

# Update 8

October 2014

## Welcome to this, the 8<sup>th</sup> CHI+MED newsletter

It seems like a long time since the previous newsletter. This is because Jo, the Editor, rapidly became overwhelmed by the sheer amount of activity and number of news items that could be included. So what she's chosen now is a small and rather random selection of what is possible. More in a future edition before too long. In this edition, we cover up-coming events, publications for non-academic audiences, Paolo's work with the FDA, some of the CHI 2014 activities, our 'Number Entry' interdisciplinary theme, and updates on PhD students.

Do keep in touch, and enjoy reading.

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All links mentioned in this document can be found in one place on our blog <http://bit.ly/currentnewsletter>

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## Coming up

### Involving patients in research – co-designing an app for high blood pressure

Karen Li (Swansea University) is running a series of workshops which match people who have high blood pressure with clinicians and designers. The aim is to get them working together to create a (non-functioning) prototype app for hypertension, but also to develop a framework that will be used to evaluate the prototype. The process involved in developing the prototype will generate a variety of outputs from groups activities such as card-sorting techniques, group discussion and drawings and designs and these will be used for further study. This type of mixed-audience workshop is an example of 'co-design' where people with a health condition work with designers and healthcare professionals and provides an opportunity for each group to learn from the others.

There's more information on the [CHI+MED blog](#), and on the workshop's page: "[Participatory design workshop series on developing MOBILE-based SELF-Management intervention for hypertension patients \(MoSeMa\)](#)".

### An international symposium on Interaction Design and Human Factors (IDFH2014)

This symposium will be taking place in Kochi, Japan later this year (on 25-26 November 2014) and several CHI+MED staff from Swansea, UCL and QMUL are on the [organising committee](#). The event will focus on interaction design and human factors, with particular regard to topics concerning human error and human cognitive-motor control. For more information please see the [conference website](#).



### ECLIPSE launched (Sept 9th 2014)

Funded by the NIHR (National Institute for Healthcare Research), the ECLIPSE (Exploring the Current Landscape of Intravenous Infusion Practices and Errors) project builds directly on CHI+MED research. This new project aims to identify key issues related to intravenous medication errors and to develop strategies to minimise the incidence of such errors. We will conduct a national study of the frequency and types of medication errors, reviewing current practices so as to inform future strategy in purchasing, deployment and use of IV medication technology.

If you have any further questions, please email Jo Iacovides ([i.iacovides@ucl.ac.uk](mailto:i.iacovides@ucl.ac.uk)).

At the launch event we introduced the project in more detail and Professor Nick Barber (Director of Research, Health Foundation) delivered a keynote talk. The event offered an opportunity for representatives from NHS Trusts to ask questions about the project and express interest in taking part in the study. We propose to work with 16 acute hospitals (including 2 children's hospitals) and 6 oncology day care units, representing a range of practices in terms of implementation and use of drug error reduction software.

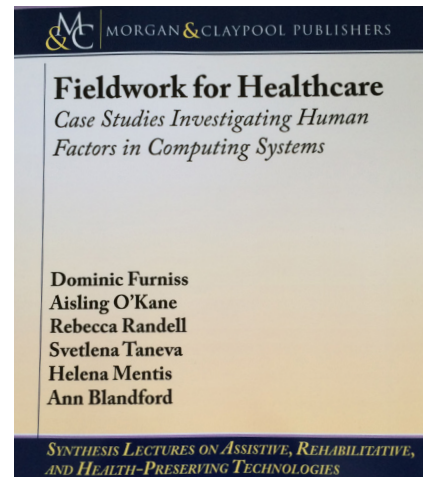
The word 'Eclipse' is written in a large, grey, serif font. The letter 'i' is replaced by a stylized sun or moon with rays emanating from it.

## CHI+MED publications

In addition to our regularly updated page of [published articles](#) (both in academic journals and professional magazines) the project has published a book (*Fieldwork for Healthcare*), resources for professionals, and a special issue of the 'cs4fn' magazine on making medical devices safer.

