Kim Erwin, Sarah Norell, Molly A. Martin, S. Margaret Paik, Valerie G. Press, Trevonne M. Thompson, & Jerry A. Krishnan

Applying design methods to care delivery science

Improving the care of minority children with uncontrolled asthma and their caregivers who present to six Emergency Departments in Chicago through a stakeholder-optimized discharge tool

Keywords: asthma, contextual inquiry, delivery science, design methods, human-centred design, health communication design, information design, asthma action plan, patient discharge, multi-stakeholder design

Governments and healthcare systems are increasingly partnering with designers to inform human-centred healthcare delivery. In response, the design field is tasked with adapting its methodology to meet the challenges of complex multi-stakeholder systems, and with justifying design decisions to healthcare partners who may have limited knowledge of, or evidence for, design’s role and impact. This paper presents a case study of design methods in the development of an information intervention for children with uncontrolled asthma presenting to six emergency departments (EDs) in Chicago, IL. We detail the process and outcomes of selecting design methods and, in the discussion section, we review the strengths and weaknesses of our choices in advancing healthcare design goals.

1. Introduction

The Coordinated Healthcare Interventions for Childhood Asthma Gaps in Outcomes (CHICAGO) Plan is a 3-year multi-site randomized controlled trial funded by the Patient-Centred Outcomes Research Institute (PCORI). Its aim is to test strategies to improve the care and outcomes of African-American and Latino children with uncontrolled asthma presenting to the Emergency Department (ED) (Martin et al. in press). The CHICAGO Plan is conducted in Chicago, IL, where African-American and Latino children bear a disproportionate share of the burden from asthma (Gupta et al. 2008).

2. Problem statement

Design was integrated into CHICAGO Plan as a “non-traditional partner” tasked with developing the patient-centred discharge tool in collaboration with clinical asthma experts (for content development) and community advocacy organization leaders (for stakeholder engagement) (Martin et al. in press, Krishnan et al. 2017, Erwin et al. 2016). Discharge instructions are routinely given to patients at the time of discharge. These instructions are typically prefabricated documents printed from
the Electronic Health Record (EHR) system. Discharge instructions usually include the diagnosis, summary of tests, instructions regarding treatment, home care plan, medication names and dosing, return guidelines and follow-up instructions (McCarthy et al. 2012).

However, systematic reviews indicate that the content, format, and benefits of such written instructions are highly variable, with relatively low rates of use (Gupta et al. 2012, Ring et al. 2011). This is because these instructions are designed by teams of medical experts, with limited input from patients, caregivers, and clinicians, and as a result, are not easily comprehended by patients (Spandorfer et al. 1995, Powers 1988, Waisman et al. 2005). Known barriers to effective communication in discharge documents include high complexity, volume, and reading levels of materials coupled with low literacy and numeracy among patients/caregivers (Guevara et al. 2003, Gupta et al. 2012).

The CHICAGO Plan investigators were aware of these issues when they proposed to design a new discharge tool to promote guideline-based pediatric asthma care. The investigators started with a Canadian instrument created by Ducharme et al. which guides providers towards evidence-based care and provides asthma instructions for patients using icons and other graphic elements (Ducharme et al. 2011). For the CHICAGO Plan, adaptation would be required to reflect the needs of high-risk African-American and Latino patients/caregivers living in Chicago. The parameters for design of the CHICAGO tool were conceived as follows:

- support a communication process that fits the demanding context and workflows of the ED, as well as the real-world context of caregivers and their families in the home setting.

3. Methods

We formulated a design process to address the requirements of multiple user groups and care environments involved in the CHICAGO Plan. With CHICAGO Plan investigators, we identified four groups of discharge document users for inclusion: caregivers of minority children with a history of uncontrolled asthma, ED physicians and nurses, ED administrators, and outpatient physicians. We targeted six EDs and their outpatient settings, in addition to caregiver home environments. Additionally, we adapted our design process to integrate CHICAGO Plan investigators with expertise in pediatric asthma, emergency care, qualitative research, and stakeholder engagement across all phases of development. Together we employed a three-phase process of Define user requirements; Prototype and refine concepts with user groups in two cycles of iteration; and Evaluate final solution with stakeholder groups (Erwin et al. 2016).

