Appendix: Description of Game Prototype

Evaluation of a Web-Based Malaria Risk Reduction Game for Study Abroad Students

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Concept

The purpose of *Life and Death in the Age of Malaria* is to educate and encourage best practices for students traveling to malaria-endemic destinations. This is important to reduce the risk of malaria infection. However, there is no prevention strategy that guarantees protection. Therefore it is equally important for students to promptly recognize and treat infections to avoid the irreversible outcomes of disability or death.

Study abroad students are increasingly traveling to non-traditional destinations in Central and South America, Africa, Asia, the Middle East, and Oceania. Students typically have limited knowledge of the health risks unique to these destinations and limited experience engaging in travel-related risk reduction behaviors.

Myths and misunderstandings about travel risks can have serious consequences, but digital educational tools offer highly accessible, tailored, and interactive options for practicing the skills associated with travel health risk-reduction.
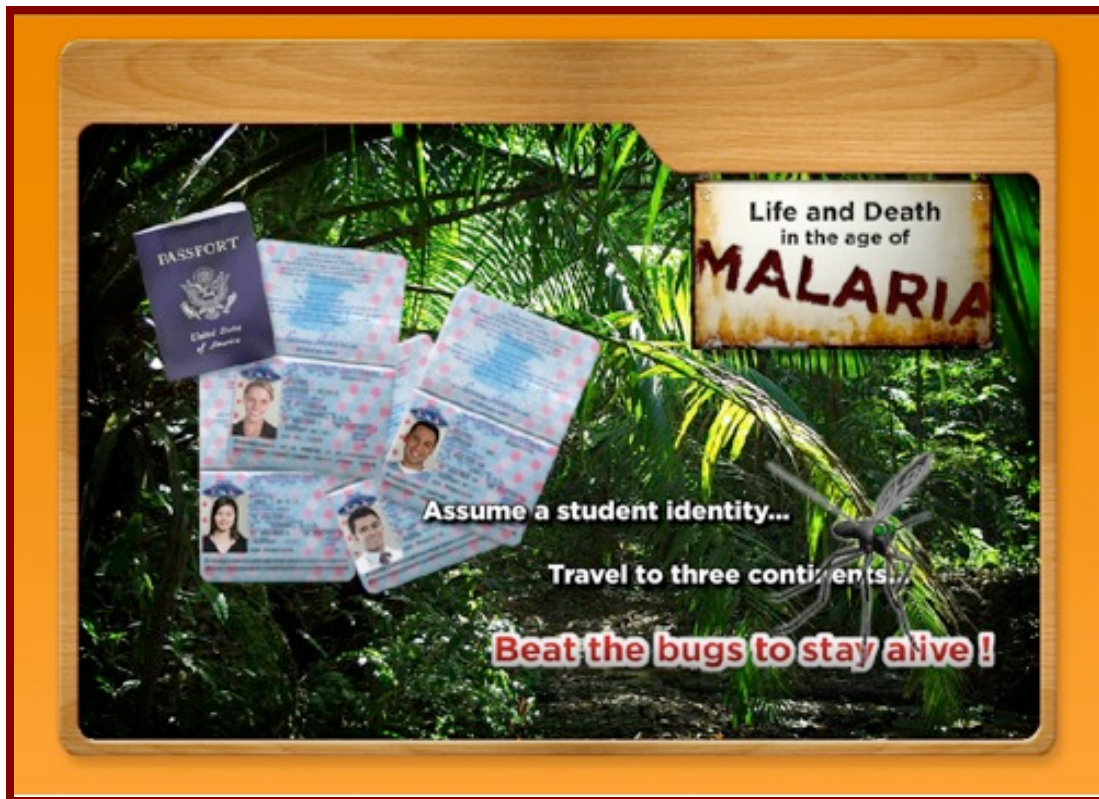
Game Synopsis and Research Focus

Players sequentially assume the identities of three student characters and make decisions during each phase of travel: *planning, abroad*, and *returned*. Resources are provided to increase player knowledge about disease prevention and management through:

- trial and error learning — feedback in response to game actions that is corrective (in a positive or negative direction) or explanatory (a rationale for the positive or negative impact)
- supplementary resources include a malaria library with FAQ and a travel health specialist character who provides pre-departure advice specific to the dialogue displayed on the screen

This prototype was designed to compare different feedback strategies due to a lack of evidence about the best way to provide feedback in a brief-exposure educational game on a topic with serious health implications. The optional use of supplementary resources was also tracked and analyzed.

Specifications

This Adobe Flash browser-based application was uniquely designed from wireframe through the iterative development of three game versions congruent with study protocol specifications. The intent was to address an identified gap in study abroad student travel health knowledge and prevention behaviors while also learning more the optimal delivery of feedback in a digital format.

Client minimum system is Adobe Flash used with any type of web browser. The game files were hosted on a Xivic Inc server and the pre/post surveys on a UW–Madison Survey Center server. The following game activities were tracked and reported as csv file data: pre/post quiz scores, time stamps for start and finish, counts for use of the resource character and library, exposure to explanatory feedback in the player-controlled feedback group, and end game health status outcomes for each trajectory. Data was analyzed using IBM SPSS 16.0 (Chicago, IL, USA).

