

## **Integrating and Producing Evidence through Participatory Design**

Journal:	<i>CoDesign</i>
Manuscript ID	NCDN-2021-0010.R3
Manuscript Type:	Original Paper
Keywords:	participatory design, codesign, evidence, public health, HIV

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## Integrating and Producing Evidence through Participatory Design

Participatory Design (PD) is increasingly applied to tackle public health challenges, demanding new disciplinary collaborations and practices. In these contexts, any proposed intervention must be supported by evidence that demonstrates it is likely to have the desired effect, particularly if it relies on investment of public funds. An evidence base can include evidence and theory from prior research, evidence generated through primary research, and evaluation. PD research generates evidence through collaboration directly with people who may use or receive an intervention, understanding their experiences and aspirations in situated contexts, without using formal abstractions or assuming evidence generated elsewhere will be directly applicable. Drawing on a case study of a collaboration with public health experts to develop an intervention using PD, we argue there is value in using existing evidence and theory to engage, inform and inspire intended users of an intervention to participate in the design process. This article aims to support PD researchers and practitioners to consider how evidence can be integrated and produced through PD, enabling collaboration with other disciplines to produce evidence-based and theory-informed interventions to address complex public health challenges.

Keywords: participatory design; social design; codesign; evidence; public health; HIV

### 1. Introduction

Participatory Design (PD) is increasingly applied in public health contexts (Driedger et al. 2007), where healthcare systems and policy makers struggle to manage increasing demand due to ageing demographics, increased prevalence of long-term conditions and communicable diseases (WHO 2020). These challenges require new ways of encouraging citizens to change their behaviour, which requires the combined expertise of behavioural science, medical and design communities (Mummah et al. 2016).

Design places value on *innovative* ideas that fulfil unmet needs; public health places importance on *proven* methods supported by rigorous evaluation. The process for *designing* new interventions is largely missing from intervention development guidance to date (Rousseau et al. 2019). Given the many persistent and complex public health

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3 challenges societies face, there is a role for design in developing innovative solutions  
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7 (Rousseau et al. 2019; Bazzano and Martin 2017).  
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10 Ethical concerns are inherent in efforts to influence behaviour (Faden 1987;  
11  
12 Niedderer et al. 2014), with potential to impinge on citizens' rights, control or  
13  
14 responsibility, raising the question of who determines desirable behaviour. Concerns  
15  
16 can be mitigated by involving people whose behaviour is being targeted for change in  
17  
18 intervention design, providing the opportunity to validate the applicability of evidence  
19  
20 to the local context (O'Brien et al. 2016). Integrating stakeholder involvement in  
21  
22 intervention development is recommended (Oliver et al. 2004); public health  
23  
24 researchers are increasingly collaborating with PD researchers to achieve this (Bowen et  
25  
26 al. 2013). Integrating PD within intervention development enables insights gained from  
27  
28 prior evidence to be aligned with input from people with lived experience (Hagen et al.  
29  
30 2012). However, there is a need to consider how to integrate evidence and theory as  
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32 inputs to PD and how evidence generated is documented and weighed alongside other  
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34 forms of knowledge (Moffatt et al. 2006).  
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40 PD is premised on active and democratised participation of intended users of a  
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42 design, without making assumptions based on prior knowledge, and is underpinned by a  
43  
44 process of mutual learning (Bratteteig et al. 2013). By collaborating with users and  
45  
46 stakeholders as experts of their knowledge and '*experience domain*' (Sleeswijk Visser  
47  
48 2009), authentic understandings of their contexts and challenges can be shared in  
49  
50 parallel to being empowered to play a central role in the design process. This situation-  
51  
52 specific perspective suggests evidence and theory generated elsewhere may not be  
53  
54 applicable (Luck 2018) and designs produced through PD may not be transferable to  
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56 other contexts (Frauenberger et al. 2015). However, public health interventions aim to  
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3 impact at a population level, hence the need to understand how local PD participants'  
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5 views relate to the wider evidence base.  
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8           This article begins by exploring how designers and PD researchers currently use  
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10 prior evidence as *inputs* to their design processes, and how evidence produced as  
11  
12 *outputs* are communicated. We present a case study from an interdisciplinary project  
13  
14 that incorporated PD to develop a social marketing intervention to encourage regular  
15  
16 HIV testing. The approach used was based on learning from previous multidisciplinary  
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18 intervention development projects (e.g., O'Brien et al. 2016; Macdonald et al. 2012),  
19  
20 where PD practice was adapted to use evidence produced by collaborators from other  
21  
22 disciplines, and in return to generate evidence through PD that is of value to  
23  
24 intervention development. We reflect on the value of integrating prior evidence and  
25  
26 theory within PD, and generation of evidence through PD, to provide insights to support  
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28 PD's application in tackling public health challenges.  
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## 45 **2. Integrating evidence and theory in PD**