For a design audience and researchers who may wish to replicate this process, we break down the design stages into five steps (Figure 1):

1. Content analysis of current discharge tools and formulation of guideline-based asthma instructions to design a discharge “provotype” (Boer & Donovan 2012)
2. Multi-stakeholder research employing diverse methods of contextual inquiry and applied ethnography to investigate discharge document usage in context
3. Analysis and visual modelling to identify and organize design requirements across user groups
4. Prototyping + refinement to propose directions back to users for feedback and refinement; and
5. **Review and evaluation** of a final solution with a panel of asthma experts (for content) and ED providers and caregivers (for fit and feasibility).

The study was approved by institutional review boards (IRBs) at all participating institutions, IRB # 2014-0412, 2014-056, 2014-15829, MSH # 14-10, 14-0534, 14-095, and 13083001-IRB01 at the University of Illinois at Chicago, Illinois Institute of Technology, Lurie Children’s Hospital, Mount Sinai Hospital, University of Chicago, Cook County Hospital, and Rush University Medical Centre, respectively.

### 3.1 Step 1: Content analysis + formulation

Using Flesch-Kincaid text assessment tools, we analyzed current pediatric asthma discharge documents used at the six CHICAGO EDs. We assessed for total word count, reading grade level, and reading ease score to understand the literacy demands of existing tools. Additionally, CHICAGO pediatric asthma experts generated new guideline-based asthma instructions to inform the design of a new discharge tool. The design team applied this content to create a discharge provotype for review by users during interviews to probe the acceptability of proposed asthma care practices. Provotypes are early-stage designed objects crafted to provoke discussion of issues in current practice and promote shared debate around change (Boer & Donovan 2012). For designers working in healthcare delivery, who typically must engage existing structures and practices rather than rebuild them from scratch, we find the use of provotypes in interviews to be a useful mechanism for exploring barriers. Provotypes act as facilitators to change, drawing out details of practice that may not emerge organically through questioning.

![Figure 1. Five-step design process to develop a multi-stakeholder discharge tool](image-url)
3.2 Step 2: Multi-stakeholder research

A convenience sample of 19 clinicians and administrators from each of the participating six EDs participated as representative users of the tool. Similarly, a convenience sample of nine caregivers of African-American or Latino children who had visited at least one of the six EDs in the past 12 months participated in focus groups, user-centred home observations, or both.

Data collection was informed by principles of contextual inquiry and applied ethnography. Contextual inquiry, with its focus on direct observation of users in the performance of work, provided an effective framework for investigating multiple sites and diverse stakeholder groups (Beyer & Holtzblatt 1999). To gather basic information about the context of use, researchers engaged in guided tours in the six EDs. Researchers photo-documented the floor plan and pathways, the technology and objects used in ED operations, the waiting room, processes for managing patient flow and the proximity of patients to staff during admission and treatment. All user groups were then engaged in in-situ interviews. Each included two interviewers, and was audio-recorded and digitally photographed. We conducted a total of 19 provider interviews: 6 with ED physicians, 4 with ED nurses, 4 with ED administrators, and 5 with outpatient clinicians. All interviews were conducted in the ED or ambulatory setting for 60–80 minutes. We also conducted 9 interviews with caregivers of African-American and Latino children with a history of an ED visit for uncontrolled asthma in the past 12 months in one or more of the CHICAGO EDs. All caregiver interviews were conducted in the home and lasted 2–3 hours.

