

NINR Precision Health: Smart Technologies, Smart Health Symposium Abstracts

PB #1 – Patient Portals: Will Teens Connect?

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ABSTRACT

Background: Adolescents are early adopters of technology; 95% of U.S. teens report they have a smartphone or access to one and 45% of teens say they are online "nearly constantly" ("Teens, Social Media & Technology 2018 | Pew Research Center," 2018). Patient portals provide mobile health education, support transition of care, and secure messaging, which are designed to engage adolescents in their health care.

Hypothesis: To quantify adolescent portal utilization patterns and determine if utilization differs between adolescents and parent proxy use for younger patients.

Methods: Retrospective analysis of 2011 – 2017 electronic portal audit records were conducted among patients aged 18 and younger with at least one outpatient clinic visit at a tertiary academic pediatric hospital and its affiliated network. Differences in utilization among parents/caregivers and adolescents were examined using multivariate analysis.

Results: During the study period, 4,930 accounts had 837,087 transactions. Approximately 45% of patient (age 0-11) parents receiving an activation code logged into the portal; adolescent activation was under 20%. Parents used the portal primarily for secure messaging 352,955 (42%); appointments related tasks 150,926 (18%); and reviewing laboratory results 115,507 (14%). Adolescents accounted for 43,447 transactions (4%), which were primarily secure messaging 10,505 (31%) and reviewing labs results 8,250 (24%). Overall, adolescents wrote fewer messages and reviewed more labs (X^2 5121.2; $p < .001$) than parents of younger children. Female teens were more likely to use the portal than male teens (X^2 1329.6; $p < .001$).

Discussion: Meaningful use metrics such as electronic access to patient records have led to increased expectations for patients and caregivers to utilize health technology to make appointments, track laboratory results, and communicate with their providers outside of the

clinic visit. This analysis of portal audit records demonstrates the majority of both proxies and patients use was for secure messaging, appointment functions, and reviewing laboratory results. Adolescents use differed from parent proxies with less secure messaging and more laboratory results review.

Conclusions: Both parents and adolescents are accessing the patient portal, although adolescents utilize the portal less and in a different manner. Further examination of potential barriers to use and means to encourage activation should be explored.

PB #2 – Feasibility and Acceptability of a Wearable Health Monitor to Measure Stress in Family Caregivers

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ABSTRACT

Background: Family caregivers (FCGs) provide complex care and are often ill-prepared for their role, thus leading to chronic stress. Failure to identify and address psychological stress proactively has health implications for FCGs and can ultimately lead to negative health outcomes for those under their care. Therefore, there is an urgent need for evidence-based approaches to measure FCG trajectories of symptoms in real-time, which will allow for the design of adaptable, individualized interventions.

The Health Tag is a wearable health monitor that attaches to the inside of individuals' clothing and measures respiratory rate and respiratory rate variability, which is entered in an algorithm to calculate the user's levels of physiologic stress. A companion smart device application provides a dashboard that reports participant's data regarding stress over time in an easy-to-read format.

Research Design/Methods: The purpose of this proof of concept study is to assess the feasibility and acceptability of a wearable health monitor (Health Tag) for measuring stress among FCGs ($n=5$) of palliative care patients. We hypothesize that: 1) participants will be adherent to wearing the health monitor over the course of two weeks, and 2) FCGs will find the health monitor and companion smart application acceptable for use.

To achieve our aims, participants will be instructed to wear the Health Tag, adhered to their clothing, 100% of the time for two weeks. Investigators will have access to patient data through a research portal. We will measure feasibility by calculating the percentage of time participant wear the device over a two-week period (adherent = wearing device $\geq 75\%$ of the time). Acceptability will be measured using the System Usability Scale and semi-structured interviews with participants to elicit information about barriers and facilitators to use.

Results/Discussion/Conclusion: This study is in-progress and will be completed in May 2019. Future research will test the device with a larger population of FCGs and correlate self-reported perceived stress outcomes with device data. The long-range goal of this research is to develop and test adaptive interventions to address FCG stress.

PB #3 – Understanding the Lived Experience of Diabetic Persons Using Technology to Support Self-management: A Phenomenological Mini-study

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ABSTRACT

Background: The purpose of this study is to understand the lived experience of diabetic persons using technology to manage their disease. Nearly 30 million persons in the United States have diabetes. Self-management is the most significant way to reduce the incidence of complications. Device and software technology are tools diabetic persons use in managing their illness, however little information exists about the diabetic persons experience with these tools.

