Journal of the American Medical Informatics Association, 2024, **31(2)**, 342–353
https://doi.org/10.1093/jamia/ocad105
Advance access publication 24 June 2023
Research and Applications

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Designing an infographic webtool for public health

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ABSTRACT

Objective: To create and evaluate a public health informatics tool, Florence, for communicating information to the public.

Materials and Methods: This user-centered design study included 3 phases: (1) an interview and survey study with public health practitioners to assess needs for creating infographics; (2) the application of assessment findings and public health-motivated design guidelines to the design and development of a public health-specific infographic design tool; and (3) a feasibility and usability study to evaluate the feasibility and usability of the tool.

Results: In phase 1, participants noted the importance of tailoring infographics to an audience and wanted flexible tools along with design guidance to help make fewer design decisions. In phase 2, we developed a prototype tool with: (1) layout and functionality familiar to PH users, (2) quick and intuitive ways to add and modify data in visualizations, and (3) health-focused visual elements. In phase 3, participants found Florence to be usable, providing an intuitive and straightforward experience, and that the focus on public health was useful.

Discussion: Based on needs assessments and existing literature, we created Florence along with public health practitioners to address their domain specific needs, ultimately leading to a tool that participants in our study deemed useful. Future research can build on our work to develop user-centered tools to meet their needs.

Conclusion: Infographics are important for public health communication. Creating user-centered solutions to address the unique needs of public health can support communication efforts.

Key words: infographic, data visualization, informatics, public health, nursing informatics

BACKGROUND AND SIGNIFICANCE

Communicating intuitive and actionable information to the public is an essential role for public health (PH), especially to save lives during PH crises.[1–3] A widely used approach to communicate information in PH is infographics-visual representations of complex information and data that convey clear messages in an engaging and comprehensible manner.[4–7,10] Infographics provide a communication medium that facilitates the spread of vital information between PH department leaders and the public[12,13] and that can influence PH efforts toward promoting healthy behavior changes among the public.[9]

Research has elucidated the importance of design in effective and meaningful infographics.[14] Prior work by Arcia et al[9] identified design rules for health focused infographics that improved understanding and increased participants' willingness to change certain behaviors to better their own health. However, applying health infographic design guidelines to create infographics requires design training and skill.[15] While large PH organizations like the Centers for Disease Control and Prevention (CDC) have demonstrated the capacity to do this successfully,[16] many local PH departments do not have the training, time, or resources to create infographics.[17,18] This presents a challenge for PH practitioners who want to create infographics that clearly and effectively convey important information specific to their communities but lack the capacity.

Further contributing to local PH department difficulties in designing infographics is the lack of appropriate tools. Currently, most design tools available to and used by PH practitioners focus on data visualization like Data Illustrator,[19] Lyra,[20] and iVisDesigner.[21] Data visualizations are graphic representations of data and serve a different purpose from infographics. Although both visualizations and infographics could contain text descriptions, the role of text in infographics is more central where the text itself could be the content. Conversely, in visualization, the graphic components are central. While data visualization tools can, therefore, help PH practitioners track and model infectious disease outbreaks,[22–30] visualization tools are mostly used for internal purposes rather than for communicating data externally with lay audiences.[28,31,32] When data visualizations are made available to the

Received: 22 January 2023. **Revised:** 24 April 2023. **Editorial Decision:** 23 May 2023. **Accepted:** 12 June 2023

public, through dashboards built using PowerBi and Tableau (eg, CDC,[33] Washington State Department of Health[34]), these dashboards are still focused on analysis rather than on communicating information and require cognitive work by the public to make sense of the data and know how to take action.

Generalized graphic design platforms such as Canva[35] and Piktochart[36] enable anyone to create professional-looking infographics through using design templates. Templates offer an approachable way to create infographics that does not require coding or design expertise. While prior research on PH data visualization has involved the development of visualization tools, literature specific to infographics has mainly focused on the automatic creation of and information extraction from infographics.[37–39] To our knowledge, no research has examined whether and how PH professionals use template-based infographic tools to communicate critical health information with lay, local audiences.

OBJECTIVE

The purpose of our study was to apply the stages of the human-centered design (HCD) life-cycle to create and evaluate a PH infographic tool, Florence. The phases of our study were to: (1) assess PH practitioner challenges in and needs for creating infographics; (2) apply assessment findings and PH-motivated design guidelines to the design and development of Florence—a PH specific infographic design tool; and (3) evaluate the feasibility and usability of Florence. Study phases align with the International Organization for Standardization HCD standards.[40] Phase one activities aimed to understand context of use and specify user requirements. Phase two activities aimed to produce a design solution. Phase three aimed to evaluate the design. Together, the rigorous application of HCD methods resulted in development of a crucial tool needed to support PH practice in creating health visualizations for lay audiences.

MATERIALS AND METHODS

Phase one: setting and sample

To better understand current practices and perspectives of PH professionals when using and creating infographics, we conducted an observational, cross-sectional needs assessment.

Our assessment involved an anonymous online Qualtrics survey and interviews with PH practitioners. The 20-min survey was conducted during August 2020 in the United States. Individuals were eligible if they currently or previously worked in a state or local PH department. We identified potential participants through convenience sampling of our research team's PH network, sent a recruitment email with an online consent form, then used snowball sampling to broaden the participant pool. While we recruited participants from multiple states to account for differences in public health policies and governance structures by state and territory, all were from Northwestern states. The Institutional Review Board at Seattle University determined our research to be exempt.