To address site-specific constraints and known challenges of engaging certain user groups, interview protocols were tailored to include additional field methods (Figure 2):

- For ED staff, who are time-pressed and can be challenging to engage, we presented a provotype discharge tool to draw out acceptability and feasibility of the asthma treatment recommendations to be tested in the CHICAGO Plan. Because researchers were not allowed to observe actual discharge of children with asthma due to confidentiality concerns, ED staff were also asked to participate in simulation activities, such as an experiential walk-through of the treatment sequence and performance of discharge. Simulations allowed researchers to observe workflows and process details in ways that could then be explored through follow-up questions.

- Outpatient-doctors, who are recipients of both ED discharge instructions and patient post-ED treatment, were presented with a toolkit and instructions to “build the discharge document you wish patients received in the ED.” The toolkit was composed of sticky notes with the same asthma instructions as the provotype, but the information was presented in smaller, modular units to allow for sequencing and annotation. Researchers asked outpatient-doctors to talk out loud as they designed their documents. This provided access to their mental models and conceptions of asthma care and caregivers.

- Caregivers often need more support and encouragement to help tell their stories, especially to researchers from outside their community and everyday context. We employed four different drawing activities to help caregivers build narrative structures around ED experiences, asthma management practices, understanding of asthma, and the community of care around their children. Home tours were conducted to gain insight into prevalence of asthma triggers, as well as home storage and accessibility of medications and asthma instructions.
### Figure 2. Field methods to address multi-stakeholder, multi-site investigation

<table>
<thead>
<tr>
<th>1. To define content requirements</th>
<th>ED staff</th>
<th>Caregivers</th>
<th>Outpatient doctors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prototypes</strong></td>
<td>“Provotype” review</td>
<td>“Provotype” review</td>
<td>Discharge toolkit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. To define user requirements</th>
<th>ED staff</th>
<th>Caregivers</th>
<th>Outpatient doctors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In-situ interviews</strong></td>
<td>In the ED, semi-structured (1 hr)</td>
<td>In home, semi-structured (2 hrs)</td>
<td>In clinic, semi-structured (1 hr)</td>
</tr>
<tr>
<td><strong>Drawing exercises</strong></td>
<td>- Asthma Journey mapping; - Childcare mapping; - ED experience mapping;</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Simulations</strong></td>
<td>- Discharge role play; - Clinician-guided walkthrough of the patient treatment experience;</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Direct observation</strong></td>
<td>- ED guided tour (6 sites); - ED observations (5 EDs);</td>
<td>- Home tours; - Medication storage; - ED paperwork storage;</td>
<td></td>
</tr>
</tbody>
</table>

* providers recruited to represent 6 participating ED/hospital systems in Chicago

### 3.3 Step 3: Analysis and visual modelling

All interview data were analyzed using an inductive coding process modelled on Grounded Theory (Corbin & Strauss 1990). Observational data were coded using the POEMS framework (Kumar 2012). Analysts worked in pairs to ensure inter-coder reliability (SN, JR and TF). To more directly inform design, a form of morphological analysis was applied to integrate mixed media data types (transcripts, field notes, photos, drawings, annotated provotypes) into a systematic set of design parameters for review. Morphological analysis/synthesis is a process for design decision-support that uses a matrix structure to organize design requirements and components so as to help design teams explore and assess all possible solutions to a complex problem (Zwicky 1967, Ritchey 1998). To support this process, we developed a multi-level requirements framework to ensure research analysis was informing content, user needs and contextual needs (Figure 3).