Research Design/Methods: Using descriptive phenomenology, interviews were conducted with four diabetic persons at their endocrinologist's office to hear their perspective and experiences managing their disease with the support of technology.

Results: Three of the four participants described insulin pumps as the technology that they used to manage their diabetes. Data were analyzed using the Giorgi method in which interview content was coded into meaningful units and a psychological language. Further coding resulted in the data being transformed into a consistent statement on the diabetic persons experience using technology to support self-management. Consistent statements from participants were that healthcare professionals should be prepared to manage insulin pumps, insulin pump users find tech support very helpful, and that insulin pumps help them manage their diabetes.

Discussion: Themes from this study can inform future research in this area. Implications for nursing practice include increasing nurses' knowledge in the care of patients with insulin pumps, and how significant tech support is in supporting self-management.

Conclusion: Understanding diabetic persons experience with technology will allow nurses to respond to their educational and technological needs and improve their ability to successfully manage their disease.

PB #4 – Use of Virtual Reality (3D) for the Decrease of Risk of Falling on Senior Citizens

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ABSTRACT

Introduction: Falls are a health issue of high prevalence among the population of senior citizens. The 25% of senior citizens have experienced at least a fall on this year. Risk of falling is increased on senior citizens due to the decline of features as visual and hearing acuity, motor and cognitive function that affect the ability of maintaining the balance.

With the technology advances of virtual reality (3D) is one of the new modalities that provide a great variety of activities and possibilities of balance training on a senior citizen. Virtual reality (3D) substitutes the physical reality for a fictional environment with scenes, images and real appearance projections. Through virtual reality lenses (3D) achieves to stimulate the vestibular track that has the main function on the maintaining of balance, consequently it may be effective to deal with balance issues and reduces the risk of falling on a senior citizen.

Hypothesis: Senior citizens that participate on virtual reality (3D) training will have less risk of falling than control group.

Methodology: It is a quasi-experimental study with a comparison group of adults of 60-years-old. The simple will be by convenience, and once it is collected, the allocation of control and experimental groups will be random. The primary outcome will be the decrease of risk of falling, measured by balancing tests, walking and muscle strength. As a secondary outcome will be the fear of falling. The experimental group will receive a postural, walking and visio-vestibular stimulation program with progressive difficulty levels by virtual reality lenses (3D). Participants will be evaluated before and after intervention.

Discussion: Obtained results will offer evidence to involve use of technology as virtual reality (3D) on the prevention of health issues on senior citizens.

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PB #5 – Temporal DNA Methylation of *SLC46A1* is Associated with Long-term Patient Outcomes After Aneurysmal Subarachnoid Hemorrhage

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ABSTRACT

Background: Patient outcomes after aneurysmal subarachnoid hemorrhage (aSAH) are variable and often difficult to predict. Preclinical data suggest that catabolized heme products play an important role in outcomes after this devastating event. The solute carrier family 46 member 1 gene (*SLC46A1*) is a central player in heme and folate transport. The purpose of this study was to examine the relationship between DNA methylation trajectories in *SLC46A1* and patient outcomes after aSAH.

Hypothesis: We hypothesized that variability in DNA methylation trajectory groups for *SLC46A1* would be associated with variability in acute and long-term outcomes after aSAH.

Research Design/Methods: As part of a longitudinal observational study, 260 participants with aSAH were phenotyped for in-hospital acute outcomes (cerebral vasospasm [CV] and delayed cerebral ischemia [DCI]) and 3- and 12-month long-term outcomes (death and functional status using the Glasgow Outcome Scale [GOS; unfavorable = 1-3]). Methylation data were collected from DNA extracted from cerebrospinal fluid over 14 days post-aSAH at 15 methylation sites within *SLC46A1*. Participants were assigned to trajectory classes based

on site-specific DNA methylation data, with and without correcting for cell type heterogeneity (CTH). The associations between inferred DNA methylation trajectory groups and patient outcomes were tested using logistic regression while controlling for age, sex, race, and Fisher grade.