### 46 **2.1 *Inputs: Evidence***

47  
48 PD practice often begins with contextualisation. This may include literature review,  
49  
50 primary research or collaboration with subject experts to understand and frame a  
51  
52 challenge and determine the best way to engage participants in the design process. This  
53  
54 insight gathering is not intended to be exhaustive and would rarely be considered an  
55  
56 output of research in its own right, in comparison with evidence-gathering processes  
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3 used by public health researchers.  
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5 While we acknowledge many PD practitioners may use prior evidence within  
6 their process, we found limited examples of practice reported in this way. Hagen et al.  
7 (2012) propose *design artefacts* and tools to integrate prior evidence with insights  
8 generated through PD for intervention development. Design artefacts “*capture and*  
9 *communicate research findings in accessible ways*” (ibid, page 7) as e.g., personas and  
10 design guidelines, enabling a shared language for discussion among participants with  
11 lived experience, health professionals and designers. Artefacts are both *inputs* and  
12 *outputs* of design processes as they are iteratively validated and developed throughout.  
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24 Design artefacts and tools are widely discussed in PD literature, however we  
25 found limited examples explicitly describing tools integrating prior evidence.  
26 Experience-Based Co-Design (EBCD) is the most widely used approach in health  
27 contexts, offering a process for involving patients with lived experience of accessing a  
28 health service in codesigning improvements (Donetto et al. 2015) and interventions  
29 (Tsianakas et al. 2015). EBCD uses filmed narratives of patients’ health service  
30 experiences as ‘triggers’ for dialogue between patients and staff (Bate and Robert  
31 2006). Originally films featured patients involved in the project; it was successfully  
32 adapted to use films from prior research to accelerate the process (Locock et al. 2014).  
33 Villalba et al. (2019) translated evidence derived from literature review into ‘Health  
34 Experience Insight Cards’. The cards enabled health professionals to make practical use  
35 of experiences described in literature, directing discussion around real-life challenges to  
36 identify redesign opportunities.  
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## 54 **2.2 Inputs: Behaviour Change Theory**

55 Design theory offers models (Niedderer et al. 2014) and processes that support  
56 designers to apply theory from behavioural sciences within design processes (Cash,  
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1  
2  
3 Hartlev, and Durazo 2017). This includes toolkits (Hermsen, Renes, and Frost 2014)  
4  
5 and design exemplars illustrating how theory has been applied in practice (Lockton,  
6  
7 Harrison, and Stanton 2010).  
8  
9

10 Van Essen et al. (2016) propose integrating Behaviour Change (BC) theory to  
11  
12 increase design effectiveness and provide a rationale for design decisions that builds a  
13  
14 convincing case for commissioners. They caution the need to ensure integration of  
15  
16 prescriptive theory does not hamper the creative process by limiting the freedom of  
17  
18 designers to experiment and ‘*drift*’ (Gall Krogh et al., 2015), encouraging reflexive  
19  
20 modes of inquiry.  
21  
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23 While acknowledging theory can be generalised and abstract, Poggenpohl and  
24  
25 Sapo (2009) assert that theory can be ‘*building blocks*’ from which better design  
26  
27 emerges, suggesting designers ‘*erase the mistaken notion that systematic knowledge*  
28  
29 *and creativity are at odds*’ (ibid, page 10).  
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33 While the toolkits highlighted above were developed for designers to use within  
34  
35 their practice, they can be used with participants in a PD process. O’Brien et al. (2016)  
36  
37 created a deck of cards with simplified descriptions of BC techniques found effective in  
38  
39 supporting people in retirement to undertake regular physical activity. Retired people  
40  
41 sorted through the cards to determine which techniques might be appropriate for the  
42  
43 local context. However, the theoretical techniques were too abstract for participants to  
44  
45 grasp; introducing BC techniques through prototypes later in the process allowed  
46  
47 participants to provide critique.  
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50  
51 Hermsen et al. (2016) describe challenges in integrating theory from behavioural  
52  
53 sciences in design processes due to the ‘inaccessibility’ of scientific knowledge. They  
54  
55 highlight difficulties for designers in selecting appropriate theory due to lack of  
56  
57 awareness of latest developments or a tendency to ‘*cherry pick*’ theory that suits their  
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3 purposes regardless of conflicting evidence. They describe how designers tend to use  
4 evidence and theory as inspiration early in the design process but revert to ‘*gut feelings*’  
5  
6 to develop and evaluate emerging design ideas that may conflict with prior evidence.  
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### 10 11 **2.3 Outputs: Producing evidence and theory**

