalence is calculated as 28% (sum of numerators=7; sum of denominators=25; calculation is [7/25]x100). Students are prompted to evaluate the correctness of each method until they correctly deduce that the former method is incorrect because it does not account for the varying population sizes. At the end of Card Activity B, decks were collected and basic definitions and formulae of incidence and prevalence were reviewed.

Day 2: The itinerary for Day 2 was to review incidence and prevalence, introduce odds and odds ratios, and conduct a post-learning survey and student lesson feedback questionnaire. Class was begun by reviewing definitions/formulae of incidence and prevalence. Card Activity C was then initiated — prior to class, the instructor had marked a subset of cards (we marked all cards of values 2, 4, 6, 8, and 9) of a single deck with a red letter 'D'. Students were not informed how the deck was marked, they were simply told that 'D' represented a disease state. This specially-marked deck is used only for Card Activity C. The instructor dealt out the entire deck to the class so that students received either 2 or 3 cards. The instructor explained that the deck represented 52 at-risk individuals of which 20 were stricken with disease 'D', as indicated by marked cards. Table 3 represents one possible outcome of this procedure given 25 students each of whom drew 2 cards at random from a 52-card deck; for the sake of brevity, only the cards drawn by 10 of the 25 students are displayed in Table 3. [*Insert Table 3 here*]

Table 3 *Example outcome of card distribution procedure for Card Activity B for 10 individual students. Each individual student in a class of 25 students drew out 2 cards at random from a single 52-card deck; all cards of values 2, 4, 6, 8 and 9 were marked with the letter 'D' and represented the disease state, but students were unaware of this marking method. Students were not allowed to see what other students had drawn. Based on their own 2 cards, individual students formulated guesses as to what the marking method was.*

Student	2 Cards Drawn	Number of "D" Cards	Plausible Student Guess as to Marking Method
Student 1	5♦, 9♠	1	All black cards (spades, clubs) are marked 'D'
Student 2	6♠, 10♠	1	All cards lower than 10 are marked 'D'
Student 3	5♣, 8♦	1	All red cards (diamonds, hearts) are marked 'D'
Student 4	2♦, 4♣	2	All even-numbered cards are marked 'D'
Student 5	J♠, K♦	0	No idea
Student 6	7♣, 8♥	1	All cards with value 8 or above are marked 'D'
Student 7	A♣, A♦	0	No idea
Student 8	2♠, K♥	1	All cards with value 2 are marked 'D'
Student 9	A♥, 6♥	1	All non-face cards are marked 'D'
Student 10	4♠, 4♦	2	Only cards with value 4 are marked with 'D'

Students were not allowed to ask other students what cards they had been dealt nor which were marked, but were told there was a method to the card-marking and were asked to "brainstorm" what the method might be. Table 3 presents some possible conjectures for the 10 individual students. Student responses were tabulated on the whiteboard. Then, the instructor asked the class how many students had the condition and wrote the number on the whiteboard. Given this information, students were asked to consider the suggestions. For instance, from Table 3 we see Student 1 suggested that all spades may be marked 'D' but Student 2 would be able to counter that idea by saying they had a spade which was not marked 'D'; similarly, Student 3 suggested all red cards (diamonds, hearts) may be marked 'D' but Student 1 would again be able to counter by saying they had a diamond that was not marked 'D'.

After students had narrowed down the possibilities that could be tested (conceivably to only 1 possibility, depending on class size and cards drawn), the instructor suggested that odds and odds ratios are one possible method for validating student ideas. Definitions for both were presented and the concept of 'risk factor' was introduced, with the instructor explaining that the marking method used in this exercise was analogous to a risk factor. Students were encouraged to select 1 hypothesis and try out that method using odds and odds ratios to see if the hypothesis explained the disease occurrence. If their suggested risk factor did not explain the statistics, student groups were asked to individually choose risk factors and calculate odds/odds ratios until they determined what the risk factor in this scenario was. Using only the students in Table 3 as an example, assume the class had hypothesized that red cards (hearts and diamonds) were the primary carriers of the fictitious disease. Students would be instructed to calculate the odds of disease in the red cards (5/5=1.0) and black cards (5/5=1.0), and then the odds ratio (1.0/1.0=1.0). Finding an odds ratio of 1.0, students would visually see that the colour of the card is not related to disease status and they would be asked to test another of their hypotheses. Following, assume students believed that even-numbered cards were at a higher risk of disease than odd-numbered cards. This time, the odds of disease in the even-numbered cards (9/1=9.0) is much higher than that of the odd-numbered cards (1/3=0.33). Further, by calculating the odds ratio (9.0/0.33=27.0), students would find out that even-numbered cards were much more likely to be marked with 'D' than odd-numbered cards. Students then verbally shared their reactions to the activity. All cards from the marked deck were collected.

