

Development of a sleeve to improve experience, comfort and stability in paediatric intravenous therapy

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Intravenous (IV) therapy is a commonly used procedure, as it allows fast dosing of fluids and is therefore used in a wide variety of applications in hospital settings. Also in the paediatric sector, IV therapy is often a necessary procedure. However, insertion of a needle to create an IV access is generally seen as the worst, most painful and stressful experience during the hospital stay of children (Hands et al., 2010). As IV therapy for children now comes with multiple challenges on technical, emotional and medical level, a child friendly smart IV sleeve is developed within a Pioneers in HealthCare (PIHC) project, named Achilles, between Saxion Hogeschool, Medisch Spectrum Twente and Deventer Ziekenhuis. This sleeve i) secures and stabilizes the IV line, ii) reduces stress and anxiety for children and iii) has an early warning system for IV dysfunction using various sensors. The research in this thesis was executed in the scope of this PIHC project and revolves around the following main research question.

How can the design of a smart sleeve help to comfort children, between the age of 3 and 5, and avoid a traumatising experience during intravenous therapy while also securing the IV line and providing possibilities for sensor integration?

To answer this research question, the question was divided into four phases towards the development of a final concept and prototype of the IV sleeve. In the first phase, research was conducted into the target group and their current experience with IV therapy. Through literature research and interviews with children, it was found that children experience a lot of stress and anxiety right before, during and after IV insertion, causing a traumatising experience. To reduce stress, successful distraction methods, like a cooling and vibrating device called Buzzy, in combination with distraction cards, can be used. The distraction cards portray a game of seek and find to amuse children, during needle insertion procedures.

These initial findings were taken into account in the second phase, which was the ideation phase. The ideation phase covers the brainstorming and research that resulted into the first ideas for the design of the smart sleeve. Again literature research, but also co-design sessions were executed to come up with suitable ideas. Often the strategy of low-fidelity prototyping was also applied to quickly test ideas. This resulted in ideas for three different components of a total product for IV therapy; the IV band, the IV stabilization splint and the IV sleeve. The IV band is a device that helps to fixate the IV line once it is inserted in a vein. This band solves the problem of complex and time consuming taping structures that are currently used to secure the IV line. The IV stabilization splint is a hybrid textile-plastic splint that is flexible in horizontal direction and rigid in vertical direction, to immobilize the wrist joint while also remaining comfortable. This splint solves the issue of the bulkiness of splints that are currently used to avoid IV malfunction due to wrist movement. The IV sleeve is a useful cover up that allows the hospital staff to get quick access to the IV line, while it also distracts children from the stress of IV therapy with the use of distraction cards. This sleeve makes the current solution of a bleak looking bandage more interesting and amusing to hospitalized children.

The three components were further developed in the concept development phase. In this phase more detailed prototypes were developed, resulting in multiple concepts for the IV band, splint and sleeve. Furthermore, an additional feature for the stabilization of the IV tubes was added and the possibilities for sensor integration were explored.

Eventually, these resulting concepts and prototypes were evaluated in the fourth phase, in which children and a hospital nurse expressed their preferences and feedback, that ended up in the final product.

Finally, this complete research resulted in a final product that realises all the defined aspirations from the research question, to make IV therapy more comfortable and less traumatising for children, while also securing and stabilizing the IV and providing sensor integration possibilities. To assess the efficacy and usability of the final product, it is recommended to set up a final evaluation test session with children and hospital staff, to investigate if the final product would actually work in real practice. This test session could not be performed in the scope of this thesis, but the feedback from the session can be very useful to further develop the product and eventually possibly introduce (parts of) the product to the market.

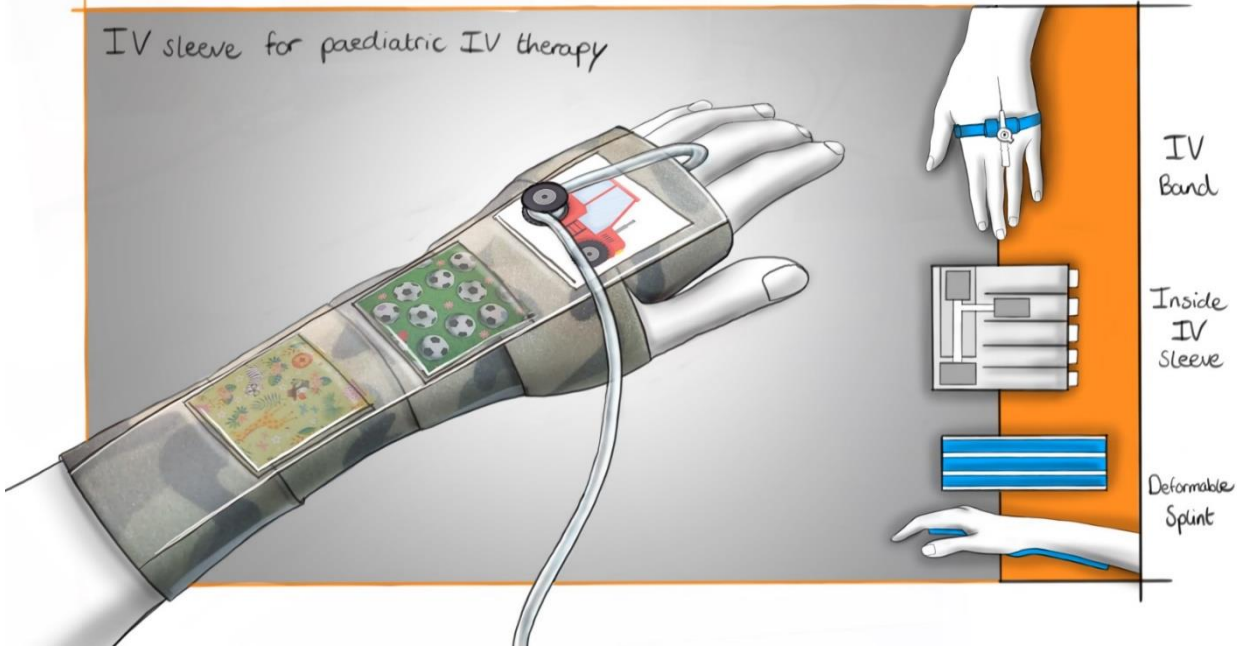


Figure 1: Final concept IV sleeve



Figure 2: Final prototype IV sleeve

References

Hands, C., Round, J., & Thomas, J. (2010). Evaluating venepuncture practice on a general children's ward. *Paediatric Nursing*, 22(2), 32–35. <https://doi.org/10.7748/PAED2010.03.22.2.32.C7597>