The theoretically derived malaria knowledge test was iteratively tested/reviewed by students and content experts and programmed using a server-side scripting language (PHP).

Purpose of game content and activities

1. Raise awareness of malaria risk, means of transmission, and possible consequences

   - Range: Risk is present in >100 countries and impacts half the world's population
   - Identity: Non-specific signs and symptoms; fever, chills, headache, fatigue, body aches, sometimes nausea, vomiting, diarrhea, anemia, and jaundice — confusion/convulsions/coma, brain damage, multi-system organ failure, and death may occur in severe cases
   - Cause: Plasmodium parasites; five types infect humans
   - Transmission: Female Anopheles mosquitoes; feed primarily from dusk to dawn
   - Consequences: Can rapidly progress to permanent disability or death

2. Provide opportunities to discriminate between accurate and inaccurate information about malaria prevention and early diagnosis and treatment. An immediate feedback loop connects game decisions to risk-reduction status through feedback that is corrective (in a positive or negative direction) and explanatory (a rationale for the positive or negative impact). Supplemental information is also available from an in-game library and a travel health specialist character.

3. Provide practice with decision-making about personal protection measures and highlight the need to urgently seek diagnosis/treatment when potential malaria symptoms occur. Signs and symptoms of malaria may occur months after leaving a malaria endemic location, which increases the likelihood of misdiagnosis.

4. Emphasize that no prevention action confers 100% protection from infection and a vaccine is not yet available. Prevention measures should be combined and used consistently.
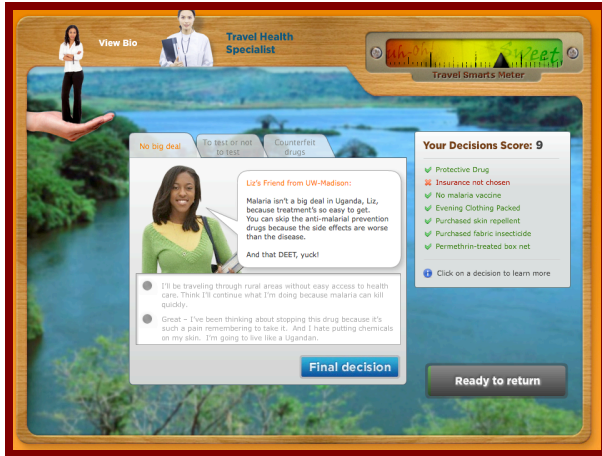
Game Mechanics

*   This travel simulation has a range of 0 to 26 possible points for one trajectory and 0 to 24 for the other two. Two points are earned for the best practice decisions, one point for the second-best decisions, and zero points for inappropriate choices.

*   The three travel trajectories function independently, with repetition of the pre-departure planning decisions to allow players to correct previous mistakes.

*   Game logic for character outcomes uses a rubric that includes cumulative points and the player response to the onset of symptoms. Outcomes include:
    a) return to good health after developing symptoms caused by malaria or something else
   b) suffer a disabling condition
    c) death

Similar to real travel, greater risk-taking behavior and lower knowledge increases the likelihood that the illness contracted by the simulated student traveler will be malaria.

Screen Organization

The main screen functions as a window into a simulated world in which players make decisions that affect the probability of acquiring malaria and of suffering a poor health outcome. The player learns about priority decisions in the various stages of travel. The library provides static information that can be accessed at any time, while the Travel Health Specialist provides context-specific advice related to the action being displayed in the central screen during the pre-departure phase of travel planning.

*   Data from the game is read from the database into the various panels
*   Data is separated into logical chunks to make it more easily managed by the player

- ▪ Panel locations are fixed
- ▪ Additional dialogue from game characters and animations appear as textboxes layered on top of the base user interface
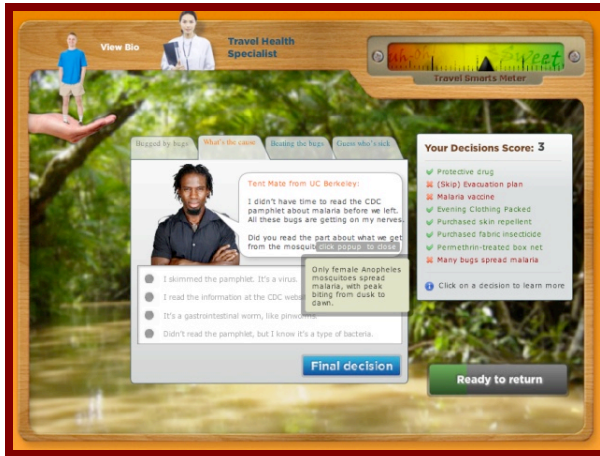

Game Evaluation

A repeated measures experimental design was used to determine which in-game feedback strategy was most effective for knowledge acquisition and which produced the greatest player satisfaction with the game experience. The data revealed a strong learning effect across conditions (effect size =.767). Providing explanatory feedback with every decision (automated) yielded the greatest knowledge gain, while there was no significant difference between conditions for player satisfaction.