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14 Evidence generated through PD is often embodied in collaboratively produced  
15 prototypes (Hagen et al. 2012). Prototypes can integrate different types of information,  
16 embody theory and form a hypothesis to be tested (Koskinen et al. 2011). Creating  
17 prototypes can generate knowledge, however this depends on careful documentation to  
18 ensure insights ‘*do not disappear into the prototype, but are fed back into the*  
19 *disciplinary and cross-disciplinary platforms that can fit these insights into the growth*  
20 *of theory*’ (Stappers 2007, page 87). Explicit focus on theory and evidencing design  
21 choices ‘*does not rule out tacit moves or aesthetics; it is not an either/or situation but*  
22 *an intelligent understanding and integration of the two*’ (Poggenpohl and Satō 2009,  
23 page 6). Design is criticised for being slow to develop, position and argue for the  
24 transferable knowledge it generates (Poggenpohl and Satō 2009). Limitations in  
25 documentation and descriptions of how design has been applied prevent wider  
26 application, particularly in public health contexts (Bazzano and Martin 2017).  
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44 The design rationale (MacLean, Young, and Moran 1989) accompanying a  
45 prototype needs to articulate options considered and reasons for choices. Frauenberger  
46 et al. (2015) argue rigour and accountability in PD are nuanced concepts, differing from  
47 other fields due to the ‘*messy*’ nature of the process. The need for ‘*hard evidence*’ of  
48 design decisions and any claim to the generalisability of findings do not align with PD’s  
49 underpinning philosophy (ibid). Frauenberger et al. (2015) propose rigour is achieved  
50 through critical reflection, using appropriate language to communicate judgements and  
51 process.  
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3           Within intervention development, there is an imperative to undertake robust  
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5 evaluation to evidence that the proposed intervention addresses the challenge identified  
6  
7 (Skivington et al. 2021). Designers evaluate prototypes but rarely document or  
8  
9 communicate the knowledge gained (Stappers 2007). Finished designs are typically  
10  
11 handed over to be implemented by domain experts, with designers rarely involved in  
12  
13 evaluation (Bazzano and Martin 2017).  
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17           It is necessary to consider how PD processes and the evidence generated are  
18  
19 communicated to support implementation, particularly when collaborating with other  
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21 disciplines where evidence generated through PD needs to integrate with other forms of  
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23 knowledge.  
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### 26 27 28 **3. Case Study**

#### 29 30 31 **3.1 Context**

32  
33 Social marketing can be effective in changing HIV testing behaviour (McDaid et al.  
34  
35 2019), bringing together methods from behavioural theory, persuasion psychology and  
36  
37 marketing science to design the appropriate delivery and marketing mix (place, price,  
38  
39 product and promotion) of health behaviour messages, based on an understanding of  
40  
41 how these messages may be interpreted by viewers (Evans 2006). Within social  
42  
43 marketing development, few studies report formative or pre-testing of interventions  
44  
45 with intended recipients (Noar et al. 2007), despite evidence it increases likelihood of  
46  
47 impact (Stead et al. 2007).  
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50  
51           Within this context, public health and PD researchers collaborated on a series of  
52  
53 interrelated projects that produced an evidence-based and theory-informed social  
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55 marketing intervention brief to commission an intervention to encourage regular HIV  
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57 testing.  
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## 3.2 Methods

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6 Firstly, a systematic review (SR) was conducted of published evaluations of  
7  
8 international social marketing interventions to encourage men who have sex with men  
9  
10 (MSM) to undertake HIV testing (see McDaid et al. (2019) for a full description of the  
11  
12 SR). Interventions were analysed using social marketing (Hastings 2007), social  
13  
14 semiotic (Jewitt and Oyama 2001) and behaviour change (Michie et al. 2013) theories,  
15  
16 translated into data extraction tools enabling content analysis which identified  
17  
18 consistent aspects of effective interventions (Flowers et al. 2019; Riddell et al. 2020).  
19  
20 Evidence generated informed an intervention development project integrating a series of  
21  
22 PD workshops (described here) with intervention Optimisation Workshops exploring  
23  
24 views on theory and application (involving PD workshop participants and health  
25  
26 professionals who deliver and manage sexual health services). The academic team  
27  
28 included PD researchers and social scientists with expertise in sexual health, alongside  
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30 health improvement practitioners from the sexual health service commissioning the  
31  
32 intervention.  
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38 Sixteen potential intervention recipients were recruited into two phases of PD:  
39  
40 Exhibition Workshops and a Codesign Workshop. Social scientists led recruitment  
41  
42 through existing networks, targeting a diverse mix of gay, bisexual and other MSM.  
43  
44 Participants were given a £40 voucher for each workshop they attended. Workshops  
45  
46 were audio recorded.  
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### 3.2.1 The Exhibition Workshop

51  
52 The first workshop was conducted three times with different groups (of 4 to 6  
53  
54 participants) to enable depth of discussion while permitting a diverse group totalling 14  
55  
56 MSM participants. Two PD researchers and one social scientist facilitated each session.  
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3 A health improvement expert joined one session.  
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5 An icebreaker activity introduced the context of social marketing, inviting  
6 participants to share an example of a marketing intervention that resonated with them.  
7  
8 The second activity aimed to sensitively discuss HIV testing and the specific BC the  
9 proposed intervention was trying to achieve. Four statements distilled from prior  
10 research (Flowers et al. 2017) were printed on a sheet as prompts, representing different  
11 reasons why people do not undertake HIV testing, alongside corresponding  
12 demographics (see Figure 1). For each statement, participants were asked to suggest  
13 possible barriers and facilitators for HIV testing. PD researchers recorded the discussion  
14 on the sheet.  
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25  
26 [Figure 1 near here]  
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28 The third activity sought to understand participants' preferences and  
29 requirements for interventions. It aimed to build awareness and confidence in critiquing  
30 social marketing through exposure to different design strategies and theories. An  
31 exhibition of intervention materials from the SR was curated. From nineteen analysed  
32 studies, visual materials from eleven were selected to showcase a range of different  
33 approaches. Intervention visuals were displayed on easels, wall-mounted shelves, a  
34 tablet computer (web-based intervention) and a TV screen (video-based interventions)  
35 (see Figure 2). Each intervention had a placard explaining: country of origin, mode of  
36 delivery, applied design strategies and theories; initially concealed to avoid influencing  
37 participants' first impressions, which they discussed as a group. The facilitator read out  
38 the information on the placards, and participants discussed their views. Finally,  
39 participants were asked if they thought the intervention would encourage them to test  
40 more frequently before a sticker was removed to reveal whether the intervention was  
41 found to have achieved effective BC. The 'reveal' was intended to keep the activity  
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3 engaging, reminiscent of a game. Each workshop finished with a group discussion of  
4 participants' overall impressions of the interventions and any conflicting preferences.  
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7 [Figure 2 near here]  
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10 Workshop data (transcribed from annotated materials verified for completeness  
11 using audio recordings) were analysed using design questions (see Table 1). Questions  
12 were based on the data extraction tool created for the SR (Riddell et al. 2020), which  
13 drew on social semiotic theory to deconstruct prior interventions' design decisions and  
14 components. Findings from each workshop were tabulated and campaign attributes  
15 highlighted by participants as desirable in all three workshops were identified, alongside  
16 any attributes that provoked differences of opinion. This process resulted in *design*  
17 *principles* from participants' commonly agreed attributes and *conflicting requirements*.  
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28 [Table 1 near here]  
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### 32 3.2.2 CoDesign Workshop 33 34

