

Controlled Trial of a Video Game to Improve Health-Related Outcomes Among Adolescents and Young Adults with Cancer

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Abstract

We conducted a randomized controlled trial to test the effect of Re-Mission, a state-of-the-art videogame intervention, on cancer-related knowledge, quality of life, cancer-specific self-efficacy, and medical treatment adherence among adolescents and young adults with cancer. The PC-based game was developed based on empirical needs-assessment studies and theoretical models of behavior change. The game consists of 20 missions inside fictional cancer patients undergoing chemotherapy, radiation, or immunotherapy. Players control a nanobot (microscopic robot) that destroys tumor cells, battles bacteria, and manages side effects with traditional therapies. 375 male and female cancer patients, ages 13-29, were enrolled at 34 medical centers in the US, Canada and Australia, and randomly assigned to receive PCs containing a control commercial video game or the same control video game plus Re-Mission. Outcomes were assessed at baseline and at 1 and 3 months. More than 80% of patients eligible to play Re-Mission did so. Data were analyzed on an intent-to-treat basis using a repeated-measures ANOVA. Patients' cancer-related knowledge, quality of life, and self-efficacy to manage their cancer increased in the Re-Mission group. In 54 patients prescribed oral 6MP chemotherapy, blood levels of 6MP were maintained at higher levels among patients in the Re-Mission group compared to controls. Analysis of MEMS cap data showed that 217 participants who played Re-Mission also took their antibiotics more consistently than controls. Results show that a theoretically-based, data-driven intervention delivered in an appealing interactive videogame context can significantly increase cancer-related knowledge, quality of life, self-efficacy and treatment adherence.

Background

- Adolescents and young adults with cancer are at increased risk for several adverse outcomes, including sub-optimal self-care, poor medical treatment adherence, and long-term psychological sequelae.
- Interventions to address these issues are limited by the historical under-representation of this population in studies of health behaviors and medical treatment.

Response: We hypothesized that a rationally-engineered and theoretically-based videogame intervention might facilitate health behavior change in adolescents with cancer by engaging them in scenarios where success required an understanding of:

- Basic physiology and the biology of cancer (e.g., malignant cell growth, metastasis, residual disease, and recurrence)
- Principles of cancer therapy and its side-effects (e.g., mechanisms of chemotherapy & radiation, role of consolidation treatment, neutropenia and bacteria)
- Biological ramifications of symptom surveillance, side-effect management, and self-care behavior (e.g., in infection, chemo-resistance, and disease recurrence)

Our underlying assumption was that scenarios capturing key medical principles in the contingencies of game-play would implicitly inform players about the critical role of their own behaviors in optimizing medical outcomes during cancer therapy. Strong motivational benefits may also come from a personal opportunity to fight visible cancer "enemies."

Method

HopeLab 04-001: The Re-Mission Outcomes Trial

Eligibility:

Ages 13-29 years
 Physician-diagnosed with any type of cancer
 Primary or recurrent disease
 Projected to be treated (chemo/surgery/radiation) for ≥ 4 mos.
 Comprehend study instruments / procedures in Eng/Sp/Fr
 No history of seizures due to photosensitivity

Participants:

375 enrolled (34 sites in U.S., Canada, Australia)
 Age: Mean = 15.93, SD = 2.76
 Gender: 68% male
 Ethnicity: 57% White, 20% Hispanic, 9% Black, 14% Other
 Diagnosis: 49% leukemia, 34% solid tumor, 16% lymphoma

Procedure: Participants were randomized within sites to receive a Shuttle PC having either a control video game (Indiana Jones and The Emperor's Tomb) or the same control video game + Re-Mission. Background data and outcomes were assessed at baseline and at 1- and 3-month follow-ups. PCs were returned for analysis.

Primary Outcomes:

Cancer-related knowledge – Information specifically contained in Re-Mission was assessed by a questionnaire instrument optimized by Item Response Theory.

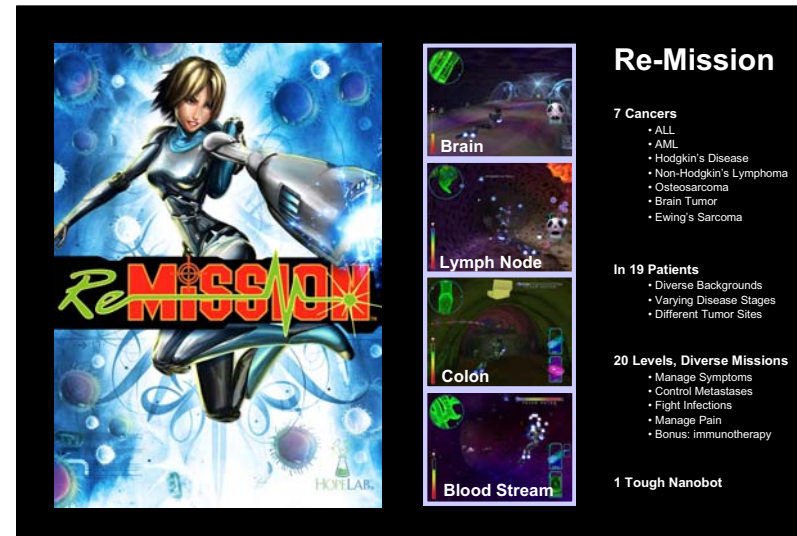
Quality of Life – General quality of life was assessed by the *Pediatric Quality of Life Scale (PQL)*.