For most game decisions, students did not seek supplemental information to enhance their learning. A self-regulation model dimensional analysis showed that students' beliefs about malaria (pre- and post-) were most inaccurate in the timeline and consequence dimensions, a reflection of the complex features of this disease that are difficult to understand and to remember.

Key Components

1 — Loading screen: Game play is primarily intuitive with some pop-up cues (no freestanding tutorial). Screen 1 displays the topic, method for advancement (clicks), and use of audio features.
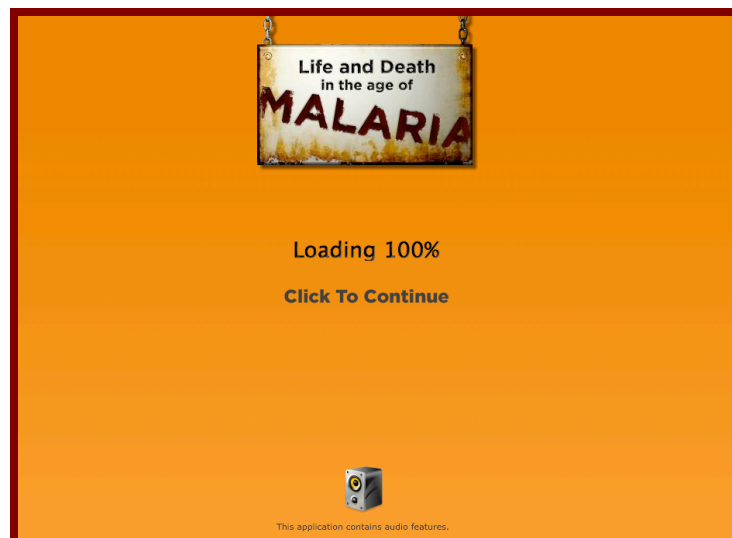
2 — Welcome screen: Screen 2 introduces the concepts of student travel and of the risk related to mosquitoes when traveling to tropical climates. A softly buzzing female Anopheles mosquito (the type that transmits malaria) flies in to ask players to click on her to begin game play.
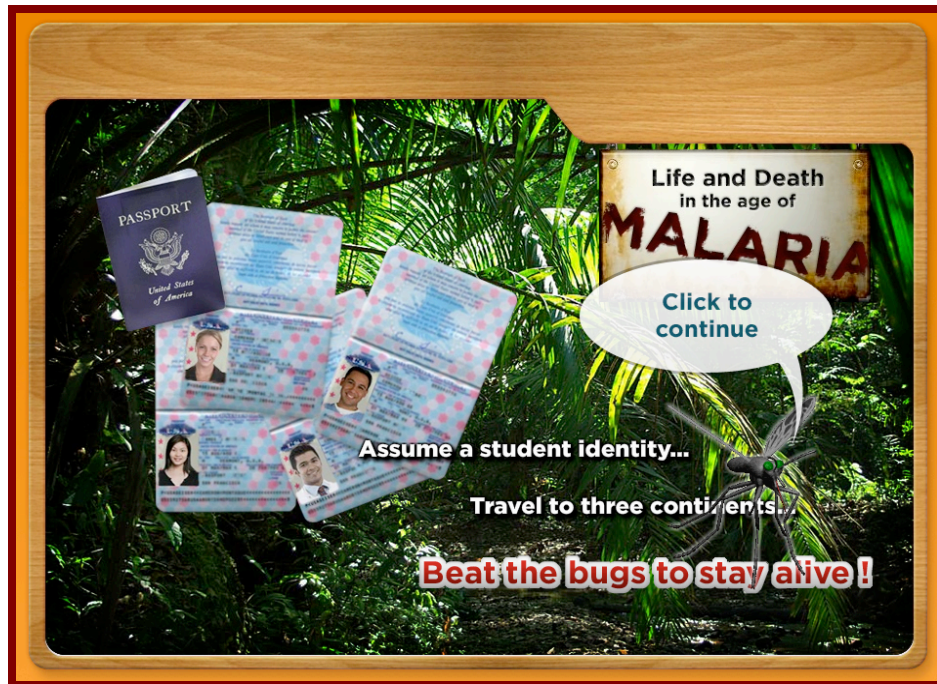

3 — The "Stinger': Next a short animation is used to grab students' attention by presenting newspaper headlines based upon actual cases involving student travelers.