***Fieldwork for Healthcare: case studies investigating human factors in computing systems***, published by Morgan & Claypool, arose from discussions within UCL about some of the challenges experienced in navigating the healthcare space as an outsider (i.e. a researcher who is not a health employee, and does not have years of formal training in healthcare or medicine).

Aimed at healthcare fieldwork researchers it contains 12 chapters reflecting on the practical issues involved in doing human-computer interaction (HCI) fieldwork in a healthcare setting. It looks 'under the bonnet' of HCI research reflecting on individual experiences, and will be accompanied later this year by a second volume "*Fieldwork for Healthcare: Guidance for investigating human factors in computing systems*" which will offer some practical suggestions. Ann Blandford, Dom Furniss, Aisling O'Kane and Atish Rajkomar from UCL's Interaction Centre are editors and co-authors for the books.



### Our industry-focused publications

In addition to our research publications we've added three [Technical Reports](#) to our website. Written by **Chris Vincent** and colleagues at UCL these are practice-oriented documents issued for guidance.

They cover the use of personas and scenarios in design as a way to avoid designing in isolation by encouraging consideration of design possibilities and discussion of what products should do and why (*IP001*), standards that are applicable to infusion pump design (*IP002*) and guidelines to help reduce number entry error though consideration of the way in which infusion pump input mechanisms are specified (*IP003*).

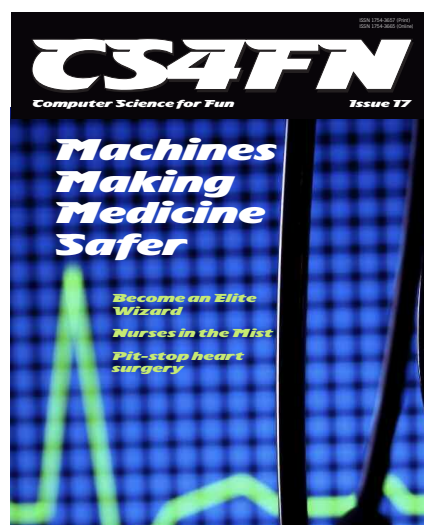
IP001: [Personas and scenarios](#) (infusion devices).

IP002: [Infusion pump standards guide](#).

IP003: [Guidelines for number entry interface design](#) (infusion devices).

### CHI+MED in schools - cs4fn magazine

*cs4fn* (Computer Science for Fun) is a well-established portal to enthuse children and young people about computer science. It includes a website ([www.cs4fn.org](http://www.cs4fn.org)) and the hugely popular series of *cs4fn* magazines for school children. We 'hijacked' Issue 17 of the magazine and the 'CHI+MED special' talks about how computer scientists, and other types of scientists, working together across the project, are finding ways to make medical devices safer for patients. Several thousand copies of the magazine have been posted to teachers, parents and schoolchildren who have subscribed to receive one or more copies and a copy has also been sent to every secondary school in the UK. [PDF copies](#) are also available from the *cs4fn* website.



The magazine is part of our expanding public engagement work and CHI+MED has also instituted an 'internal funding' grant for people on the project to try out different public engagement mini-projects. Last year we supported Sarah Wiseman (UCL) to take her stand up comedy routine (about number entry) to the Edinburgh Festival and we've recently supported the winners of our Persuasive Games competition held earlier this year at UCL.

## Persuasive Games

“Games are used as a medium to communicate a message, to challenge players’ assumptions, to expand people’s perspectives, and to encourage them to reflect on serious ethical and societal issues.”

Jo Iacovides (UCL) has been working with teams of students to develop some games which illustrate CHI+MED principles in an engaging way. Over a period of two months, the teams were challenged to create a persuasive game (one that’s designed to make you think) that would get people reflecting on the causes of human error and raise awareness of blame culture within a healthcare context. Competition winners were selected through a combination of expert judging and testing with a group of players - and the overall winner was Nurse’s Dilemma (which also won the people’s choice) and the runner up was St. Error Hospital - you can play the games, and find out more about them, [on the CHI+MED blog](#).