Results: After correcting for CTH, associations were identified between cg00497630 and GOS at 3 months (Beta=0.237, CI=0.103-0.524, p=0.0005) and mortality at 12 months (Beta=0.373, CI=0.154-0.903, p=0.0279). Only the association with GOS at 3 months met the empirical significance threshold calculated in permutation testing (p=0.002).

Discussion: If replicated, the results of this study could provide insight into the potential role of *SLC46A1* in long-term recovery after aSAH and this gene may offer potential as a therapeutic target to improve outcomes after aSAH. Moreover, the analysis approach developed here may be applicable in future studies examining temporal patterns of DNA methylation.

Conclusion: DNA methylation trajectories at cg00497630 in *SLC46A1* were associated with long-term outcomes after aSAH in our sample. These findings should be replicated in a larger sample.

PB #6 – An Exploration of Sedentary Time in Individuals with COPD

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ABSTRACT

Background: Time spent sedentary has been identified as an independent risk factor for poor health outcomes. Patients with chronic obstructive pulmonary disease (COPD) are amongst the least active, and sedentary time in this patient population is poorly understood.

Purpose: To use accelerometer data and calculate the Fragmentation Index (FI), and the BODE index to explore sedentary time in a sample of veterans with COPD.

Research Design/Methods: Patients completed a 6-Minute Walk Test (6MWT) and were given the Actigraph® GT3X to wear for seven days to quantify time spent sedentary. The FI was calculated using the ratio of total sedentary time divided by the number of sedentary bouts for each participant per the accelerometer data. The FI is a measure that can help summarize patterns of how the sedentary time is accumulated into a single number. The BODE index calculated indicates the percent likelihood of 4-year survival in patients with COPD and is comprised of body-mass index (B), airflow obstruction (FEV₁) (O), dyspnea measured by the Modified Medical Research Council scale (D), and exercise capacity (E) measured by the 6MWT. Pearson r correlation was used to explore relationships between FI, BODE and sedentary time.

Results: 21 participants with COPD were enrolled. Patients were older (age = 71+5), with moderate-to-severe COPD (FEV % predicted of 47+15.0%), with a 56+27 yr of smoking, and a 6MWT distance of 451+81 m. Participants spent 44 minutes of each hour sedentary (73.9 ± 9.3%). The average FI was .04±.005. The BODE index score was 1.5 (1.2). The BODE index was associated with increased in sedentary time (P=.04).

Discussion: Older adult veterans with COPD display high levels of sedentary time that seem to be accumulated in larger bouts. The BODE index was associated with increased in sedentary time, which may suggest that patients with higher BODE scores spend more time sedentary and have a decreased chance of survival.

Conclusions: These results highlight some associations of sedentary time in individuals with COPD. Further research in larger more varied cohorts of COPD individuals is needed to understand what specific factors contribute and predict to ST and how this may be addressed in the clinical setting.

Results: Support the notion that older veterans with moderate-to-severe COPD are highly sedentary in their daily life, but they have longer bouts of sedentary time that are not broken up.

PB #7 – Acceptability of a Newly Developed Symptom Reporting App: Perspectives of Children and Parents

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ABSTRACT

Background/Objectives: Children receiving cancer treatment suffer multiple symptoms, yet often struggle to describe these symptoms. mHealth resources, including apps, offer developmentally meaningful, multi-sensory approaches to support symptom reporting.

Hypothesis/Study Aim: This study investigated the acceptability of an investigator-developed symptom-reporting app from perspectives of children receiving chemotherapy and their parents.

Design/Methods: Children received a tablet computer containing the app to use between two clinical visits for chemotherapy. This game-based app features a personalizable avatar to guide children to report symptoms using brief checklists, drawing features, and short-answers. It also includes a drawing page, diary, and daily goals checklist.

After using the app, children and parents participated in semi-structured interviews addressing the app's acceptability. Interview questions included child/parent perceptions about the app itself (positive and negative) and suggestions for improvement. Analysis was guided by descriptive, qualitative content analysis. Children's and parents' responses were analyzed separately and organized into categories and subcategories.

Results: Nineteen children (7 females) (median 8 years; range: 6-12) and 19 parents (18 females) (median 35 years; range: 26-48) participated. Children used the app a median of 4.5 days (range 1-12). Children and parents endorsed the app's facilitation of choices, expression, and creativity. Parents, specifically, addressed perceived benefits of the app as a resource to facilitate the child's voice in reporting his/her symptoms. Most children (n=10) and parents (n=8) denied dislikes about the app; several identified limited interactivity, difficulty remembering to complete the app daily and navigation-related issues. Children and parents suggested increasing interactivity and incentivization and enhancing navigation as potential improvements.