4 — Choose Your First Identity: After reviewing the character Bios (travel destinations and storylines), players choose their first assumed identity and proceed through decision-making scenarios involving the three phases of travel: *planning, abroad*, and *returned*.
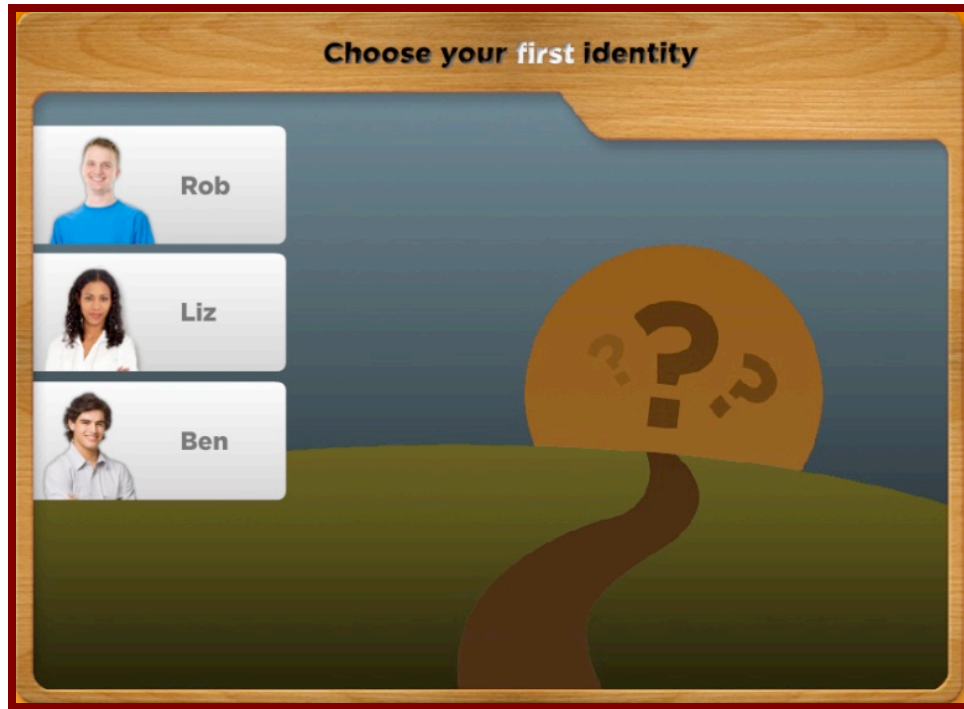
The background scenery signals where the student traveler is located during game play: pre-departure in the U.S. (San Francisco, CA; Madison, WI; New York, NY), then abroad (Brazil, Uganda, and India), and finally after returning to the U.S. (if the student traveler is still alive and can return).
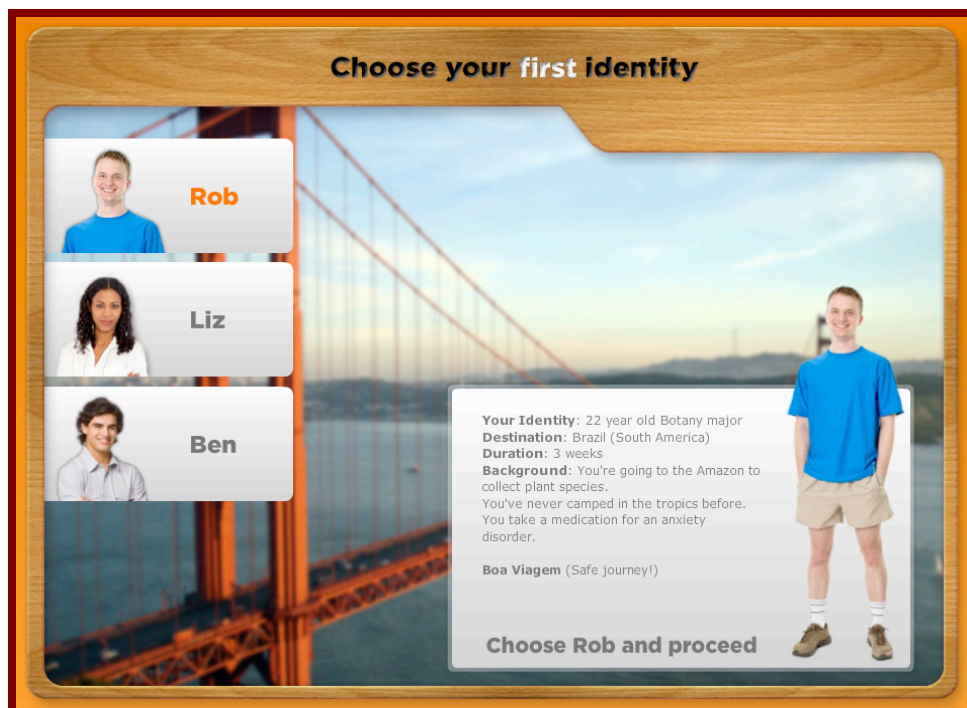
4 — Choose Your Identity (continued): After completing the first travel trajectory, players loop back to complete the remaining two travel trajectories for more practice with pre-departure decision-making and exposure to more scenario-specific malaria information.

5 — Getting Started: For the first travel trajectory, an animated arrow with a brief text statement asks players to use the Health Care and Skin Protection tabs on the left margin to prepare for departure (i.e., to purchase drugs, insurance, vaccines, clothing, bednet, skin repellent and fabric insecticide).