35 In the Codesign Workshop, 13 GBMSM participants (11 who took part in the  
36 Exhibition Workshop and two new participants) used bespoke design tools underpinned  
37 by BC techniques and design questions (see Table 1) to design social marketing  
38 interventions.  
39  
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44 An icebreaker activity invited participants to introduce themselves and reflect on  
45 the interventions critiqued in the Exhibition Workshops (on display), highlighting one  
46 memorable intervention. Three statements used in the previous workshops were  
47 reintroduced (see Figure 1), and participants were asked to choose a statement that  
48 resonated with them. This split participants into three groups, each supported by a PD  
49 researcher and a sexual health expert. The statements were then used as prompts for the  
50 groups to build personas based on their collective experiences without explicitly talking  
51 about themselves.  
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3 The design principles and conflicting requirements distilled from the Exhibition  
4  
5 Workshops were introduced to stimulate discussion among the groups. The design  
6  
7 activity was structured using questions (see Table 1) printed on a tool (see Figure 3),  
8  
9 which the PD researcher annotated to capture the conversation. BC techniques  
10  
11 identified in the SR were printed on cards (see Figure 4), supported by applied examples  
12  
13 drawn from the Exhibition Workshops. A storyboard template asked participants to  
14  
15 think through how their persona would engage with the intervention and its behavioural  
16  
17 impact. PD researchers supported participants to create a visual prototype of their  
18  
19 intervention (see Figure 5).  
20  
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23  
24 [Figures 3 and 4 near here]  
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26

### 27 **3.3 Intervention Designs**

28  
29  
30 ‘Join the Testing Revolution’ aimed to change behaviour by emphasising collective  
31  
32 responsibility and caring for others through personally committing to regularly testing.  
33  
34 This included the message that through regular testing, HIV could be eradicated.  
35  
36 Participants wanted to target a broader audience beyond MSM, so the intervention  
37  
38 featured a diverse friendship group with various genders, ethnicities, and body types.  
39  
40 The intervention would be delivered as posters on public transport, social media and in  
41  
42 pubs over an extended period, with QR codes to provide more targeted information.  
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46  
47 [Figure 5 near here]  
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49  
50 ‘C’Mon Test’ [local slang meaning Come on, Test] provided a light-hearted way  
51  
52 of conveying the need for regular testing, alongside practical information on where and  
53  
54 how to test. Posters featured a running dialogue between two characters, visually similar  
55  
56 to social media messaging. The intervention was longitudinal, with the characters’ story  
57  
58 and relationship unfolding over a series of iterations. Placing posters in public places  
59  
60 (rather than targeting only venues GBMSM were likely to be), participants aimed to

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2  
3 remove the stigma of HIV testing by communicating the positive consequences of  
4  
5 knowing your status.  
6

7  
8 The third intervention (untitled) provided a message of hope for those who may  
9  
10 be afraid of a potential diagnosis, represented by imagery of a hand reaching out.  
11  
12 Messages were intended to dispel existing deep-rooted beliefs around HIV, using  
13  
14 relatable examples of real testing experiences and a reassuring tone of a positive  
15  
16 outcome regardless of the test result (i.e., focus on treatments available). The  
17  
18 intervention was suitable for various settings (e.g., schools, prisons and community  
19  
20 venues), thus normalising testing without emphasising the risk to specific populations.  
21  
22 Interestingly this group contained older participants than in other groups, with lived  
23  
24 experience of negatively framed social marketing interventions in the 1980s (Kershaw  
25  
26 2018).  
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### 30 31 32 **3.4 Analysis and Integration** 33