Visual modelling was also employed as a form of synthesis. Factor models, process models and stakeholder models were used to filter data into design-ready perspectives on user needs and experiences.
3.4 Step 4: Prototyping + finalization

Six concepts were developed by the design team; three of which progressed into early stage prototypes. Prototypes are particularly useful in healthcare because they offer a concrete medium with which to engage users in the preliminary construction of a new future. We intentionally constructed multiple prototypes so designers and users could simultaneously compare and contrast different solutions for their fit, feasibility and potential value. The use of multiple prototypes corrects a known weakness of iterative prototyping, which tends to foster a narrowed focus on refinement of detail rather than critical questioning of a prototype’s underlying premise (Mogensen 1994). Nine caregivers, ED clinicians (physicians and nurses), and ED administrators were engaged in two iterations of review and refinement of the three prototypes to converge on a single discharge tool that incorporated health literacy and information design principles (maximum Flesch-Kincaid 6th reading grade level; reduced word count, sentence length, text blocks, and medical jargon; consistent use of typographic hierarchy and underlying grid; and key information presented in illustration and callouts) (Oates & Paasche Orlow 2009, Osborn, Cavanaugh, & Kripalani 2010).

3.5 Step 5: Review and evaluation

The CHICAGO investigators (clinicians, social scientists, community health workers and supervisors) reviewed the new discharge tool with the design team to assess stakeholder input and to finalize language and instruction. The design team then engaged six physicians and six nurses from two hospital sites, as well as eight adult caregivers of children with asthma from a single pediatric pulmonary clinic, to assess their preference for the newly developed tool compared with a current tool from one of two different CHICAGO EDs. Both documents were presented in black and white, and labelled neutrally (Document A and Document B). The design team crafted a mixed method approach, combining a published quantitative assessment tool (Gibson survey) with a qualitative card sorting activity (Figure 4). The Gibson tool was chosen because it includes two survey variations, one designed for clinicians (30 questions), and the other
designed for patients (15 questions), each taking approximately 10 minutes to complete. Questions use a 5-point Likert scale (strongly disagree to strongly agree) to evaluate five domains—i.e. purpose, appearance, usefulness, overall impact and, for clinicians, content (Gibson, Ruby, & Craig 1991). We converted both Gibson surveys to digital form and administered them to participants on an iPad. Card sorting was chosen for its ability to provide a structure for capturing narrative and rationale for preferences among caregivers and clinicians. Card sorting works to surface mental models and evaluate participant agreement by asking each participant to sort cards with phrases into categories, as makes sense to them (Cataldo et al. 1970, Nawaz 2012). Eleven cards were presented to clinicians, and another eleven were presented to caregivers. All cards were crafted in conjunction with a survey designer to propose first-person statements, such as “I think this document provides more guidance for my patients after discharge.” Statements were reviewed for readability using Flesch-Kincaid, and written to include both behavioural and attitudinal probes.

4. Results

4.1 Step 1: Content analysis + formulation

Flesch-Kincaid analysis of current discharge paperwork shows that cognitive human factors need to be better accounted for. Documents are long: the averaged word count of five tools is 933, exclusive of the site tool with an extreme 2500 word count (Figure 5a). Content is above the guideline-recommended 6th reading grade level for half the tools; half of discharge tools employ writing strategies that score as “fairly difficult” to “difficult” to read (Figure 5b). Adherence to information design guidelines to promote effective reading strategies—such as optimal line length; effective use of typographic hierarchy; use of position, columns and white space to create focus; chunking of long texts into smaller units—is low (Figure 6). Illustrations are low resolution and offer textbook-style content. Standardized and personalized instructions are not clearly differentiated, meaning critical at-home instructions may be hard to locate.
Figure 5. Word count (a) and reading scores (b) of existing discharge tools from six CHICAGO clinical sites.

COLORED BY READING EASE (higher is better)

- 60–70 Plain English. Easily understood by 13- to 15-year-old students.
- 50–60 Fairly difficult to read.
- 30–50 Difficult to read.
- 0–30 Very difficult to read. Best understood by university graduates.
Figure 6. The Ducharme tool (Ducharme et al. 2011), a sample discharge tool from a CHICAGO clinical site, and an early-stage “provotype”. 
CHICAGO investigators used guideline-based recommendations to formulate the new asthma discharge instructions. The resulting text scored at a 7.3 reading grade level, with a reading ease of 65.4. The design team divided the text into four action steps: follow up with your doctor; take asthma medications, keep asthma under control (a self-assessment test), tips and FAQ. They also used a tri-fold brochure to sequence action steps one per panel. The prototype was intentionally under-designed, avoiding the use of colour, illustration and other elements that could signal a finished product. This made users focus on content and promoted critique and correction.

