Resolving the OcuCheck: A Human-Centered Design Approach.

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Abstract: The OcuCheck is a point-of-care device that uses nanotechnology to quantify specific biomarkers in the tear film that result from micro leaks from the corneal wound after a serious eye trauma or surgical incision. Current methods for evaluating corneal wounds or injuries require specific training and access to a Slit Lamp, a large, immobile device that is not typically available outside of the clinical setting. To complement the novel technology housed within the device the design of the OcuCheck needed to be more accessible than the Slit Lamp.

Design, research, and prototype testing were focused upon use of materials, patient needs, ease of use, scale, location of device when not in use, and product protocols. Rather than simply creating a utilitarian solution we strove to pre-empt usability and implementation challenges through use of empathy. This device has the potential to disrupt the healthcare industry by creating a product that incorporates the patient’s physical and emotional comfort into the design.

Keywords: Eye Injury, Medical, Biosensor, Human-Centered Design, Point-of-Care

1. Introduction

The OcuCheck is a hand-held, point of care device that can be placed at the outer edge of the eye to sample a teardrop and analyze it. The device can detect if the internal ocular fluid has leaked into the external tear film, which would indicate a break in the cornea that can be either from a trauma or a wound disruption. The results of the test will be objective. The OcuCheck has been designed to be more accessible than the Slit Lamp and to be used in a variety of settings. It can be used by office technicians and primary care providers. The OcuCheck will change the standard of care for ocular trauma and wound assessments. It can save time and money and will improve outcomes for patients.
2. Research

2.1 Background
Traumatic and surgical wound monitoring is vital for eye professionals. Post-surgical wound leaks can result in vision loss from subsequent infections if not repaired in a timely manner. Wound monitoring is important for patients who have undergone surgery for treatment of cataracts, glaucoma, and eye trauma. Current methods for evaluating corneal wounds or injuries require a trained eye professional and the use of a Slit Lamp, which is not typically available outside of the clinical setting.

Reports show that up to 59% of patients who have undergone filtering surgery for treatment of Glaucoma will develop a wound leak at some point in their lifetime (Henderson, Ezra, & Murdoch, 2004). Surgical wound monitoring is also needed for cataract surgery. Blindness from infection occurs in 14% of patients with mild infections and up to 30% of patients with severe infections (Yamada, Sawada, Kuwayama, & Yamamoto, 2014; Leng, Miller, Flynn, Jacobs, & Gedde, 2011). Undiagnosed wound leaks are the main cause of these infections and early detection and correction of the leaks can prevent infection (Radhakrishnan et al., 2009). Each year in the United States, 2.5 Million eye injuries occur. Corneal leaks resulting from trauma need to be diagnosed and repaired within 8 hours of injury for the best vision outcomes.

2.2 Observation and Experience
We observed patient exams at Ophthalmologist and Optometrist offices and interviewed physicians and staff that interacted with the patients during these exams. Our designers experienced the use of the Tono-Pen®, a handheld tonometer that has many similarities to the OcuCheck in terms of handling and function.

We focused on authentic behaviour of the medical specialists within the context of an eye trauma, interpreting their body language and micro facial expressions to see beyond what was said during interviews. This guided us to understand the functional and supra-functional (e.g. emotional, cultural) needs of the user and generate iterative design concepts (McDonagh, 2016; Thomas and McDonagh, 2013). This human-centric design approach, driven by the needs of both the patients and medical professionals, helped to extract visual cues, patterns of behaviour, and product design opportunities. The patient’s physical and emotional comfort and needs were integral to the research and design.

3. Conclusion
When a product is less intimidating, the patient will be more receptive to its use and it can improve health outcomes. Allowing the emotional and physical comfort and needs of the patient to inform the design can have a significant effect on healthcare from both patient and provider perspectives.

The technology within the OcuCheck is being developed by InnSight Technology, Inc. This material is based upon work supported by a National Science Foundation Small Business Innovation Research Grant. The next phase of funding has been approved. The next stage of the project will include user testing. Feedback from both patients and medical professionals will be used to create new iterations and optimize the design of the device.
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ABSTRACT

The OcuCheck is a painless, safe device that uses nanotechnology to quantify specific biomarkers in the eye. The device employs non-invasive skin contact to collect tear fluid, which can then be analyzed for various biomarkers. This allows for early detection and management of eye diseases such as glaucoma. The device is portable and easy to use, making it accessible to a wide range of patients. The design of the OcuCheck was informed by research on user needs and preferences, ensuring that it is both effective and user-friendly.

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