Phase one: measures and procedures

The survey started with questions regarding participants' experience and views on using infographics in their work, professional experience, and demographics. The primary questions covered target audience demographics, purpose of infographics, and perceived usefulness of infographics and desired improvements they would make on their own infographics. For those who had created infographics, open-ended survey questions asked about their process of creating infographics. All respondents were asked about the training and resources needed to create infographics. To explore survey results in more depth, we conducted interviews over Zoom during June–July 2021.

Each 30- to 45-min interview began with a definition of infographics and 8 infographics examples. Questions asked about current infographic creation workflow including tools used, frequency, and satisfaction rating. Next, participants were asked to rate the amount of flexibility of their current tools and the desired level of flexibility for an ideal infographics tool. Examples of tools with low flexibility (eg, a static template where only text could be changed) and a high amount of flexibility (eg, Piktochart) were provided. Finally, a video demonstrating a prototype of a PH infographic webtool with potential features was shown. Follow-up questions asked about useful and desired features, benefits and challenges regarding infographic creation, and how a webtool could address them. Participants received a $25 Amazon gift card.

Phase one: data analyses

Data were analyzed using axial coding. One researcher coded every transcript line to derive initial codes. Two researchers reviewed the codes, categorizing them into broader themes. Then researchers independently coded all interviews and open-ended survey results, discussing any discrepancies. Conflicts were resolved by an additional research team member. Procedures for credibility, transferability, dependability, and confirmability were incorporated throughout the process to ensure trustworthiness. This included field notes, team debriefings, reflexive journaling, consideration of negative cases, and audit trail maintenance.

RESULTS

Phase one: findings

Survey ($N = 21$) and interview ($N = 11$) needs assessment participants included practicing and retired PH professionals from at least 5 different states and mostly representing local PH departments (Table 1). The survey and interview results illustrate current practices in creating PH infographics including the purpose, creator, data used, audience, and tools for infographics they make. Following best practices for publishing qualitative informatics research,[41] exemplar quotes are found in Table 2. Most trends found through the survey were reiterated and elaborated by interview participants with regard to the audience and purpose of creating and using infographics, as well as the process, challenges, and desires. A majority of respondents used infographics for communication and education. Five survey participants specified that they use infographics to communicate results from surveys and research articles, either to the public or other professionals. Four respondents focused on sharing educational information on PH topics, including COVID-19 topics and vaping/e-cigarette use.

Theme one: most participants create their own infographics

Twenty-five of our 32 needs assessment participants (78.1%) create their own infographics. Those who used pre-existing

Table 1. General characteristics of study participants by study aim and design

Characteristics	Phase 1: needs assessment		Phase 2: feasibility evaluation	Phase 2: usability evaluation
	Survey	Qualitative interview	Qualitative interview	Tasks and interview
Age (years), mean±SD	47 ± 13	56 ± 12	61 ± 11	26 ± 10
Gender, *n* (%)	21 (100)	11 (100)	4 (100)	19 (100)
Female identified	16 (76)	7 (64)	2 (50)	17 (89)
Male identified	4 (19)	4 (36)	2 (50)	2 (11)
Not reported	1 (5)	—	—	—
Location, *n* (%)	21 (100)	11 (100)	4 (100)	19 (100)
Alaska	3 (14)	3 (27)	—	—
California	—	—	—	1 (5)
Idaho	2 (10)	1 (9)	—	—
Oregon	3 (14)	—	2 (50)	1 (5)
Washington	11 (52)	—	2 (50)	17 (89)
Other	—	5 (45)	—	—
Unknown	2 (10)	2 (18)	—	—
Organization type, *n* (%)	21 (100)	11 (100)	4 (100)	—
Local public health department	10 (48)	5 (45)	2 (50)	—
State public health department	7 (33)	3 (27)	1 (25)	—
Community health agency	1 (5)	1 (9)	—	—
Other	2 (10)	1 (9)	1 (25)	—
Unknown	1 (5)	1 (9)	—	—
Student type, *n* (%)	—	—	—	19 (100)
Graduate	—	—	—	6 (32)
Undergraduate	—	—	—	11 (58)
Not in school	—	—	—	2 (10)
Occupation, *n* (%)	—	—	—	19 (100)
Student	—	—	—	11 (58)
Practicing nurse	—	—	—	6 (32)
Other health professional	—	—	—	2 (11)
Position, *n* (%)	21 (100)	11 (100)	4 (100)	—
Director	5 (24)	4 (36)	3 (75)	—
Epidemiologist	4 (19)	1 (9)	—	—
Manager	5 (24)	2 (18)	—	—
Other	5 (24)	3 (27)	1 (25)	—
Unknown	2 (10)	1 (9)	—	—
Infographic experience, *n* (%)				
Created infographic before	17 (81)	9 (82)	2 (50)	11 (58)
Shared or presented an infographic	21 (100)	10 (91)	4 (100)	—
Used PowerPoint for infographic	—	5 (45)	—	8 (42)
Experience in public health (years)	18 ± 12	28 ± 12	29 ± 9	—
Experience working with public health data (years)	14 ± 12	14 ± 11	18 ± 11	—

infographics instead of creating their own stated that finding the right infographic is difficult, since they found existing infographics to not be relevant and applicable to their audience. Participants who created their own infographics described the following workflow: (1) data collection, (2) message formation, and (3) infographic creation using a design tool. Six participants said they collect their own local data to make infographics more relatable to their target audience.

Theme two: audience-specific infographics are critical

While survey responses highlighted the general benefit of using infographics such as simplification of a complex issue and the visual appeal, interview participants shared the particular advantage of *creating* infographics—tailoring the design and information in the infographics to their audience. To localize infographics participants described strategies that included updating visuals to align with target audience demographics and tailoring messages to the audiences' health literacy. As participants' expertise was not in design, they described wanting access to more resources for ideas and visual material (eg, images, illustrations).