4.2 Step 2 + 3: Multi-stakeholder research and analysis

Analysis of interview data produced themes about in-home asthma management practices and ED discharge experiences (Erwin et al. 2016), but the team needed requirements to direct design. An example of an identified home theme is “caregivers need tools to help coordinate care outside the ED”; a related design requirement is “easy to talk to.” An ED experience theme is “discharge experience is fragmented with multiple clinician hand-offs”; its related design requirement is “create a teaching tool.” See Figure 7 for a complete list of design requirements.

For the design team, visual modelling functioned as a non-linear analytic process better optimized for the design context than Grounded Theory coding. A visual model of stakeholder perceptions and a factor model that organized issues in care delivery proved to be an important communication tool for the CHICAGO consortium to engage its funders, supporters and community stakeholders (Figures 8 and 9).

4.3 Step 4: Prototype + refine

We identified six possible concepts, each optimized to address a stated priority or observed behaviour. The top three concepts were selected to move into prototyping:

1. Medication-optimized to clarify treatment plan, identify medications and detail dosing, frequency and start/stop times for caregivers (targets caregivers, ED providers and outpatient doctors);
2. Visually-optimized to teach children directly and engage them in their own care; use illustration to identify medication devices, help with symptom recognition and trigger identification (targets children, caregivers and nurses);
3. Resource-optimized to include digital links to diverse online asthma content to help caregivers address differences in knowledge levels; also designed to motivate caregivers to expand their knowledge of asthma and self-management skills (targets caregivers).

We engaged nine stakeholders in prototype reviews: 3 caregivers; 3 ED physicians; 1 ED nurse and 2 ED administrators. Stakeholders were presented with all three prototypes in black and white to avoid colour bias. They were asked to articulate strengths and weakness of each concept, to talk about using each in the home or work context, and to state their overall preference. Colour versions were presented at the end to assess colour preferences.

Across stakeholder groups, prototype 2—the visually-optimized version—earned the strongest favourable responses for its simplicity, clarity, visual appeal, and ease of use. The final CHICAGO asthma discharge tool, called the CAPE (CHICAGO Action Plan after ED discharge) integrates select features from each prototype (Figure 10).
Figure 7. Multi-level design requirements by stakeholder group.
The finished design reflects principles of information design, such as typographic hierarchy to create priority and aid browsing. The use of an underlying grid to manage complex information, and the use of white space to create focus and group elements reduced line length and text blocks to increase legibility. The typeface, Myriad Pro, was deemed a good fit for CAPE content and audience because of its balance of legibility (clean, unobtrusive letterform design with a higher x-height), warmth (a humanist font) and range of weights (to accommodate a complex information hierarchy and compact presentation). Illustrations reflect the pediatric population for CAPE, with illustration style determined internally by the design team. The document design was calibrated for printing or photocopying in black and white for low-cost reproduction by caregivers. Word choice and writing techniques were employed to increase readability, which produced a Flesch-Kincaid reading level of 4.7 and a reading ease score of 80.5. Together, writing and design choices were optimized to meet the needs of low-literacy caregivers who need accessible asthma instructions to follow at home.
4.4 Step 5: Review and Evaluate

Results of both the Gibson and card sorting activities indicate an overall strong preference for the CAPE (Erwin et al. 2016). Gibson results for CAPE were nearly identical for caregivers and clinicians (note: Gibson questions for clinicians include a “content” category to assess for medical accuracy that is not present in patient questions). Gibson scores were more varied for current discharge tools, with caregivers offering higher scores than clinicians (Figure 11).