6 — Travel Health Specialist: Similarly, an animated arrow invites players to click on the Travel Health Specialist to learn more about this resource icon. These animated hints are provided on the first play-through only.
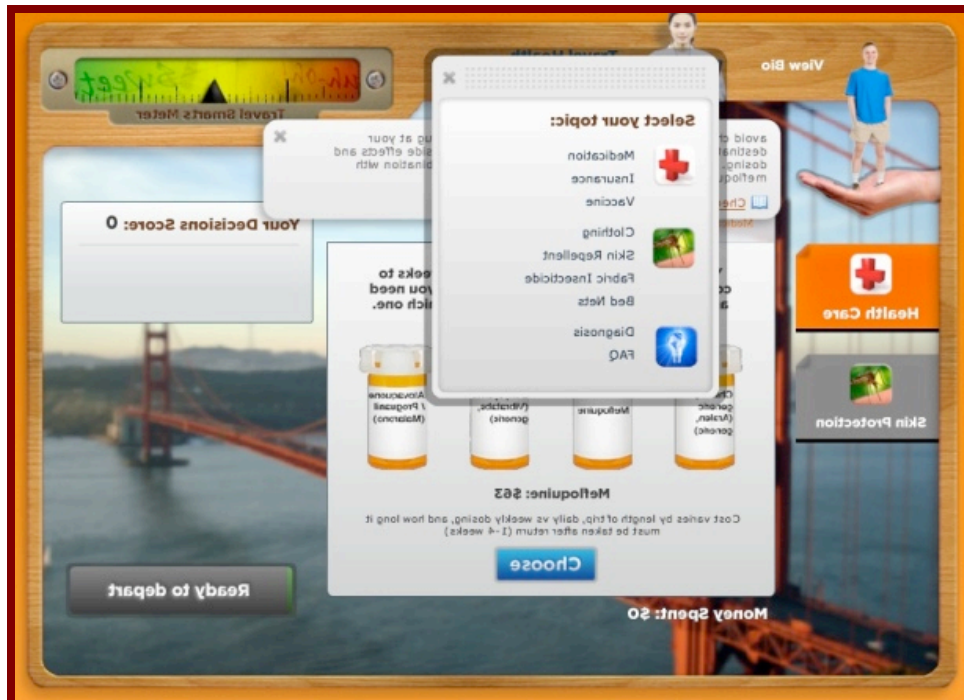
7 — Pre-departure advice: The travel health specialist gives specific pre-departure advice based on the topic on the screen.

Below Liz asks for advice about clothing to pack for Uganda.
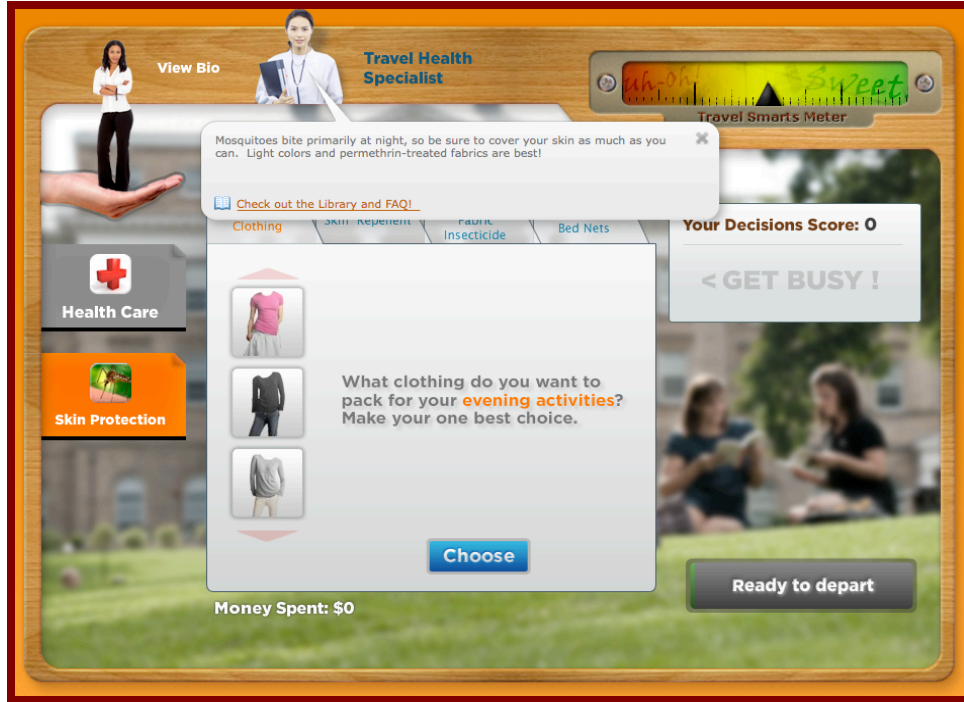
8 — Malaria Library and FAQ: Static information about malaria is available at all times, accessed by clicking on the Travel Health Specialist and choosing the Library link.