Theme three: use of general data visualization tools to make infographics

The most used tool described for making infographics was PowerPoint ($n = 6$), with Tableau ($n = 3$) and Piktochart ($n = 3$) also mentioned by multiple people. Most interview participants were satisfied with their current software, with an average satisfaction rating of 3.59 ($\sigma = 0.78$, $N = 8$) out of 5 (very satisfied). Participants generally liked the usability of their current tool(s) and specifically highlighted its ease of use, familiarity, interactivity, and flexibility. Additionally, most interviewees indicated they were not comfortable designing infographics, giving an average comfort rating of 2.84 on a scale from 1 (very uncomfortable) to 5 (very comfortable) ($\sigma = 0.52$, $N = 11$). They attributed discomfort to lack of design experience and technical ability, lack of time, and lack of funding.

Theme four: workflow drives needs when creating infographics in PH

Participants desired a high amount of design flexibility (4.32 out of 5 [$\sigma = 0.64$, $N = 11$]). They wanted a more flexible tool to have control over the infographic to tailor it to their lay

Table 2. Exemplar quotes supporting themes by study aim and design

Study phases and design	Theme	Identifier	Quote	Design decision in Florence
Phase 1: Needs assessment—Survey	*Lack of resources*	S18	"We have a publications specialist who does the final document preparation. With just one specialist, this creates a bit of a bottleneck. We started having some program staff (not publications specialist) use Vizme ahead of transferring the work to the publications specialist to help cut down on her time needed. She ended up having to recreate everything anyway in her specialized software, so this wasn't really a big time saver."	
	Current practices in infographics	S7	"Using other infographics is helpful, but they do not address local data or local programs."	
		S11	"[T]he infographics are culturally relevant and applicable to the target population."	
	Infographic creation	S7	"[W]e are not trained to create infographics and do not have the correct tools to make anything great."	
Phase 1: Needs assessment—Qualitative interview	*Localization*	P6	"[T]o communicate [local data], we try to incorporate local images. We are a fishing community that lives near the ocean, so we try to incorporate a lot of those types of visuals, whether it's [in] the graphs or the background."	
		P2	"I can make it more relevant to the audience, especially if I know my audience. If someone at the national level prepared this data about us then I can probably present the same information but do it in a way that will resonate better with the community."	Bidirectional graph-text binding
	Lack of design or technical skills	P9	"I can picture [the infographic] in my head clear as day. Like, I know what I want it to look like but then getting the actual thing to look like what's in my head, that's the technical piece and I am not great at that so it takes time."	Prebuilt editable templates available for use
		P10	"I feel uncomfortable with design, like what would be a professional picture, what would be the design that is needed for that realm of PH?"	Number of ways to represent data reduced to only essential charts Visual complexity of chart types reduced
	Data collection	P4	"[P]ersonalize [infographics] to the target audience or the area that [they] are serving rather than having national data points. It's not very compelling if I shared national level data with my [area's] elected officials board."	
	Message formation	P6	"[S]o we are not overloading people when we [create] an infographic."	
		P13	"[B]orrowed ideas from other entities."	
		P9	"[D]ata on the internet or at established agencies such as CDC, NIH, CADCA, etc."	
	Infographic creation	P13	"We don't have the resources to obtain a graphics software or program. Everything I do is through Publisher and finding images online that will suite the infographic, and being able to find similar images for consistency [is challenging]."	
	Desired workflow for creating an infographic	P5	"[F]ound [myself] almost finishing a project and then realizing [I] can't change one particular element that was critical to conveying the message."	
	PH professionals want a graphics library that is expressive but also appropriate (Health focused visual elements)	P2	"[I]t's really difficult to find the right picture when you are trying to communicate risk in a colorful way without being too colorful or insensitive."	Health-specific graphics (clip art, icons, images, etc.) library included

(continued)

Table 2. (continued)

Study phases and design	Theme	Identifier	Quote	Design decision in Florence
Phase 3: Feasibility evaluation—Qualitative interview	*Perceived usability of Florence*	F1	"If I were to do it by myself, it would only take one session to pick it up to be honest with you, it's actually pretty easy."	
	Design-related needs	F3	"Staff [won't have to] lean on someone with a graphic design background or web design background [and would] be able to at least rough something out and get a presentable infographic or [make one] for someone who has to prepare something very rapidly."	
		F2	"[M]ost small health departments don't have [graphic designers] so something like this . . . would be really critical."	
		F4	"[I] had a specific set of color schemes, fonts, so we had a way of ensuring that . . . there was some brand consistency and recognition."	
	Health specific visual elements	F3	"[P]uts a lot of people off [since] they have needle phobia. I think talking about vaccines, a picture of a vial is often less threatening."	
Phase 3: Usability evaluation—Tasks and interview	*Strengths of Florence*			
	More intuitive and straight-forward experience	U17	"I really like it. Compared to other tools this is very straightforward and user friendly. I think a lot of the other tools have a lot of extra [features] that I don't really use."	
		U1	"I liked that [Florence] provided just the buttons that I needed versus Piktochart, Canva to a lesser degree, sometimes there are too many buttons and unless you are trained or you used it a lot, it can be too much power."	
	Data entry for icon array in Piktochart	U6	"[I]t also feels like that would make the chances of putting mistakes in an infographic higher. Some people think 'oh yeah I'm great at mental math' or 'I've got this' but [then] they make a mistake because this [tool] requires a little more thinking."	
		U17	"[W]ith Florence, things were much more automated. For example, the charts would update the numbers right away whereas with Piktochart you had to go in and [manually] fix the text."	
	Visual resources	U6	"[R]eally liked this icon library because going back to PowerPoint [. . .] if I wanted to insert a picture of a hospital I then would have had to pause for a long time, search the internet for a free drawing of a hospital and then [import it] into the tool."	
	Updating values in Florence	U2	"[F]ound it easy because compared to Piktochart, when I clicked on the chart in Florence it just had the values there and all I needed to do was change it."	
	Weaknesses of Florence			
	Interface aesthetics	U1	"I think the biggest weakness for Florence is that it doesn't look as nice."	
	Less creative variability	U17	"I feel like I had more creative variability in terms of what [I] want to do [in Piktochart]. However, with that, I mentioned the charts were kind of a little bit difficult to navigate and labeling charts was a little bit difficult to navigate as well."	
	Changing category labels	U8	"I had a hard time locating how to change the category labels. I think maybe it's because of the wording [of the tab options]. Nothing really sticks out and it kind of just blends in so it's hard to find different [options]."	
	Changing color	U7	"The color [picker] was kind of weird because I mean I don't really use sort of these kinds of tools but like clicking the color in the rectangle, I didn't know you could do that. I thought you could only click on the [slider]."	