## Working with the FDA

Although our research has a UK focus much of the regulatory framework in Europe is closely allied with that in the US. **Paolo Masci** (QMUL) has spent several months visiting the FDA (Food & Drug Administration) developing a prototype generic drug infusion pump to help manufacturers test assumptions about pump behaviour.

Paolo has also created a new CHI+MED training video for designers and procurers. It looks at a range of hidden user interface problems (in ventilators, patient monitors and infusion pumps) all of which have been reasons for these medical devices being recalled by the FDA (Food & Drug Administration). The video arose after suggestions from the FDA (with whom Paolo has been working on software checking for infusion pumps) and offers suggestions for designers and staff to identify and avoid latent problems.

You can watch the video on our YouTube channel [Medical Device Training: User interfaces, design issues, and avoiding medical error](#)

## CHI+MED goes to CHI 2014

CHI+MED was well-represented at this major Human-Computer Interaction conference with staff from all sites attending. Papers were presented at the main conference and also at several workshops. Members of CHI+MED co-organised the [CHI2014 Theory Workshop](#), and showcased some of our work there:

[The Wrong Trousers: Misattributing medical device issues to the wrong part of the sociotechnical system](#) by Dominic Furniss, Ann Blandford and Astrid Mayer (UCL and UCL Hospital).

The frequency of alarms sounding from infusion pumps irritated staff and patients on a haematology ward; the alarms were wrongly assumed to be the way the device was designed and therefore beyond their control. In fact hospital management had configured it this way but weren't made aware of its negative impact on the ward.

[On Individuals' Resilience Strategies: Drawing and Applying Theories](#) by George Buchanan and Jonathan Day (City University)

This paper looks at examples of the 'resilient strategies' employed by individuals working in healthcare to help them do their job and keep patients safe. These strategies may be derived from other non-work situations; for example, post-it notes are ubiquitous reminders and a smartphone camera can be used to capture information quickly and accurately. The goal of this work is to understand what patterns of behaviour can be discovered in what people do, and how these patterns can be tested.

[In at the deep end: Contextual Inquiry and DiCoT as "flotation aids" for a novice ethnographer](#) by Erik Berndt, Dominic Furniss and Ann Blandford

Systematic approaches to observation and analysis can help a junior analyst to make sense of a complex setting. However, the costs and benefits of learning and applying such approaches have rarely been studied explicitly. We conducted an idiographic study in which a single individual systematically learned and applied Contextual Inquiry and DiCoT (a structured approach to analyzing a system in terms of Distributed Cognition) to understand how anaesthetists use infusion devices in their work. We present a reflexive account of his experiences. Contextual Inquiry was found to be a valuable tool for understanding this complex system; DiCoT built on that analysis to deliver rich insights into the design of tools and how information is exchanged around the system.

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## PhD students

We are delighted that five of our PhD students have passed their PhD vivas recently, or just have minor corrections to complete. Congratulations to Abigail Cauchi, Andy Gimblett, Patrick Oladimeji, Tom Owen and Atish Rajkomar. Patrick is still working on CHI+MED, while the others have moved on to other roles, building on the skills they developed in their PhDs.

### My PhD : Jonathan Day, City University

Errors, unfortunately, are inevitable. Regardless of how well designed or implemented an interactive system may be, numerous potential threats persist, particularly in the

typically complex and dynamic environments associated with frontline healthcare. However, potential tragedies are frequently averted thanks to the resilience, intuition and adaptability of individuals at the sharp end, which largely goes unreported and under appreciated. My work aims to investigate the variety of strategies individuals deploy which reduce the likelihood or consequence of errors, or otherwise contribute positively to safe and efficient practice. The ultimate intention is to explore how this knowledge may be applied and how such strategies may be better accommodated in future interactive medical systems and practices.