34  
35 Data from the Codesign Workshop included the transcribed workshop tools, audio  
36  
37 recordings (used to check for additional content not annotated on tools), and prototypes.  
38  
39 Each PD researcher produced a narrative description of their group's intervention,  
40  
41 including the rationale for design decisions. Transcribed tools were tabulated by  
42  
43 question so responses across groups could be compared, and intervention designs were  
44  
45 compared to the design principles and conflicting requirements distilled from Exhibition  
46  
47 Workshops. Validated design principles and new design requirements common to the  
48  
49 groups were combined to form a list of undisputed requirements (Figure 6). All but one  
50  
51 of the conflicting requirements were resolved, as the groups made the same decisions  
52  
53 about what would work best in practice, as evidenced in their intervention designs. The  
54  
55 remaining conflict was whether the intervention should explicitly target MSM. Two  
56  
57 groups chose to target the general population to avoid stigmatising MSM as at risk of  
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3 HIV, with one group explicitly targeting MSM. This was resolved through discussion in  
4  
5 the Optimisation Workshops, resulting in this requirement within the intervention brief:  
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9 *Intervention materials should provide clear information about the*  
10  
11 *consequences of undiagnosed HIV infection and HIV transmission*  
12  
13 *risks; this should be conveyed in ways which do not stigmatise all*  
14  
15 *MSM and clarify that it is behaviours and not identity that confers*  
16  
17 *HIV risk.*  
18  
19

20  
21 Social scientists conducted secondary analysis of tabulated data and narrative  
22  
23 descriptions to identify: i) marketing mix key components: product, place, promotion  
24  
25 and price, producing a narrative summary, ii) BC techniques applied (using the itemised  
26  
27 BC Taxonomy devised by Michie et al. (2013)). Individual BC techniques and  
28  
29 examples of their application identified from the SR and PD findings were discussed by  
30  
31 health practitioners and MSM to explore acceptability, viability and optimal application  
32  
33 in Optimisation Workshops. These workshops additionally gathered data on systemic  
34  
35 barriers and facilitators to implementation.  
36  
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38  
39 [Figure 6 near here]  
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41  
42 Consistent use of three underpinning theories (social marketing, social semiotics  
43  
44 and BC) enabled data to be integrated and compared. This highlighted differences  
45  
46 between the SR and PD findings (McDaid et al. 2019; Langdridge et al. 2020; Riddell et  
47  
48 al. 2020). PD participants' negative views of explicitly sexual and naked imagery (i.e.,  
49  
50 they disliked these interventions and thought this kind of imagery would not encourage  
51  
52 BC) could be viewed as contradictory considering their common use in interventions  
53  
54 judged as effective within existing literature. In addition, participants disliked  
55  
56 interventions that included stereotypes of MSM or used attractive actors with unrealistic  
57  
58 physiques, despite these interventions being judged effective in previous studies.  
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### 3.5 Output

Findings of the SR, Exhibition, Codesign and Optimisation workshops, all underpinned by social marketing, social semiotic and BC theories, were integrated into an evidence-based and theory-informed brief for commissioning. The brief described: background and research process, overall requirements (including behavioural goal, tone, mode of delivery, visual design, placement, duration), detailed intervention requirements, and issues for implementation. Based on the insight gained on PD participants' varying HIV literacy and the idea proposed in the 'C'Mon' test prototype, a sequential intervention was outlined, aiming to build knowledge over time, with detailed proposed content for each stage. The brief was subsequently translated into an invitation to tender by health improvement specialists from the service, and a design agency was commissioned.

## 4 Discussion

Our discussion will consider how evidence was integrated through activities and tools, reflecting on the resulting impact on participation and the outputs of PD and the interdisciplinary process.

### 4.1 Validating the evidence base for the local context

Exhibition Workshops invited participants to share their knowledge of the context and critique interventions from the SR. This was carefully framed, explaining that placards contained researchers' interpretations, and we sought their views as experts in the context. This missing perspective was identified as a limitation of the SR, in that the researchers were not representative of the intended recipients (McDaid et al. 2019).

PD participants' negative views on the use of explicitly sexual and naked imagery, stereotyping and attractive models may reflect that 12 of the 19 interventions reviewed were from outside the UK, from 2009-2016, which may not be in line with

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2  
3 local participants' current views. Design process and rationale for interventions were  
4  
5 rarely reported, leaving us unable to determine if consistent use of these aspects in prior  
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7 interventions was due to evidence of effectiveness (e.g. through pre-testing with  
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9 intended recipients comparing sexualised and non-sexualised imagery), assumed  
10  
11 effectiveness because of common use, or a lack of originality (see Langdridge et al.  
12  
13 (2020) for a more nuanced discussion on the use of sexualised imagery in  
14  
15 interventions). Our PD findings are supported by Drumhiller et al. (2018), who found  
16  
17 MSM prefer images that are not identifiable as MSM to avoid stigmatising this group as  
18  
19 solely affected by HIV.  
20  
21  
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23  
24 This highlights the value of integrating PD outputs with other forms of  
25  
26 knowledge generated during intervention development and the importance of including  
27  
28 PD as one component of a multi-stage, multi-method design. SR findings were *filtered*  
29  
30 through PD, outputting validated, updated and supplemented evidence. Optimisation  
31  
32 Workshops gave a further opportunity to iterate findings, discussing contradictory  
33  
34 evidence with all stakeholders to determine where priority should be given. The multi-  
35  
36 stage process enabled evidence outputs from each stage to form inputs to the next,  
37  
38 resulting in an iterated and integrated evidence base validated for the local context.  
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#### 43 ***4.2 Making complex evidence and theory tangible, engaging and informative***