audiences. Some participants stated their desired amount of flexibility differed based on the time constraints of their situation. For times where quick messaging was crucial (eg, sharing pandemic-related information), they reported a lower flexibility score desired than for other times. Although participants wanted more design flexibility, they also desired more design guidance and wanted to make fewer design decisions. Two participants' desired workflow included transferring important design decisions to the computer through automation. These seemingly contradictory results were founded on the conflict between PH professionals' design skill-level and their desire to tailor infographics for their audiences. Accordingly, most tool features that participants desired related to taking design responsibility away from the user, such as via infographic templates and automated slide design suggestions. Three participants desired more audience involvement in the creation process including a feedback loop where audience members give feedback that supports improvements to the infographic.

Phase two: using phase 1 results to design Florence

Using insights from phase 1, we designed Florence, an infographic webtool for PH professionals (Figure 1). We established and followed 3 design guidelines based on phase 1 results: (1) the tool layout and functionality should be familiar to PH users, (2) adding and modifying data in visualizations should be quick and intuitive, and (3) visual elements should be health focused. Table 3 summarizes how key findings from phase 1 informed the design of Florence. Supplementary Appendix A provides decision details and design guidelines we applied to designing Florence. The resulting interface is shown in Figures 1–3.

The phase 1 interviews demonstrated that PH professionals appear to desire flexibility for customizing infographics for their specific audiences but also lack the design knowledge necessary to create effective infographics. To address the contrast between skill and desire, we strived to provide PH users with a variety of editable health-related templates. Editable templates take away the responsibility of designing an infographic from scratch, while still providing flexibility for inserting, repositioning, and removing infographic elements. While existing infographic tools use templates, many cover topics such as business, education, and media that are nonhealth-related. In our work with health departments and preceding this study, we found that users spent a considerable amount of time searching for templates and adjusting them to fit health-related topics (authors' unpublished data). By providing a variety of health-focused templates, users can spend less time on changing designs or layouts and more time tailoring content and infographic data. Florence was also designed to focus on providing a range of health-related visual elements. With stock visual elements, it can be difficult to find visualizations that appropriately match the topic and audience. Offering a variety of health-related graphics allow PH nondesigners to choose images that are descriptive and appropriate. The technical description on the implementation and functionality of Florence are provided in Supplementary Appendix A.

MATERIALS AND METHODS

Phase three: setting and sample

To assess Florence's feasibility and usability, we conducted interviews in September 2021 and a think aloud and interview study in March 2022. The feasibility study included 8 participants identified from the participant pool in phase 1. As we desired at least 15 usability study participants and data were being collected during a uniquely busy time for PH