Discussion: Data support preliminary acceptability the app as a resource for symptom reporting. Parents noted that it had potential clinical utility as an option for less intimidating, more accurate self-report of the child's symptoms. Responses are guiding continued development of the app prior to evaluation of efficacy as a resource to support symptom management.

Conclusion: Apps may support a child-centric approach to symptom reporting. Future studies need to address the role of apps in addressing clinical outcomes. Future directions also include investigation of the app as a resource to support symptom assessment in other pediatric subpopulations.

PB #8 – Daily Diary and Ambulatory Activity Monitoring of Sleep in Patients with Multiple Sclerosis: An Investigation into Causal Hypotheses of Overheating-revoked Awakenings

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ABSTRACT

Background: Adults with multiple sclerosis (MS) have a variety of neurological symptoms including heat intolerance due to thermoregulatory dysfunction. Our research shows that this dysfunction leads to overheating-revoked awakenings (ORA), which reduced sleep quality and efficiency. This study examined the relationship between ORA and eight confounding factors, including two biological (BMI, age), four behavioral (daily energy expenditure, pre-sleep activity intensity 2-hours before sleep, bedtime, sleep onset time), and two environmental (day-time light exposure, room temperature). We hypothesized that biological, behavioral, and environmental factors are related to the possibility of ORAs among people with MS.

Research Design/Methods: We continuously monitored these factors among adults with MS for seven days. Sleep, light exposure, skin temperature, and energy expenditure were measured using an actigraphy watch (GENEActiv Sleep), the room temperature was recorded by a wireless temperature sensor (iButton), and a sleep diary provided self-reported sleep quality. ORA during sleep were marked with actigraph and skin temperature data.

Results: We have enrolled 30 adults with MS (28 females; mean age 45.5 years; SD,10.4) and collected about 5000 hours of data. Pearson's product-moment correlation evaluated ORA occurrence and these factors. Analytic results indicate that ORA has a moderate (linear) correlation with pre-sleep activity intensity ($r = 0.4761$), age ($r = -0.3560$), and skin temperature during sleep ($r = -0.3541$). Other factors, such as BMI, bedtime, sleep onset time, and daylight exposure, show either a weak or almost no correlation with ORA.

Discussion: The current findings illustrate a moderate positive correlation between pre-sleep activity intensity and ORA among people with MS. An explanation is that pre-sleep activity can increase body temperature and sleep arousals on all sleep nights, which enforces thermoregulatory dysfunction of patients with MS lead to ORAs.

Also, the fact that ORA co-relates to age and averaged skin temperature provides insight to develop a personalized intervention approach to relieve ORAs.

Conclusion: The continuous monitoring of adults with MS generated insights into improving sleep efficiency by reducing OIAs. This will ultimately advance MS self-management by providing actionable insights for the development of personalized MS care to improve sleep quality.

PB #9 – Methodological Considerations for Pre-clinical Gut Microbiota Studies

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ABSTRACT

Purpose: Rodent models are commonly used to test hypotheses about the gut microbiota (GM) in health and illness. The ability to compare results across GM studies has been challenging, however, because pre-clinical researchers employ different methods. For example, many studies include rats that underwent surgical procedures, and it is not known whether having surgery could alter GM results. The aim of our study was to determine the effects of surgery on acute changes in the abundance of fecal bacteria. We also tested for sex-differences in GM characteristics in Wistar-Kyoto (WKY) rats.

Hypothesis: We hypothesized sex, surgical transmitter implantation and prophylactic subcutaneous antibiotic administration will be associated with differences in GM profiles (i.e., differences in gut bacterial abundance and/or diversity).

Method: The GM was assessed by 16S rRNA sequencing using amplification of the V4 region. To examine the effect of a surgical procedure, we implanted a permanent monitoring/telemetry device into 5 male WKY rats. Following standard antibiotic prophylaxis procedures, these rats received enrofloxacin intraoperatively (5mg/kg SQ). To determine whether surgery and antibiotic prophylaxis affected the GM, we compared pre-surgery results with post-surgery results (1st, 2nd, and 7th post-operative days) and also compared results with an antibiotic only group (n = 2; no surgery). To evaluate sex-related GM differences, we collected fecal samples in duplicate from a separate group of 3 male and 3 female WKY rats (no surgery/no antibiotic).