9 — Tracking Progress: Players can track their progress on the right side of the screen using the *'Your Decisions' Log* that records all actions taken**,** the *Numeric Score* based on the quality of the actions**,** the *Travel Smarts Meter* that graphically reflects the *Numeric Score*, and the *Travel Phase Progress Bar***.**


10 — Symptom Development: Players need to decide what to do when each student character develops non-specific symptoms. Low knowledge and fewer in-game prevention actions heighten the probability that the symptoms are caused by malaria infection, which reflects reality.

Below Ben develops symptoms while visiting his aunt's family in India.

10 — Symptom Development (continued): Symptoms develop after Rob and Liz return to the US.
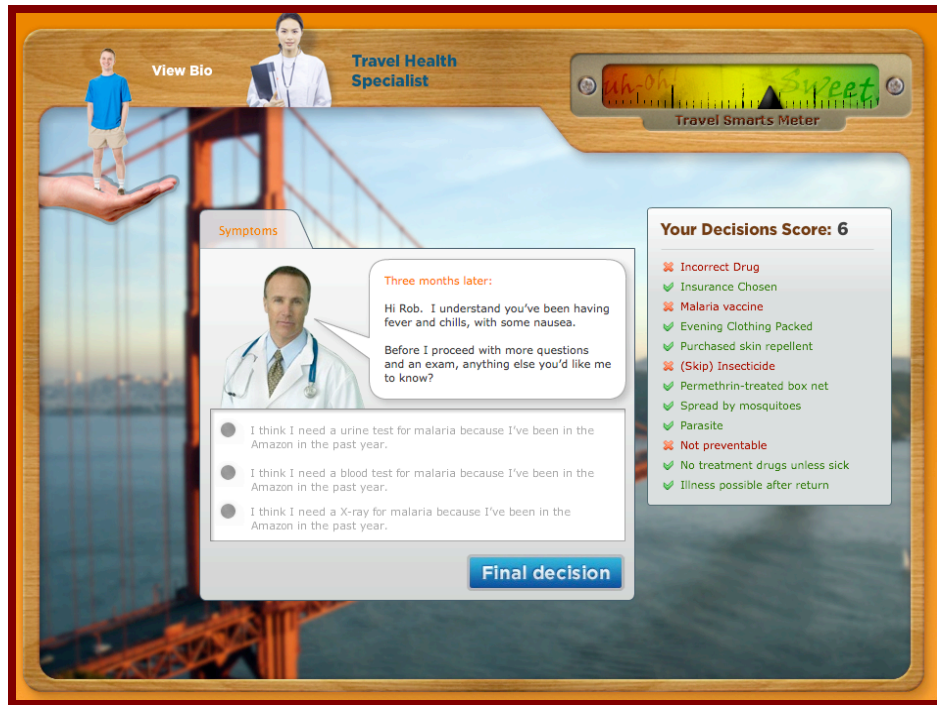