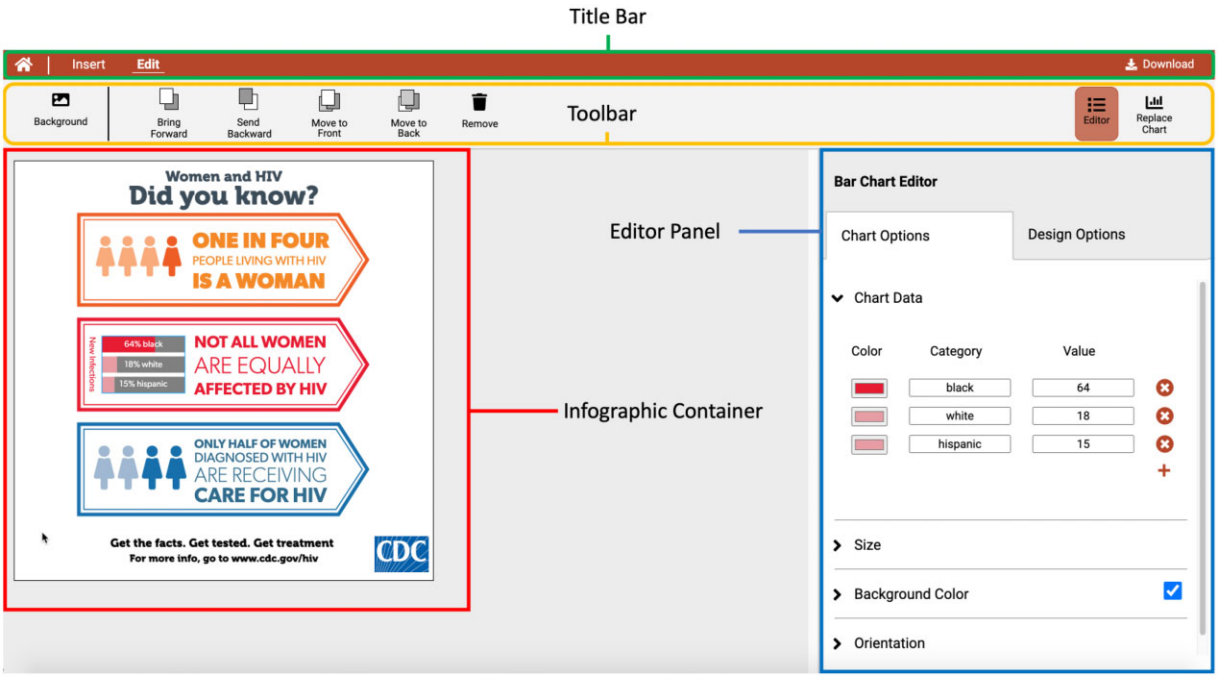

Figure 1. A screenshot of Florence's user interface when a bar chart has been selected. The title bar offers the overarching features of adding and editing elements. The toolbar is used for selecting an element type to add or changing the position of the element. The editor panel gets updated based on which element is selected on the infographic container. The infographic template on HIV was selected from a list of templates on the main page.

Table 3. Application of phase 1 key results and resulting Florence design decision

Key results	Representative quote	Design decision in Florence
PH professionals appear to lack the design expertise to create infographics (Familiarity)	"[I] can picture [the infographic] in my head clear as day . . . but then getting the actual thing to look like what's in my head, that's the technical piece and I am not great at that" (P9) "I feel uncomfortable with design, like what would be a professional picture, what would be the design that is needed for that realm of PH?" (P10)	Prebuilt editable templates available for use Number of ways to represent data reduced to only essential charts Visual complexity of chart types reduced
PH professionals want to create localized infographics (Quick and intuitive infographic creation)	"I can make it more relevant to the audience, especially if I know my audience. If someone at the national level prepared this data about us then I can probably present the same information but do it in a way that will resonate better with the community" (P2)	Bidirectional graph-text binding
PH professionals want a graphics library that is *expressive* but also *appropriate* (Health focused visual elements)	"[I]t's really difficult to find the right picture when you are trying to communicate risk in a colorful way without being too colorful or insensitive" (P7)	Health-specific graphics (clip art, icons, images, etc.) library included

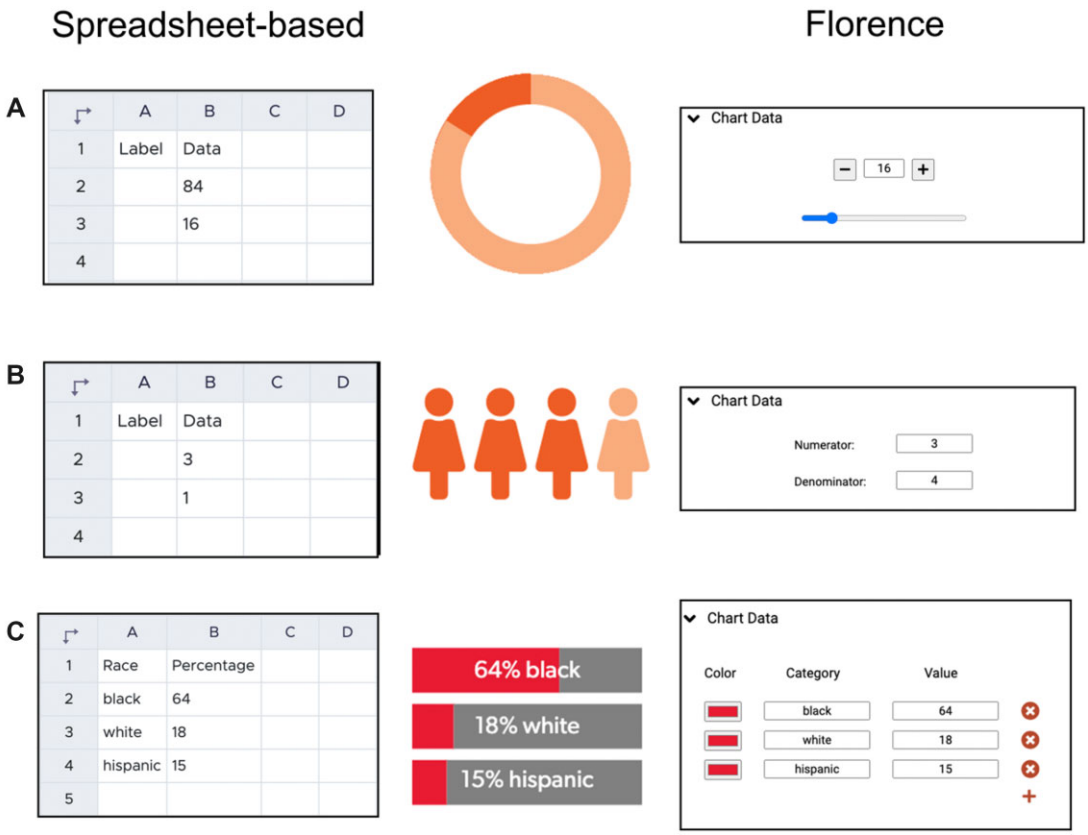

Figure 2. An image visually comparing spreadsheet-style data entry to Florence's method. (A) Data entry for pie/donut charts. (B) Data entry for icon arrays. (C) Data entry for bar charts.

professionals distracted by the pandemic, we identified proxy PH professionals from among nursing students focused on PH and from practicing health professionals with a PH focus (Table 1). Nurses are currently the largest proportion of the PH workforce, accounting for more than 20%, and have a similar level of training in design, making them an adequate PH professional proxy group.[8,42] The recruitment methods used and demographics were like phase 1. Both phase 3 activities were completed using Zoom video conferencing with participants receiving a $25 Amazon gift card.