44  
45  
46 The exhibition of intervention materials made complex theory tangible through applied  
47  
48 examples. This resonates with the challenge O'Brien et al. (2016) found in conveying  
49  
50 BC theory to participants, however our example illustrates a way to achieve this before  
51  
52 codesign activities. Participants responded well to the activity's playful nature; the  
53  
54 'reveal' (of whether the intervention was effective) engaged participants in a rich  
55  
56 discussion about whether strategies used in other countries would work for them.  
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1  
2  
3 Involvement of team members with sexual health expertise in the workshops  
4 was vital in answering participants' questions and clarifying misconceptions or  
5  
6 uncertainties around HIV testing and prognosis. It was an opportunity to appreciate the  
7  
8 wide variation in existing knowledge about HIV: the key insight inspiring the sequential  
9  
10 intervention design concept. Wider team involvement in the workshops gave them  
11  
12  
13 experience of the PD process: witnessing how engaged participants were and  
14  
15  
16 understanding the discussion's nuance and the resulting designs' rationales.  
17  
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### 20 21 **4.3 Building confidence and critique**

22  
23 Reflecting on the efficacy of the Exhibition Workshop format, this initial stage of  
24  
25 mutual learning (Bratteteig et al. 2013) provided participants with a space to consider  
26  
27 their preferences concerning design strategies and theory and gave them a shared  
28  
29 language and reference points to enable collaboration in the Codesign Workshop.  
30  
31 Researchers shared technical knowledge about different design strategies drawn from  
32  
33 the SR, and participants related this to their own lived experiences to articulate their  
34  
35 design requirements. The decision to repeat workshop one with three smaller groups  
36  
37 was crucial for nurturing this capacity building and developing participants' confidence  
38  
39 in an intimate environment. By separating the Exhibition and Codesign activities into  
40  
41 two distinct stages, participants had time to reflect on what they had seen and learned  
42  
43 before implementing this knowledge in a codesign setting.  
44  
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48  
49 By introducing prior evidence, it could be argued we led participants rather than  
50  
51 being open to their views and ideas. Participants' perspectives take precedence; where  
52  
53 this is made clear to participants through careful facilitation, prior evidence can be  
54  
55 useful to open up and deepen debate. Furthermore, it provided participants with an  
56  
57 opportunity to share fresh insight or dispute the validity of evidence generated in other  
58  
59 contexts. The facilitator needs to encourage this kind of critique, presenting evidence  
60

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2  
3 with the caveat that it may or may not be relevant. We would argue evidence  
4  
5 empowered participants rather than led them. By informing them about different design  
6  
7 strategies and theories, advising about practicalities and latest advice about testing, and  
8  
9 breaking down the process into clear steps, participants were empowered to design  
10  
11 interventions.  
12  
13

14 PD was not intended to produce the final design, instead being used to elicit  
15  
16 requirements. It could be argued intended intervention recipients should be involved in  
17  
18 PD following development of the evidence-based and theory-informed brief. We argue  
19  
20 this earlier participation is vital to validate the evidence base for the local context and  
21  
22 ensure intended recipients have a role in setting the agenda.  
23  
24  
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#### 28 ***4.4 Integrating the outputs of PD with other forms of knowledge***

29  
30 Three underpinning theories (BC taxonomy, social marketing, social semiotics)  
31  
32 functioned as '*anchoring mechanisms*' (Hermsen et al. 2016) and ensured the findings  
33  
34 of each stage could be separated into their component parts and consistently compared.  
35  
36 There is concern in the design field that this approach from behavioural science is  
37  
38 reductionist, oversimplifying complex acts to establish the influence of single factors  
39  
40 (ibid). This difference in perspective can be seen in the approaches used in Codesign  
41  
42 and Optimisation Workshops: participants considered intervention design holistically  
43  
44 during codesign and discussed BC techniques separately during the Optimisation  
45  
46 Workshops. While designers are comfortable with the *messiness* of the design process  
47  
48 (Frauenberger et al. 2015), theory can provide structure to make it more accessible to  
49  
50 collaborators from other disciplines (Hermsen et al. 2016). Working collaboratively  
51  
52 with social scientists ensured robust theory selection and supported theory to guide  
53  
54 development and evaluation of emerging design ideas (ibid).  
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3 As described by Hagen et al. (2012), evidence and theory-informed design  
4 artefacts created as inputs for PD workshops (e.g., the exhibition placards and BC  
5 cards) also evidence what was considered and taken forward (or not) into codesigned  
6 intervention prototypes, and how design decisions were informed by theory and prior  
7 evidence. In hindsight, including design artefacts and prototypes as outputs alongside  
8 the brief may have been of value to design agencies in understanding and responding to  
9 the brief, and to demonstrate the robustness of the process to support investment.  
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#### 20 ***4.5 Validating Constraints***

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23 Despite the importance placed on evidence in intervention development, it will always  
24 need to be weighed alongside current constraints of financial, staff and service resources  
25 to ensure the service can deliver the intervention. Working in partnership with the  
26 sexual health service commissioning the intervention from the outset ensured the brief's  
27 feasibility. Service constraints were explored with participants in the final stage of  
28 Optimisation Workshops; however, we reflect that just as prior evidence needed to be  
29 validated by intended intervention recipients, constraints should have been introduced  
30 and discussed prior to codesign, allowing participants to understand and challenge them.  
31 Introducing constraints requires the same careful consideration as prior evidence and  
32 theory, to ensure they inspire rather than hamper creativity (Gall Krogh et al., 2015).  
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#### 48 ***4.6 Limitations***