Cancer-specific Self-Efficacy – Subjective ratings of one's ability to manage symptoms and side-effects, adhere to treatment regimens, and communicate cancer-related issues were assessed by a questionnaire based on Social Learning Theory.

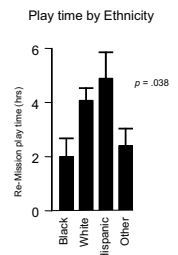
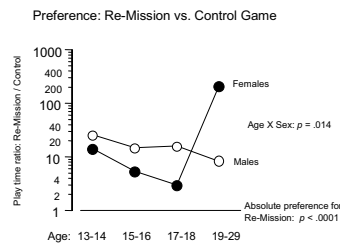
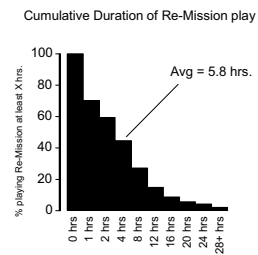
Adherence – Self reported medical treatment compliance was assessed by the *Medication Adherence Scale (MAS)* and the *Chronic Disease Compliance Instrument (CDC)*. Objective measures of adherence included:

- Monitoring of Rx antibiotic use by MEMS cap (n = 217).
- Monitoring of 6MP chemotherapy blood metabolite levels by HPLC (6MMP and 6TG in n = 54 participants with 6MP Rx).
- Clinical staff-verified participant attendance at scheduled medical clinic visits through study duration.

Statistical analysis: Differential change from baseline to follow-up was analyzed using a 2 (group: Re-Mission vs. Control) x 2 (time as a repeated measure: Baseline vs. Follow-ups) factorial ANOVA. All analyses were conducted on an intent-to-treat basis. Outliers were addressed by rank-transformation, and count data (MEMS Cap) were analyzed using Poisson regression.

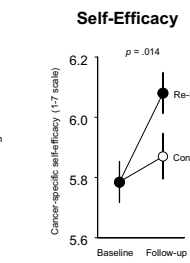
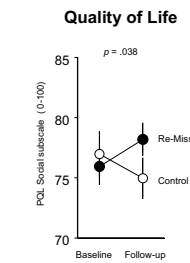
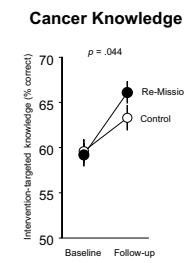


Re-Mission Utilization

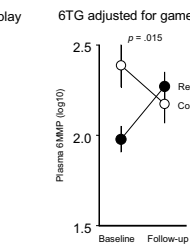
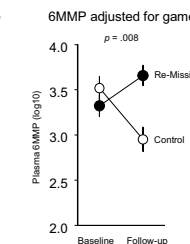
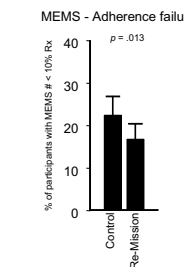
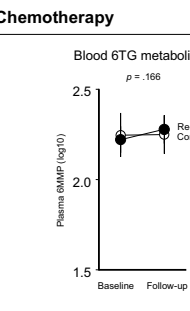
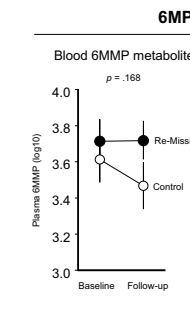
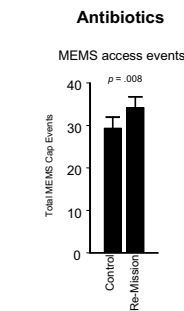


Results

Psychological Outcomes



Treatment Adherence



Conclusions

In a multi-site randomized trial of 375 young people with cancer, the Re-Mission video game significantly improved:

- Cancer-related Knowledge
- Quality of Life
- Cancer-specific Self-Efficacy
- Medical treatment adherence:
 - MEMS Cap-monitored antibiotic utilization
 - Blood chemotherapy metabolite levels

Ancillary findings:

- In contrast to objective measures, self-reported adherence was uniformly high and not significantly impacted by Re-Mission.
- Medical clinic visit attendance was consistently high (average 98% of scheduled visits attended), and not significantly impacted by Re-Mission.
- DSMB found no attributable risk of adverse events for Re-Mission.

Novelty: The Re-Mission Outcomes Study is novel in 2 major respects:

- It is the first controlled trial of any intervention targeted specifically at adolescents and young adults with cancer.
- It also represents the largest randomized controlled trial of a videogame intervention.

Implications:

Video games represent a potentially powerful tool for altering health-related psychological outcomes and behavior, particularly in adolescents and young adults.

A key step in realizing that potential involves specific engineering of game content and structure to engage beliefs and perceptions underlying health-relevant behavior (e.g., adherence, symptom reporting, communication). This "rational psychological targeting" approach provides a general model for implementing health-supportive interventions in the context of social technologies and "serious games."