Transitioning, the instructor asked students to consider what real-life risk factors were relevant for human diseases, and asked students to name specific diseases and their risk factors that they knew. For instance, students might suggest obesity for type II diabetes, smoking for lung cancer, or a defective allele for hemophilia. A list was compiled on the whiteboard. The diversity of risk factors was explored in terms of inherited vs. acquired, physical vs. behavioural, controllable vs. uncontrollable, and other groupings as suggested by the students. Finally, a post-comprehension survey was administered and, once finished, students completed a lesson feedback questionnaire. Students did NOT receive any feedback on their pre-learning surveys prior to undertaking the post-learning survey (i.e., they did not know their score nor the 'correct answers').

Assessment

All procedures for human subjects research used in this lesson, including the lesson plan and all assessment tools, were approved prior to execution by the Drake University Institutional Review Board. The pre- and post-comprehension surveys contained all items necessary for assessing the 3 learning goals (see Results). Survey items (see Table 5) were open-response and evaluated using paired-samples t-tests. Survey items 1 and 2 corresponded to Goal 1. Survey items 3, 4, 7, and 8 correspond to Goal 2. Survey item 5 corresponds to Goal 3. The remaining survey items (6, 9, and 10) concerned knowledge ancillary to the principal goals.

Additionally, a subjective feedback questionnaire was given to students regarding their perception of the lesson. Twelve statements were presented, and students indicated a response ranging using a 7-point numerical scale where 1= 'strongly disagree' to 7= 'strongly agree'.

Results

Results from the pre- and post-comprehension surveys are presented in Table 4.

Table 4 Performance on pre- and post-comprehension surveys. P-values in the post column represent results of Wilcoxon signed-rank test between pre and post time points. N=24.

Survey Item	Rubric Maximum Score Possible	Pre (mean ± SE)	Post (mean ± SE) (p-value)
1. Define incidence	3	1.08 ± 0.22	2.96 ± 0.04 p<0.001
2. Define prevalence	3	1.33 ± 0.27	2.96 ± 0.04 p<0.001
3. Data set: Calculate incidence	2	0.83 ± 0.14	1.79 ± 0.10 p<0.001
4. Data set: Calculate prevalence	2	0.75 ± 0.16	1.29 ± 0.16 p=0.012
5. Name diseases by category (incidence/ prevalence high/low)	2	1.63 ± 0.20	2.25 ± 0.19 p=0.003
6. Define "odds ratio"	3	1.13 ± 0.22	1.71 ± 0.22 p=0.011
7. Data set: Calculate odds	3	1.17 ± 0.12	2.58 ± 0.18 p<0.001
8. Data set: Calculate odds ratio	2	0.25 ± 0.12	1.67 ± 0.16 p<0.001
9. Data set: Generate conclusion based on odds ratio	2	0.83 ± 0.21	1.83 ± 0.12 P=0.001
10. Describe use of odds ratios in epidemiology	2	1.25 ± 0.18	1.54 ± 0.15 p=0.053

Student ability to define 'incidence' and 'prevalence' (Goal 1) both increased from pre-lesson to post-lesson (Table 1, items 1 and 2, $p<0.001$). Furthermore, although not one of our main learning goals, we found that student ability to define 'odds ratio' also increased, albeit to a lesser though still significant extent (Table 1, item 6, $p=0.011$). Student ability to calculate incidence, prevalence, and odds/odds ratios (Goal 2) all improved from pre-lesson to post-lesson (Table 1, items 3, 4, 7, and 8, $p\leq0.012$). Goal 3 assessed student ability to name one disease that fits three different descriptive pairings of incidence and prevalence. This goal was different from the other two in that students did not practise this skill during the lesson, though the thought was introduced by the pre-learning survey itself. Student ability to pair diseases to incidence/ prevalence patterns increased from pre-lesson to post-lesson (Table 1, item 5, $p=0.003$).

