

'Matula'

Development of a Mailable Midstream Urine Collection Device

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Introduction

Urimon is a company that investigates the prognostic possibilities of urine analysis. It does this by means of keeping track of biomarker levels and profiles in urine samples over time, in order to detect changes that indicate the onset of disease. Samples collected by Urimon are stored in a biobank (Stibion) to make them also available for other research for early disease detection. Urimon requires a minimum of 50 milliliters per urine sample in order to gather sufficient data. These data will, hopefully, in the future prove the value of Urimon's research: an effective and patient friendly tool to detect disease early, when chances of cure are still high.

Problem description

To collect urine samples, Urimon participants receive a box with a urine collection kit. The box is delivered to their home by a delivery company. Participants have to catch a midstream urine sample into a urine container. Subsequently, they need to bring the container to the laboratory after having made an appointment for this.

This is a costly, time consuming and inefficient means of collecting and transporting a urine sample.

Moreover, there is no standardized method to collect a midstream urine sample. Therefore, differences in collection procedures by people at home may interfere with sample quality and thus affect the accuracy of urine analyses.

Goal

Urimon is looking for a means to deliver the urine container and collect a 50 milliliter midstream urine sample through regular mail. Firstly, this would allow Urimon to scale up their research to a national level and include many more participants. It would eliminate the need to contract multiple laboratories and delivery companies to facilitate their logistics. Secondly, it would significantly lower costs. Thirdly, a urine collection device could provide a standardized method for collecting midstream urine samples. This could benefit urine analysis quality.

Research

Research was done on existing urine collection devices and corresponding experiences, general ergonomics, the Urimon urine analysis process and finally the current and proposed logistical process.

Besides this, Urimon participants received a questionnaire to get a better understanding of the current user experience of collecting urine (Bitkina, Kim, & Park, 2020). From this group a

selection was invited for focus group meetings to get a more detailed insight on habits and difficulties in the urine collection process.

Design method and prototype

On the one hand using the information from existing devices and the ergonomic research, and on the other hand the input from the questionnaire and focus group meetings, several concepts were developed (Hayward, 2022).

To ensure the collection of a midstream urine sample through the use of the device, a new midstream collection mechanism was developed.

This ultimately led to a final prototype that is intended to help solve the logistical problems that Urimon encounters. The final prototype was 3D printed and tested by a small group of volunteers (*Figure 1*).



Figure 1. Left: current urine collection container. Right : 3D print of final prototype.

Conclusion and recommendations

The final prototype proved to be partly successful in collecting a 50 milliliter midstream urine sample. Testers of the prototype reported several issues that need improvement.

The midstream collection mechanism appeared to work on a macroscopic level. This means the urine sample was collected without the first part.

Also, the prototype meets the required dimensions to allow delivery through regular mail.

However, in order to transform the prototype into a satisfactory and effective urine collection device, the user experience has to be optimized and the midstream collection mechanism has to be validated to examine the quality of the midstream sample.

References

- Bitkina, O., Kim, H., & Park, J. (2020). Usability and user experience of medical devices: An overview of the. *International Journal of Industrial Ergonomics*.
- Hayward, G. (2022). Urine collection devices to reduce contamination in urine samples for diagnosis of uncomplicated UTI: a single-blind randomised controlled trial in primary care. *British Journal of General Practice*, 225-233.