The development of symptoms weeks or months after departing from a malaria-endemic destination is a significant hazard for travelers if the potential for malaria infection is not recognized and the illness is not urgently diagnosed and treated.
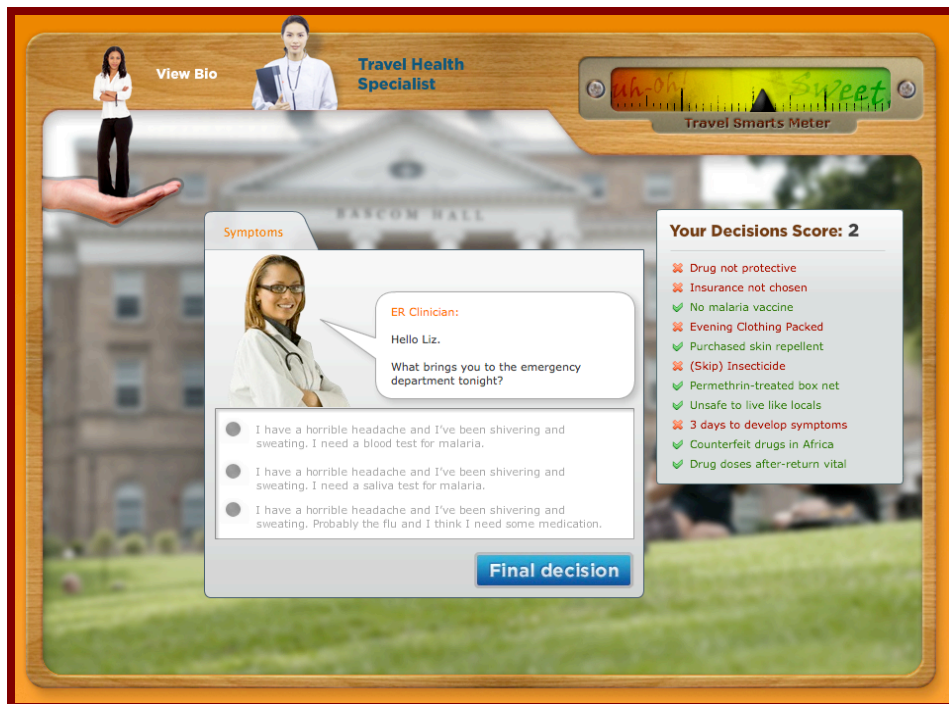
11 — End Game: A summary statement about character outcome is based on total score and player response to the onset of symptoms. Below the Travel Smarts Meter shows a very low score (i.e., low malaria risk reduction competence), resulting in a life-threatening outcome for Liz.
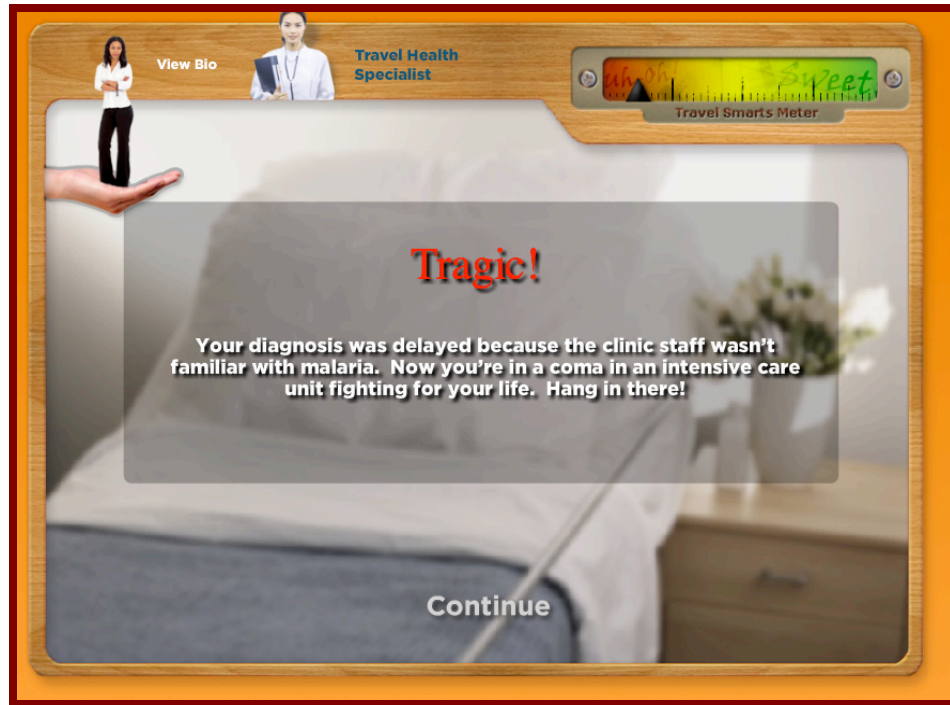