Card sorting provided insight into clinician’s Gibson scores. Clinicians overwhelmingly chose the CAPE in response to card statements such as I think this document will have a greater impact on my patient’s health. Clinicians praised the CAPE for its clarity and ability to support self-management training. Card-sorting also provided a channel for clinician feedback and frustrations with current discharge tools, noting current designs are “a non-verbal way of saying ‘I’m not worth anything and I get the second-hand print out,’ you know?”

Caregivers in card-sorting favoured the CAPE, although less strongly than clinicians (Figure 12). Card sorting drew out perceived points of value, such as “it’s more kid-friendly” and would be helpful to show family, friends and other children how to care for asthma. Card sorting also revealed differences in language usage, with one caregiver interpreting the statement “this document is more overwhelming” as a positive statement. The majority of caregivers chose the CAPE in response to statements such as This document is better for my family. Document B (the current tool) was chosen for negative statements such as This document is more overwhelming and positive statements, such as I think that with this document, my family would visit the Emergency Department less (interpreting length of document as an indicator of better instruction). A few caregivers chose “neither document” for statements such as This document is more overwhelming and This document is more confusing.

Figure 9. Model of factors in asthma treatment adherence.
OVERALL FORMAT

• 4 simple steps to organize action, conversation;
• Written in second person to increase personal relevance;
• Strong typographic hierarchy and underlying grid to organize content;
• Simplified language and reduced medical jargon (Flesch-Kincaid reading grade level of 4.7);
• Illustrations average 50% of content and visual space;

Medical clarification

• Medical instruction broken down into clear steps;
• Illustrations of tools to clarify/teach unfamiliar terms;
• Checkboxes required so as to trigger discussion with caregiver;
• Colored stickers provided to distinguish inhalers;

Symptom recognition + action steps

• Spotlight structure to organize action, signal the dangerous progression of asthma;
• Illustrations to diagnose child’s status;
• Friendly style to engage kids;
• Call-outs to reinforce illustrations—brief and written in jargon-free language;

A “smart” document

• QR code (bottom) links smart phones to more online asthma resources;
• Step-by-step instruction to help caregivers understand proper inhaler technique;
• Simple language and illustration helps kids teach themselves and siblings;

Figure 10. The final discharge tool, or CAPE, responds to multi-stakeholder needs and uses. Reproduced from J. Comp. Eff. Res. (2016). 5(1), 17–30 with permission of Future Medicine Ltd.
Figure 11. Gibson scores for the CAPE compared to current discharge tools.

Figure 12. Tally of card sorting results for caregivers.
5. Discussion

Design methods and tools require tailoring to fit the complexity of the healthcare delivery context. The CHICAGO Plan employed a large number of design methods in the investigation and design of its asthma discharge tool. The selection and tailoring of these methods was not without discussion and debate. In this section, we reflect on those choices to promote thinking and dialog about the strengths and weaknesses of applying established design approaches to the design of healthcare delivery.

Content analysis: The Flesch-Kincaid assessment provided objective baseline data on current tools and helped define design goals. When applied to design solutions, Flesch-Kincaid also provided credibility to medical researchers and providers, who use such information to make and justify practice-based decisions. Quantitative metrics also helped the team manage design changes: clinical experts are inclined towards precision, which tends to add text and medical jargon. Word count and reading level scores helped the CHICAGO team negotiate changes and stay within target usability guidelines. We recommend use of validated text assessment tools, such as Flesch-Kincaid, as part of standard practice when designing any information intervention for healthcare.