Students had an opportunity to evaluate the lesson using a questionnaire (Table 5). Questionnaire items 1-8 addressed aspects of the lesson corresponding to incidence and prevalence, whereas items 9-12 addressed aspects of the lesson relating to odds/odds ratios. Students indicated confidence in their ability to articulate knowledge of concepts and formulae related to incidence and prevalence (items 1-4), and felt that both the playing card gimmick (items 5 and 6) and the specific disease examples (items 7-8) improved their understanding of incidence and prevalence, though the former more so than the latter. Similarly, students indicated confidence in their ability to articulate knowledge of concepts and formulae related to odds/odds ratios (items 9 and 10) and felt the playing card gimmick (items 11 and 12) had improved their understanding of odds/odds ratios.

*Table 5 Student evaluation of pedagogical methods, given anonymously after the post-comprehension survey. Students responded along a numerical continuum where 1=strongly disagree, 4=neutral, 7=strongly agree, and 2-3 and 5-6 represent values in between those cardinal points. Results of 2-tailed paired samples t-tests comparing some specific survey items were all not significant: * items 1 vs. 2, p=0.66; †items 3 vs. 4, p=1; ‡items 9 vs. 10, p=0.16.*

Item	Average ± SE	# of Respondents (Range)
1. I understand the difference between incidence and prevalence	6.60 ± 0.16	25 (4-7)
2. I could verbally explain the different between incidence and prevalence correctly to a peer	6.56 ± 0.17*	25 (4-7)
3. Given a data set, I could correctly compute incidence and prevalence figures	6.50 ± 0.17	24 (4-7)
4. Given a data set, I could correctly compute incidence and prevalence figures to a peer	6.48 ± 0.15†	25 (4-7)
5. The playing card activity used in the lesson increased my understanding of incidence and prevalence	6.64 ± 0.14	25 (5-7)
6. I would recommend the playing card activity for teaching incidence and prevalence in future classes	6.64 ± 0.15	25 (4-7)
7. The specific disease examples used in the lesson increased my understanding of incidence and prevalence	6.25 ± 0.21	24 (4-7)
8. I would recommend using these same disease examples for future classes	6.03 ± 0.23	24 (4-7)
9. Given a data set, I could correctly compute an odds ratio	6.48 ± 0.15	25 (5-7)
10. Given a data set, I could correctly compute an odds ratio to a peer	6.40 ± 0.18‡	25 (4-7)
11. The playing card activity used in the lesson increased my understanding of odds ratios	6.52 ± 0.14	25 (5-7)
12. I would recommend the playing card activity for teaching odds ratios in future classes	6.64 ± 0.13	25 (5-7)

Discussion

A basic understanding of concepts such as incidence, prevalence, and odds are important for global citizenship as it helps students understand disease and health patterns around them, and are particularly important for students pursuing careers in epidemiology or health fields. From a teaching standpoint, educating undergraduates on appropriate usage of these concepts carries the normal responsibility of introducing a new and difficult topic in a stimulating and understandable way, but (as the earlier anecdote revealed) the additional responsibility of replacing pre-existing yet faulty knowledge. Limited data from the quaternary educational sector demonstrates that nursing and medical students struggle to see applications between traditional lecture modes on epidemiological concepts and clinically-relevant circumstances (Astin et al, 2002; Clayden, 1990; Evans, 1990). Some educators have adopted a scenario-based approach to health statistics (as opposed to more traditional, calculation-based approaches). Both approaches teach the same formulae and concepts, but in the scenario-based approach the focus is on the scenario itself, including the thought processes that are needed to select the appropriate formulae or concepts to solve the scenario. Students reported the scenario-based approach was more stimulating than the calculation-based approach because it helped them better understand connections between formulae/concepts taught in the classroom and real-world applications (Dutton et al, 1991; Freeman et al, 2008; Nandi et al, 2000). Such approaches may be equally efficacious at the tertiary level.

In this communication, we relay a technique for helping tertiary-level students understand epidemiological concepts of incidence, prevalence, and odds/odds ratios with a standard deck of playing cards as a medium. Results from our objective index (Table 4) indicated that student scores on topic comprehension and problem-solving improved from pre- to post-lesson. Results from our subjective index (Table 5) indicated that student confidence in knowledge of the topic increased and that they felt the playing cards were a worthwhile teaching tool. Limitations of this study include the fact that there is no comparison (control) group using an alternate approach, and that students encountered the exact same problems and questions on the pre- and post-lesson surveys.

A clear understanding of basic concepts in epidemiology is of merit to both medically-oriented students as well as the lay public. We hope that the pedagogical technique tested here will be of interest and practicality to educators at the tertiary level especially, but possibly at secondary and quaternary levels also.

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