The decision-based rubric helps players at two levels when they make in-game choices to reduce risk; infection can be prevented, or an infection can be cured with no residual problem. However, choosing the wrong diagnostic test may precipitously place the game character in jeopardy when points are low enough to assure that malaria will be the cause of character symptoms.
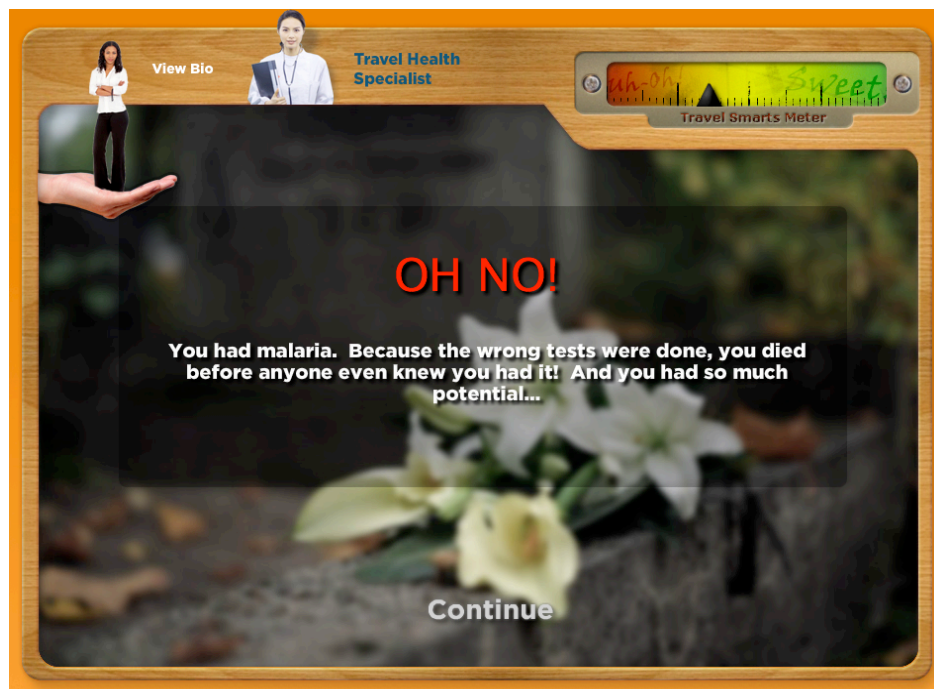
11 — End Game (continued):
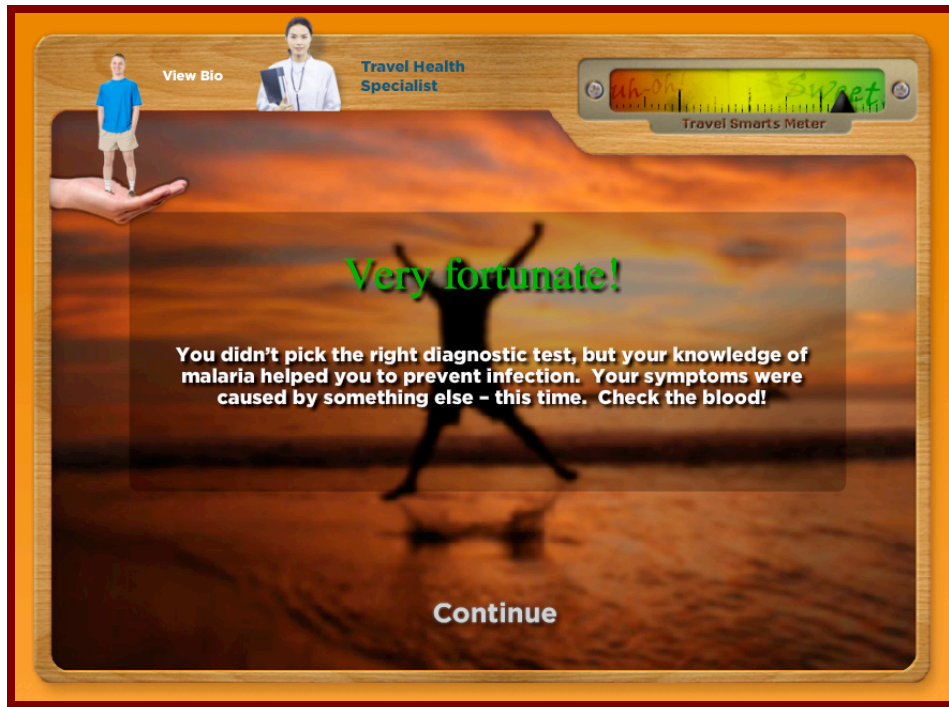
12 — Take Away Points: The final screen at each travel destination sequentially displays key points learned at that destination, followed by the Continue link to proceed to the next destination or the post-game quiz (malaria knowledge test).
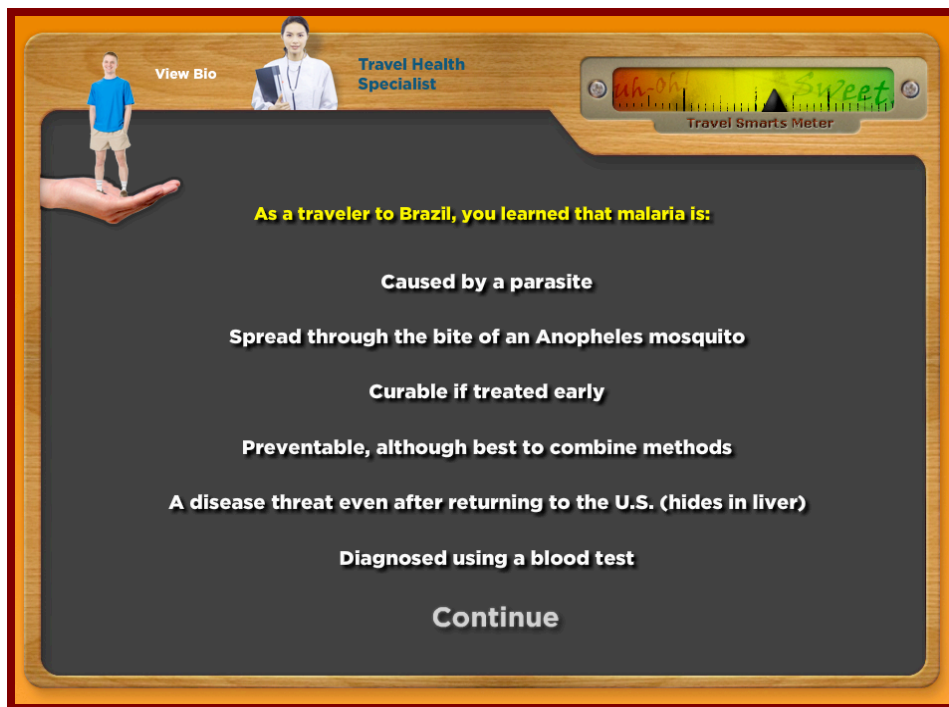
During the 2010 game evaluation study (*N* = 482), the mean time duration to complete the three travel trajectories was 18.5 minutes (the design goal was 15-18 minutes based on user-test feedback).