Phase three: measures and procedures

Feasibility study interviews started with a presentation of a definition and examples of infographics and questions about their current experience with infographics, similar to the phase 1 interviews. Then we showed a video of Florence, demonstrating features and potential options in this tool for

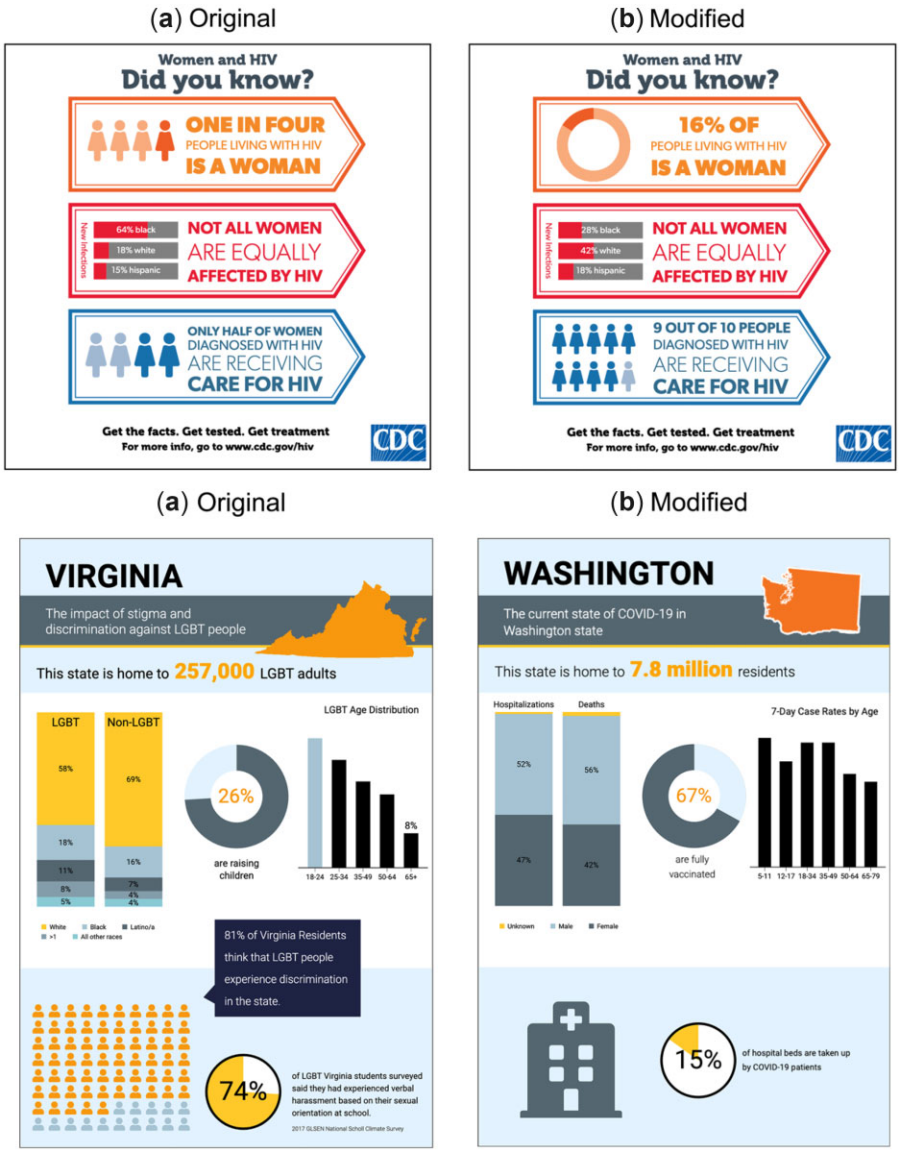

Figure 3. The infographic at the start of task (left) and after the participant has localized the data for Task 1 or changed the topic for Task 2 (right).

creating PH infographics. Participants were asked about additional features they wanted, the usefulness of such a tool, and potential benefits and challenges of using Florence.

The usability study's goal was to compare Florence's ease of use to Piktochart, an existing general design tool. Piktochart was used as a point for comparison since it offers various templates and multiple participants in phase 1 had used the tool. The usability study included 2 activities—a structured interview of their experience conducting tasks with Florence and an anonymous poststudy survey. We used a semistructured interview guide, beginning with a definition of infographics, questions on their current workflows, and a brief introduction to Florence. Participants completed 2 tasks that centered around basic features of the tool including inserting, removing, and modifying the visuals and data in the infographic. Supplementary Appendix B includes detailed descriptions of the evaluation activities. After the tasks, participants were asked which tasks were easiest and most difficult and why, and about desired features. Eight interview questions were adapted from the Questionnaire for User Interface Satisfaction and focused on assessing Florence's layout, organization, performance, and reliability.[43] Remaining questions compared Florence to Piktochart and had participants rate both tools' ease of use, strengths, and weaknesses. Each interview concluded with an anonymous Qualtrics survey that included questions from the Post-Study System Usability Questionnaire (PSSUQ). The PSSUQ is a quantitative validated questionnaire that consists of 16 items that cover 3 subsections of usefulness, information quality, and interface quality. Studies indicate the PSSUQ has excellent internal consistency (alpha of .97) and is a reliable measure (ranging from .83 to .96) for uncovering major and minor usability problems.[44] Scores use a 7-point Likert scale, where 7 is "strongly agree" and 1 is "strongly disagree." Both the subscales and overall scores are averaged into composite scores, with scores higher than 4 considered good usability.[45]

Phase three: data analyses

Feasibility interviews were analyzed through axial coding using the same analysis methods described in phase 1. For the

usability interviews, summative content analysis was used to measure and categorize each usability issue that arose. Summative content analysis begins with counting and quantifying content (or words) and moves to latent content analysis where the underlying meaning of the content is the focus. This approach is well suited to assessing transcripts as it examines frequency and patterns, along with discovering underlying meaning.[46]

RESULTS

Phase three: findings

Our 4 feasibility interviews were each approximately 60 min and usability tasks and interviews ($N = 19$) were approximately 45 min. Table 1 describes our participant sample.