Jonathan Day, [Jonathan.Day.2@city.ac.uk](mailto:Jonathan.Day.2@city.ac.uk)



## Cross-project integrative research themes

We've developed and refined four integrative research themes which bring together different groups from across the project to work on particular challenges. These are:

1. Understanding and improving data entry
2. Understanding normal practice
3. Tools and methods for safe usable devices
4. Moving from a blame to a learning culture

In this issue of the newsletter, we focus on the first of these themes, 'Understanding and improving data entry'.

### Understanding and improving data entry

A range of different errors can occur when programming a device such as an infusion pump and these fall into two main categories: incorrect data entered in the first place or an incorrect sequence of steps used when entering the data. In this theme we are examining people's thinking processes and the factors in the design of the device that can affect these categories of error.

#### a) Wrong data entered

Most research into touch screen or mobile typing hasn't focused solely on number entry. As number transcription is a very different task from text transcription it may not be appropriate to apply understanding gleaned from text-work to a number-related task. Users may think about numbers as just a string of digits or as a whole number, whereas individual typed letters don't have much meaning when separated from the word. While keyboards (virtual or otherwise) are fairly similar, ways of entering numbers vary considerably - numbers can be entered serially on a digit-by-digit basis, or incrementally (much like using a dial to increase volume).

The style of number entry interface influences the type and severity of errors that might be made and there is a trade-off between speed of entry and error. For example numeric keypads (such as on computer keyboards) are fast but it's easy to miss a decimal point which can cause a serious order-of-magnitude error [1] whereas slower number entry interfaces result in fewer or less severe errors. Work looking at which numbers are used most in hospitals [2] has led to a way of evaluating the suitability of an existing number entry interface for an infusion task as well as tailoring interfaces to better meet the needs of

someone programming an infusion pump. This has led to sample interfaces on a prototype infusion pump, which is used for testing, being adapted.

A study on how users check for errors [3] challenged some assumptions about how the device might help, again with a trade-off between speed and accuracy. The three values needed to programme an infusion are interdependent and if two are known the third can be calculated (the values are volume to be infused or VTBI, Rate and Time). Where two values are entered and the device displays the resulting third value for checking we found that users were poor at checking this. From a safety point of view it appears that entering all three numbers is better, with the device checking for any conflicts, however this does take longer. Other work based on infusion pump logs [4] has helped to identify software features which could improve the safety of devices with a 5-key user interface.

Our approach to verifying infusion pump user interfaces against reference specifications for safety requirements has been demonstrated for the data entry system of a commercial medical device (against relevant FDA requirements) [5] as well as in the development of the FDA's Generic Patient-Controlled Analgesia pump user interface prototype [6].

#### b) Wrong process of entering data

An interruption when programming an infusion pump can increase error rates. In particular interruptions that seem superficially related to the task can be more disruptive than interruptions that are irrelevant, something that existing interruption management systems do not account for [7].

If steps are taken to slow people down before they are able to resume their task then this can reduce the likelihood of a 'resumption error' from being made [8]. People also create their own inventive methods (called 'resilience strategies') to mitigate the disruptiveness of errors [9].

Often a nurse will need to programme two or more pumps together. In many cases it is easier to enter, for example the Rate, into each pump and then the Time rather than complete the process for each pump separately – this is known as 'interleaving'. When people interleave they are more likely to omit steps during the task [10] yet the design of hospital charts can encourage interleaving, which can lead to unsafe programming of the pumps. Hospital charts that don't group together the values that are needed to programme a single pump increase the likelihood of the programmer making an error [11]. Interestingly we have also found that making the chart harder to read can lead to an increase in the accuracy of data entered [12].

Ruksenas has produced a mathematical framework for exploring the consequences of different sets of cognitive assumptions about users (and their task environment) as a part of the user evaluation process [13]. This paper is related to earlier experimental studies on the simultaneous programming of two infusion pumps. The same framework has also been applied to timing analysis [14]. Currently, a version of the framework is being investigated which would generate predictions about the likelihood of user error in a statistical format more easily interpreted by human factors experts.

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Our [full list of publications](#) is also available.

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