Sigma's 30th International Nursing Research Congress

Person-Directed Team-Based Process for Nurse-Led Invention: Development of Three Novel Technologies to Support Cancer Survivors

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Purpose: Nurses have a long history of engaging with patient stakeholders to invent and evaluate new solutions to unmet needs. As the pace of technology development accelerates with the emergence of novel tools such as machine learning and nanotechnology, nurse scientists have an important leadership role to play in ensuring that the process of invention remains ethical and supportive of patient's goals and needs for human caring. The purpose of this presentation is to provide an overview of a theory-guided team science process for nurse-led invention of new technologies.

Methods: Theoretical underpinnings of our approach to nurse-led invention include Jean Watson's unitary science of human caring, emancipatory and feminist nursing theory, and frameworks for human-centered design thinking. Through a purposively-inclusive process of stakeholder (patient and family member, clinician, industry/community partner) engagement involving in-depth interviews, observation, and collection self-report measures, we identify opportunities for technological innovations with the potential to support cancer survivors' own visions of what 'health looks like' for them. We then form teams of scientists and technologists with the expertise necessary to begin an iterative process of invention prototyping and evaluation involving novel tools from the basic and behavioral sciences, such as microfluidics, machine learning-driven algorithms, and nanotechnology.

Results: In this presentation we provide three empirically-based case examples illustrating our invention process in action. The first project is an NIH-funded pilot study of the use of computational eyeglasses to measure functional impacts of fatigue among breast cancer survivors. The purpose of this project was to render certain aspects of an otherwise invisible symptom visible and trackable through quantitative measures of eye function using a low-cost technology. This study was conducted in collaboration with computer engineers and neuroscientists. The second case example features a collaboration with chemical engineering to develop pregnancy test-like microfluidic devices that allow cancer survivors to determine when toxic byproducts of chemotherapy have cleared their systems and body fluids such as breast milk, semen, and vaginal fluid. The third and final case example illustrates early efforts to create 'smart' garments such as gloves, socks and underwear made of vibrating nanoparticle-coated textiles designed to palliate peripheral neuropathies.

Conclusion: Lessons learned from this work include challenges associated with navigating ethical aspects of research with partners from diverse disciplines and private industry groups, the importance of negotiating issues of intellectual property such as patents and data ownership up front and continuously throughout the project, and considerations for sustainability, scaling, and global collaboration. Through the use of clinical nursing knowledge and a theory-guided person-centered approach, nurse scientists can provide valuable leadership linking between patient-identified needs to teams of scientists from diverse disciplinary backgrounds in a position to invent solutions.

Title:
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Keywords:
cancer survivorship, invention and team science

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Abstract Summary:
This session, led by an oncology nurse scientist and inventor, will provide an overview of a theory-guided nurse-led technology invention process. Three empirically-based case examples featuring co-design with cancer survivors and experts from a wide variety of disciplines (chemistry, engineering, neuroscience, computer science, and business) will illustrate the process.

Content Outline:

1. Introduction
    1. Recent History of Nurse-led Invention/Inventors
        1. Example 1: 1950s -Bessie Blount Griffin, electronic feeding system for paralyzed veterans
        2. Example 2: 1960s -Lupe Hernandez (nursing student), alcohol-based hand sanitizer
        3. Example 3: 1980s-2010s-Jackie Campbell & Nancy Glass, Danger Assessment & MyPlan app for violence prevention
        4. Example 4: 2013- Brad Macy - Macy catheter for hospice care
    2. Role & Definition of the Nurse Inventor
        1. Inventor, defined: Not just patent-holders, but the person with the spark of an idea that leads to a new thing in the world (Lemelson Foundation)
        2. Role
    3. Nursing Values, Concepts, & Expertise That Inform the Process of Invention
        1. Caring Science, Human Dignity & Person-centeredness
        2. Healing & Holism
        3. Wellness & Health Promotion
        4. Nursing Ethics
    4. Current & Predicted Trends in Nurse-led Innovation & Invention
        1. ANA Innovation Advisory Board & RWJF Innovation Roadmap
        2. Industry Collaborations: J&J Innovation Quickfire Challenges
2. Illustrating the Process (visual diagram)
    1. Theoretical Basis for the Process
        1. Design Thinking & Co-Design
        2. Post-colonial & Emancipatory theory
        3. Feminist theory
    2. Co-Designers & Stakeholders Who Inform and Direct the Process
    3. What We Learn From/With our Co-Designers/Stakeholders:
        1. What does health look like for you?
        2. How can technology/environments/supportive care/policy better support your achieving/maintaining that?
        3. Identification of opportunities for invention/innovation
    4. How We Invent:
        1. Team Science
        2. Co-Design/Design Thinking
            1. Value Proposition Canvas

        2. Iteration/Rapid Cycle Prototyping & Evaluation
    5. How We Translate/Disseminate:
        1. Clinical, Industry & Community Partnerships
        2. #SciComm & Public/Lay Forums
        3. Business Models/Entrepreneurship
        4. Peer-reviewed Publications/Presentations
3. Empirically-based Case Examples Illustrating the Process
    1. Case Example #1: Wearable Eyetracking Technology to Monitor Functional Impacts of Fatigue in Breast Cancer Survivors
        1. Study Background & Purpose
        2. Our Team (cancer survivors, neuroscience, computer science, nursing)
        3. Methods & Materials (computational eyeglasses)
        4. Mapping the invention process
        5. Prototypes & associated Intellectual Property
        6. Outcomes & Next Steps for Tech Development
    2. Case Example #2: Microfluidic Devices for Home Detection of Toxic Byproducts of Chemotherapy in Body Fluids
        1. Study Background & Purpose
        2. Our Team (cancer survivors, chemical engineering, nursing)
        3. Methods & Materials (microfluidics)
        4. Mapping the invention process
        5. Prototypes & associated Intellectual Property
        6. Outcomes & Next Steps for Tech Development
    3. Case Example #3: Nanotechology-based “Smart” Garments to Palliate Peripheral Neuropathies
        1. Study Background & Purpose
        2. Team (cancer survivors, chemistry, nursing)
        3. Methods & Materials (nano-particle coated textiles)
        4. Mapping the invention process
        5. Prototypes & associated Intellectual Property
        6. Outcomes & Next Steps for Tech Development
4. Limitations and Lessons Learned
    1. Negotiating Ethical Issues & Challenges
        1. Within teams with diverse disciplinary backgrounds
        2. When working with private/industry partners
    2. Navigating Intellectual Property & Patents
    3. Issues of Sustainability, Scaling & Global Collaboration
5. Conclusions
    1. Value & contributions of a nurse-led invention process
    2. Future Directions

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