Data collection: Qualitative methods and participatory design are familiar to medical researchers and community partners in the US; design methods, however, are not. For CHICAGO investigators, drawing and provotypes were unfamiliar and required explanation, examples and evidence to build consensus for use. Post-analysis, these techniques are now considered by the consortium to have brought new information and value to the formative research process. The provotype, for example, drew out the meaning of discharge from ED providers as a serious act and highlighted the symbolic significance of its tools. Journey mapping pinpointed caregivers’ mental models of asthma: for families of children with uncontrolled asthma, drawings were filled with fluctuations without clear explanations as to their causes, while families with control of asthma had specific stories or a narrative thru-line to explain each dip and peak. Design’s contextual methods for user inquiry are highly compatible with healthcare design practices. They also provide a missing perspective on the real-world conditions in which treatments are expected to be used. Additionally, the visual data produced by contextual approaches supports communication of projects to funders, other academic practitioners and community partners. Weaknesses we encountered using contextual approaches included accessing providers, caregivers and clinical sites for extended periods of time, and gaining the trust of participants to allow us to document their environment and practices.

Analysis + visual modelling: The design team applied several conventional analytic approaches to field data with partial, but not sufficient, results for designing. As a cataloguing framework, POEMS was effective in organizing in-situ data from tours and observed behaviours, but was not effective at producing an integrated perspective on the experiences, processes and conditions of users. Grounded Theory-based coding was more productive in identifying patterns and themes in user experiences. Grounded Theory is the gold standard in qualitative analysis and the expected practice in both design and healthcare research. While it excels at describing and explaining the phenomena being studied, the design team needs to generate more specific requirements from the data. The multi-level requirements framework was an effective improvisation for CHICAGO that we are now testing in other healthcare design projects.

Provotyping and prototyping: The ability to rapidly and thoughtfully “make” is not well-represented in healthcare
and medical research, and so may be one of design’s strongest contributions. Prototypes and provotypes are both productive. Mogensen defines prototypes as preliminary versions of the future, i.e. guesses about potential solutions that can be reviewed, tested and refined by the people who will eventually be asked to use them (Mogensen 1994). Provotypes, in contrast, are objects designed to provoke discussions of current practice, drawing out tensions and issues (Boer & Donovan 2012). Provotypes are often coupled with cooperative design practices to engage users in co-design of early stage concepts. This may explain why for CHICAGO the toolkit was the most revealing of the provotypes, as it allowed us to watch and listen to providers negotiate their own beliefs about asthma care and treatment in the act of building a tool from a predefined kit of parts. For healthcare design, where time with providers is limited, provo- and proto-types are effective in engaging stakeholders in defining relevant directions. Healthcare partners, however, may need instruction on the role and objectives of each tool to pre-empt concerns about fidelity and finish.

Evaluation tools: Healthcare design brings new pressures on designers to evaluate solutions using tools and methods that are validated and meet research standards. Validated design evaluation tools for health communications (i.e. MIDAS (the medication information design assessment scale); CIRF (the consumer information rating form) (Krass, Svarstad, & Bultman 2002), etc.), are used by healthcare researchers, but were not developed with designers, and so do not adequately address factors valued by design, such as fit with context of use, interaction with others, the performance of self, etc. The mixed method approach developed for the CHICAGO Plan was one response. But the design field will be better served by joining healthcare researchers in developing design evaluation tools that reflect design knowledge.

6. Conclusion

Experiences with the CHICAGO Plan suggest that design’s strengths in systems thinking, people-centred methods and collaborative work processes make it a strong complementor to the deep expertise of medical researchers. This is a new collaborative context for design, one that challenges designers to work more systematically to create design processes that meet the needs of complex multi-stakeholder systems. It may also be that design for healthcare will require new frameworks and practices to engage fully in this context. We present this work as a case study to help designers think critically about the strengths and tailoring of established methods to fit the healthcare setting. Design and healthcare professionals share a mission to make things better for all—patients, providers, caregivers and staff, even the communities in which stakeholders live and work. The merging of our two fields holds great potential for transforming care delivery for everyone.