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50 While this case study provides an example of how evidence and theory can be applied  
51 in PD research and reflections of researchers on the value this brought, comparative  
52 research would be required to conclude whether this results in enhanced outcomes from  
53 PD.  
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## 5 Conclusions

As PD is increasingly applied in public health contexts, it is necessary to consider how to draw upon and generate compelling evidence to demonstrate to funders, policy makers and practitioners that proposed intervention designs will have the desired outcomes. This article demonstrated how evidence and theory can be applied in PD, and considered the value this brought in validating an evidence base locally, engaging and informing participants, building confidence, and providing a shared language for codesign. We reflected on the value of theory to support integration of evidence produced through PD with other forms of knowledge, how the multi-stage, multi-method approach resulted in an iterated and integrated evidence base, and how design artefacts can evidence the robustness of the process.

While the tools and activities presented are bespoke to the context, this article offers researchers possible strategies to draw on prior evidence and theory within PD. There is an opportunity to further debate using and producing evidence through PD. Given the pressing need for innovation in tackling complex public health challenges, new approaches that involve people with lived experience alongside published knowledge of what can work are vital. By collaborating with and learning from other disciplinary perspectives, we can strengthen PD approaches and secure investment for implementation.

## Acknowledgments

This study was funded by Scottish Government Chief Scientist Office (CSO) under Grant CGA/17/27. Julie Riddell and Lisa McDaid were funded by the UK Medical Research Council (MRC) and Chief Scientist Office at the MRC/CSO Social & Public Health Sciences Unit, University of Glasgow (grant number MC\_UU\_12017/11, SPHSU11; MC\_UU\_12017/12, SPHSU12; MC\_UU\_00022/3, SPHSU18). We would like to thank our workshop participants

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3 for sharing their experiences and ideas. Ethical approval for the codesign was granted from the  
4 University of Glasgow Ethics Committee (application no. 400170069).  
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## 7 **Disclosure**

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10 No potential competing interest was reported by the authors.  
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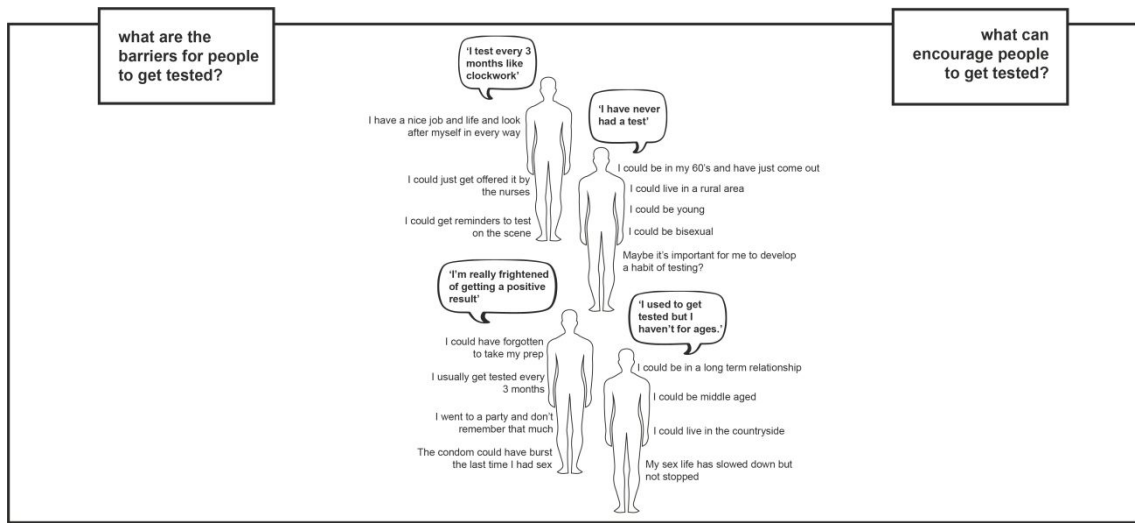
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Table 1: Design questions distilled from the systematic review

<i>Question</i>	<i>Sub Question</i>
Who?	Tell us more about the person and their life...
	Why aren't they currently testing? [i.e. barriers]
What?	What messages might overcome this and persuade them? [i.e. facilitators]
	What behaviour change techniques might persuade them?
How?	What tone should we use to get the message across?
	What visuals could support this message?
	What text and other materials should support this?
Where?	Where should they see the intervention? E.g. online dating sites, posters in public places, gay scene, magazines, social media...
When?	When should the intervention run and for how long?