Feasibility results

Overall, Florence was well-received by participants. Most of the difficulties reported by feasibility interview participants resulted from initial unfamiliarity with using new software and could be addressed with a simple tutorial or explanatory tooltips. Multiple participants noted that Florence would enable PH professionals to create an infographic rapidly, which would support the nature of their work. When asked to rate a *specific-to-PH* infographic webtool's usefulness in comparison to existing *general* infographic webtools on a 5-point Likert scale (1 = not useful, 5 = extremely useful), participants on average indicated that a PH-specific tool would be very useful (mean 4.6, $\sigma = 0.6$). The main expected benefit was that the tool would contain templates, features, and graphics directly related to PH. Participants also discussed the utility of having PH-specific elements available, rather than sorting through infographics templates for business or education and images unrelated to PH topics. Thus, feasibility interview results reinforced phase 1 results indicating more PH-specific visual resources should be made accessible for PH infographics.

Usability results

PSSUQ.

PSSUQ results indicated Florence is well designed, with good user satisfaction (Table 4). Strengths and weaknesses of Florence were identified from interviews and participants' behaviors and verbalized thoughts during the tasks. Of note, a characteristic identified as a weakness of Florence (eg, limited design features) was often a strength of Piktochart (eg, having a wide range of design features), and vice versa.

Strengths of Florence.

Florence's slight edge over Piktochart (Table 4) appeared to be from its simplified functionality and layout. Participants consistently mentioned that the simplicity of Florence provided a more intuitive and straightforward experience, when creating and updating an infographic. Participants also preferred Florence's data entry method. Most struggled with updating the values of visualizations in Piktochart due to the data entry interface. This contributed to Piktochart's higher difficulty score. Several participants indicated that Piktochart's interface could lead to undetected mistakes. This was apparent when 14 participants were not able to update an icon array without explanation. Conversely, no participants required explanations when updating chart data in Florence. Graph-text binding was also a valuable feature of Florence, where changing a text element (ie, data labels) would automatically update the associated visual element (eg, the length of the bars). Participants, thus, felt Florence offered more automated support. Given the simple data entry interface and graph-text binding, most participants ($N = 11$) reported that the easiest task to perform in Florence was updating the chart data. A few participants commented on the convenience of Florence's visual resources.

Table 4. Feasibility ($N = 4$) and usability ($N = 19$) evaluation results

Feasibility ratings for Florence	
Ratings	Mean ± SD
Ease of use[a]	1.75 ± 0.5
Usefulness of a PH specific tool[b]	4.60 ± 0.6
Poststudy system usability Questionnaire scores for Florence[c]	
Construct	Mean (SD)
System quality	6.3 (.76)
Information quality	5.4 (1.1)
Interface quality	6.1 (.80)
Overall	5.9 (.76)
Usability results	
Evaluation type	Mean ± SD
Task 1:	Time
Florence	5.84 ± 1.54
Piktochart	8.58 ± 3.01
Ease of use rating[a]	Score
Florence	1.94 ± 0.64
Piktochart	3.18 ± 0.95

[a] Score from 1 = easy to use to 5 = difficult to use.
[b] Score from 1 = not useful to 5 = extremely useful.
[c] Score from 1 = strongly agree to 7 = strongly disagree (16 items) with scores of >4 indicating good usability.

Weakness of Florence.

The strengths of Florence's simplified layout, proved to also limit its features for participants. Multiple participants discussed this tradeoff between design flexibility and complexity by stating that Florence's simplistic interface was the tool's greatest weakness as it was less visually appealing. Issues with its layout and text-editing system were identified as another clear weakness. More specifically, 8 participants had trouble with locating how to change category labels in the visualizations. To change the labels in Florence, participants had to select the "Design Options" tab in the editor panel; however, for many participants the name of the tab did not lead them to look there. This indicated the need to better group Florence's features and improves the naming of feature groups to be more intuitive and easily identifiable by PH nondesigners.

DISCUSSION

The phase 1 assessment of the infographic needs and challenges among PH professionals, identified that, despite the existence of infographic webtools, participants were generally using tools not specific to infographics, because of their familiarity and ease of use. Findings indicate localizing the textual and visual information for specific audiences they are trying to reach or inform was considered essential for PH infographics. Yet, it appears challenging for PH users to find

appropriate PH-specific infographic templates and health-related visual resources.

Advanced design tools for professional designers, such as Adobe Photoshop, offer an extreme amount of design flexibility, but have a steep learning curve. Yet, our results showed that even simple template-based design tools for nonprofessional designers making infographics can be overwhelming for PH nondesigners who have extremely limited time and minimal to no design background. Our findings show that design tools should use familiar layouts and functions to provide appropriate design flexibility with a lower learning curve. For example, infographics could be integrated into existing tools similar to the Design Idea feature in PowerPoint. More specifically, the tool could suggest infographic style layout when a mix of data, graphics, and text are present on a single slide. Supporting infographics in tools that PH professionals are most familiar with would reduce the burden of creating PH infographics, and in turn support more active use of infographics to inform the public.