Results: Data analysis is ongoing. The GM microbial community in male rat fecal samples was significantly different than that of female rats (R=0.619; p=0.001). 16S analyses are currently being performed to evaluate the effects of surgical transmitter implantation and antibiotic administration on the gut microbiota.

Conclusions: The study is important for determining whether surgical procedures affect GM results and whether male and female WKY rats have different GM profiles at baseline. We found there to be a strong effect of host sex on fecal microbial community structure, further emphasizing the importance of studying male and female animals for externally valid results. Our study represents a critical first step for designing reproducible pre-clinical research on the GM.

PB #10 – Designing & Developing Virtual Simulations for Cultural Competence in Nursing Education through Community Engagement

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ABSTRACT

Background: Cultural competence is essential for nursing professionals from novice to experts. With increasing cultural diversity among patient populations, nurses need adequate preparation to identify key cultural care concepts across populations that directly link to health outcomes. Many culturally diverse populations are identified to have health disparities. Educating nurses to identify cultural care concepts through using virtual simulations is novel.

Hypothesis: Virtual simulations that are designed effectively through engaging with cultural communities of interest will promote cultural competence among nursing professionals.

Research Design/Methods: Community Based Participatory Research. Utilized two distinct boards (community and clinical) who represented the cultural group and served as key informants. Effectiveness measured through process evaluation.

Results: Partnerships with community using cultural and clinical experts is effective in designing and developing virtual simulations for cultural competence.

Discussion: It is essential that we prepare our nursing workforce to deliver culturally competent care using technology that has anytime access capability. Since, much of nursing education is moving to an online platform, it is becoming an emerging need to use advance technology like virtual simulations to prepare present and future nursing workforce to deliver culturally competent care for diverse population groups especially targeting those that are identified to be health disparate.

Conclusion: Virtual simulations that are designed and developed through directly engaging with the cultural community of interest enables to capture cultural care essentials that are directly linked to health outcomes. Additionally, it also enables development of culturally relevant virtual simulations.

PB #11 – Genetic Variability Due to Anthracycline-induced Cardiotoxicity in Breast Cancer

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Background: Despite the high efficacy in curative treatment of breast cancer, chemotherapy such as anthracyclines (doxorubicin, daunorubicin) pose a significant risk of cardiotoxicity, leading to an increased risk of morbidity and mortality in these patients. Cardiotoxicity may vary from asymptomatic manifestations to life-threatening symptoms of heart failure and death. The mechanism of anthracyclines involves the intercalation of DNA causing severe mutations in molecules involved in absorption, transport, metabolism and elimination of the drug.

Hypothesis: Anthracycline-induced cardiotoxicity will be associated with SNPs that are related to anthracycline absorption, transport, metabolism and elimination.

Purpose: The purpose of this review is to identify known single nucleotide polymorphisms (SNPs) associated with anthracycline-induced cardiotoxicity in breast cancer patients.

Design: This is a literature review which will summarize all studies conducted that included and identified SNPs involved in anthracycline-induced cardiotoxicity.

Methods: We conducted a literature search in PubMed and Embase in March 2019 to identify SNPs associated with anthracycline-induced cardiotoxicity.

Results: There are at least 18 identified SNPs that are associated with anthracycline-induced cardiotoxicity.

Discussion: In order to increase understanding of mechanisms of cardiotoxicities and to increase detection and improvement of management of cardiotoxicity in breast cancer, genetic polymorphisms should be studied to identify high-risk patient profiles.

Conclusions: SNPs involved in absorption, transport, metabolism, and elimination of cytotoxic drugs, such as anthracycline therapy have been identified and should be studied to identify the relationship between drug response and incidence of cardiotoxicity. Susceptibility for the occurrence of anthracycline-induced cardiotoxicity, with interindividual variability, determined by the interaction between genetic and phenotypic factors, is multifactorial. Larger studies on genetic polymorphisms should be performed to identify patients at a risk for developing cardiac side effects, who can benefit from early therapeutic measures.