Submission date: 19 June, 2017
Accepted date: 27 July, 2017

Acknowledgements

The CHICAGO Plan was funded through a PCORI award (contract #AS-1307-05420; Clinicaltrials.gov registration #NCT02319967). The statements in this report are solely the responsibility of the authors and do not necessarily represent the views of PCORI, the PCORI Board of Governors, or the PCORI Methodology Committee. The study was also partially supported by the University of Illinois at Chicago Centre for Clinical and Translational Science, an award from the National Institutes of Health’s National Centre for Advancing Translational Sciences (grant #UL1TR002003). We thank the children, caregivers, and clinicians who helped us to design the CHICAGO Plan.
We also acknowledge members of the CHICAGO Plan consortium: Ann and Robert H. Lurie Children’s Hospital of Chicago (Sana Ali, Janet Flores, Carmen Goralski, Rajesh Kumar, Michael Miller, Jacqueline Ortega, Zachary Pittsenbarger); Chicago Asthma Consortium (Stacy Ignoffo*, Joenell Henry-Tanner); Chicago Department of Public Health (Roderick Jones, Cortland Lohff); Illinois Emergency Department Asthma Surveillance Project (Michael McDermott); IIT Institute of Design (Kim Erwin*, Tara Flippen, Thomas MacTavish, Sarah Norell*, Paula Falco, Ariana Shadlyn, Jie Yang, Jamie Rivera); John H. Stroger, Jr., Hospital of Cook County Hospitals and Health Sciences System (Maureen Damitz, David Massaquoi, Kenneth Soyemi, Thomas Senko, Trevonne Thompson); Respiratory Health Association (Kate McMahon*, Joel Africk, Amy O’Rourke); Rush University Medical Center (Jane Kramer, Rabia Malik, Pamela Manning, Giselle Mosnaim*); Sinai Health System (Jeanette Avila, Helen Margellos-Anast, Fatima Padron, Jessica Ramsay, Nazia Saiyed, Tala Schwindt, Gloria Seals, Leslie Zun); University of Chicago Medicine (Susannah Butters, Ashley Hull, S. Margaret Paik, Valerie Press, Julian Solway, Crystal Stevenson, John Kim, Nicole Twu, Nicole Woodrick); University of Illinois at Chicago (Michael Berbaum, Nina Bracken, Jennifer Buenrostro, Yi-Fan Chen, Julie DeLisa, David De La Torre-Dorado, Dameka Edwards, Alexander Frye, Kevin Gibbs, Maciej Grabarek, Sai Illendula, Hajwa Kim, Jerry Krishnan, Molly Martin, Sharmilee Nyenhuis, Trevonne Thompson).

* Kim Erwin and Sarah Norell are now at the University of Illinois Chicago, Chicago, IL; Giselle Mosnaim is now at NorthShore University Health System, Chicago, IL; Kate McMahon is now at the Chicago Department of Public Health; and Stacy Ignoffo is now at the Sinai Health System.

References


265


**About the authors**

**Kim Erwin**, MDs, is Associate Director of Population Health Sciences at the University of Illinois at Chicago, and a Research Professor at the UIC School of Design. Kim applies design methods to align medical interventions with human behavior to accelerate adoption by patients and clinical staff. Prior to joining UIC, Kim Erwin was Associate Professor at the IIT Institute of Design and Director of its Center for Collaborative Healthcare Design.

Email: kerwin4@uic.edu

**Sarah Norell**, MDs + MFA, is Senior Design Strategist at the Population Health Sciences group at the University of Illinois Chicago. Sarah applies service design methods to care delivery to help speed implementation of proven interventions. Prior to joining UIC, Sarah was the Assistant Director of the Center for Collaborative Healthcare Design at IIT’s Institute of Design.

Email: snorell@id.iit.edu

**Molly A. Martin**, MD, MAPP, is an Associate Professor of Pediatrics and a Fellow in the Institute for Health Research and Policy at the University of Illinois at Chicago. Dr. Martin is an established leader in the fields of behavioral intervention design and testing, especially as they relate to community health workers (CHWs). She is also active in local and national policy efforts that target health disparities.

Email: mollyma@uic.edu