The primary anticipated benefit of having a PH-specific infographic webtool was the inclusion of health-related visual elements. Our sample of PH professionals described often struggling to find appropriate visual elements that matched the health topic that they were working on. Recently, a free open-source repository of health icons was published to support global health projects.[47] We encourage the incorporation of such repositories in current design tools as well as the development of similar publicly available repositories of visual resources that both PH practice and prevention-focused researchers in academia could utilize. We further identified an opportunity in the emerging trend in health journals (eg, British Journal of Medicine) where the results are summarized as an infographic,[48] to increase recall and comprehensibility of the results.[49] Infographics in journals often contain original visual elements on health topics, but these elements are currently embedded on the infographic and shared as a single image file. This means that the individual graphic elements cannot be repurposed as a resource for practicing PH professionals. Furthermore, the increasing recognition that various forms of bias and stigma are frequently associated with certain health conditions (eg, suggesting that obesity is primarily a result of poor eating behaviors) only increases the need to ensure PH visualizations and infographic elements are user- and expert-informed to mitigate stigma. Thus, we encourage researchers to share their underlying graphic materials, in addition to their infographic templates, to benefit communities and create a pool of visual resources that can enrich infographics across health domains, particularly PH. Through transdisciplinary academic-community collaboration the shared goals of generating inclusive, useful health-focused design elements could be realized.

Lastly, 3 participants interviewed in phase 1 desired more audience involvement throughout the infographic creation process, as it is often difficult to judge an infographic's aesthetics or effectiveness in reaching one's audience. Ideally template design should be tested with members of the target audience and the audience engaged throughout the design process.[11] Alternatively, infographic webtools should at least incorporate a feature to collect feedback from the public by connecting with crowdsourcing platforms, where members of the community use collective intelligence to solve problems, often for a small cost per person. Brabham et al.[50] proposed the Peer-Vetted Creative Production approach in PH, using crowdsourcing. Using a similar framework, the infographic creator can ask crowdworkers to rate the aesthetic appeal of an infographic or answer factual questions based on the infographic to assess the infographic's comprehensibility. This allows for quick feedback and for tailoring messages, as the creator can select crowdworkers who represent their target viewers to promote an iterative design of the infographic. Future versions of Florence could consider integrating this into the tool. Another direction for future work is examining the accessibility of both the webtool and the infographics that it generates. Using recommended approaches to engage with diverse users with varied abilities in usability studies as well as when developing solutions to improve accessibility is important to ensure a usable system.[51,52] Of high importance in infographic development, the color palettes used should accommodate for individuals who have colorblindness. Additionally, incorporating data sonification would improve accessibility for individuals who have low-vision or blindness.[53] This area of future work is essential to ensure equitable access to public health tools and the infographics those tools generate.

LIMITATIONS

The generalizability of our findings is limited due to our small sample sizes. However, feasibility and user studies with small sample sizes are common in the field of Human-Computer Interaction, especially for studies involving health professionals,[54,55] and can serve as a basis for future work. Another limitation is the involvement of a different sample population for the third phase compared to first 2 phases. The nursing student participants may have lacked the professional expertise and perspectives of experienced PH professionals. Furthermore, the variations in age, technology and professional experience among our participants could have influenced the outcomes of each phase. An additional, larger user study with a diverse group of PH professionals is needed to assess differences across various age and experience groups and ensure that the tool is fully addressing the needs expressed in earlier phases. Furthermore, a future study with a larger group of participants from diverse locations and positions is needed to confirm the generalizability of the results. While our participants included professionals in various states with different public health governance, they were all from the Northwest US. Our study showed that effective PH messaging with infographics need to be tailored to specific audiences. Thus, involving PH professionals in other areas of the United States in future studies is critical for discovering how effective messages and infographics may vary by state and region.

CONCLUSION

Our study identified the current and desired workflows of creating PH infographics through an online survey and interviews with PH professionals. Since a limited number of PH organizations have infographics designers, most PH professionals in our sample had to create infographics themselves despite a lack of access to essential resources and specific tools needed to create effective infographics. This, combined with our participants feeling uncomfortable when designing infographics, led these PH professionals to desire a more supported way of creating infographics to tailor content to their local audiences. To address this, we iteratively designed an

infographic webtool—Florence—to meet these needs. Participants found Florence easy to use and anticipated that it would be more useful compared to general infographics webtools, as it offered health-related graphics and templates. Participants were also enthusiastic about the graph-text binding feature. While further efforts to build solutions for PH professionals to communicate effectively with their communities are needed, our study suggests that "less can be more" in building design tools for PH professional nondesigners and highlights the importance of health-related visual resources for creating PH infographics.

FUNDING

This work was funded in part by the Department of Health and Human Services, Office of the Assistant Secretary for Health (grant number 1 CPIMP171144-01-00).

AUTHOR CONTRIBUTIONS

H.K. and U.B. together developed the concept of the paper and the studies; H.K. and R.C. designed and conducted the studies, analyzed the data, and contributed to the writing of the manuscript; B.H. provided feedback on the study designs and contributed to the writing of the manuscript; and B.B. contributed to the writing and revision of the paper.

SUPPLEMENTARY MATERIAL

Supplementary material is available at *Journal of the American Medical Informatics Association* online.

ACKNOWLEDGMENTS

We would like to thank the members of the SHARE-NW: Solutions in Health Analytics for Rural Equity team who supported this study: Melinda Schultz and Greg Whitman.

CONFLICT OF INTEREST STATEMENT

None of the authors have any competing interests to disclose.

DATA AVAILABILITY

The data underlying this article will be shared on reasonable request to the corresponding author.

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