Figure 1



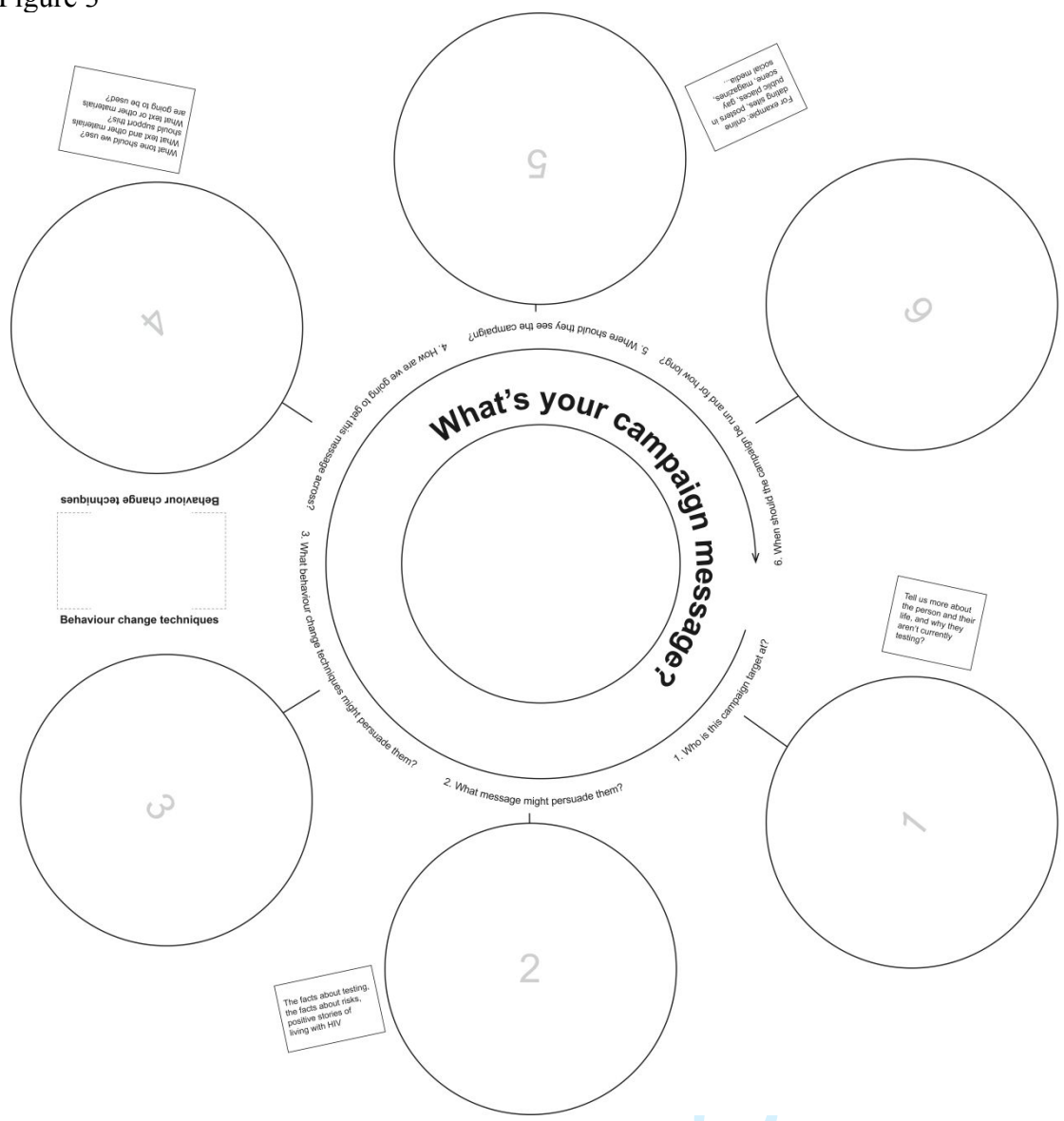
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Figure 2



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Figure 3



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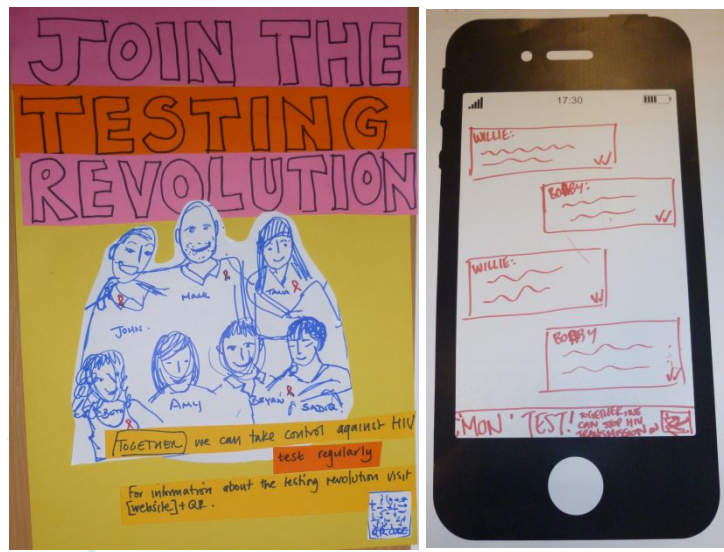
Figure 4

<p><b>Comparison of outcomes</b></p> <p><b>Information about other's approval</b> Provide information about what other people think about HIV testing. The information clarifies whether others will like, approve or disapprove of what the person is doing or will do for example:</p> <p><i>'I wouldn't want to have sex with someone who doesn't test regularly'</i></p>	<p><b>Natural consequences</b></p> <p><b>Information about emotional consequences</b> Provide information (e.g. written, verbal, visual) about emotional consequences of HIV testing for example:</p> <p><i>Positive stories of people living well with HIV</i></p> <p><i>Relief of knowing either way rather than living with the fear you are HIV positive</i></p>
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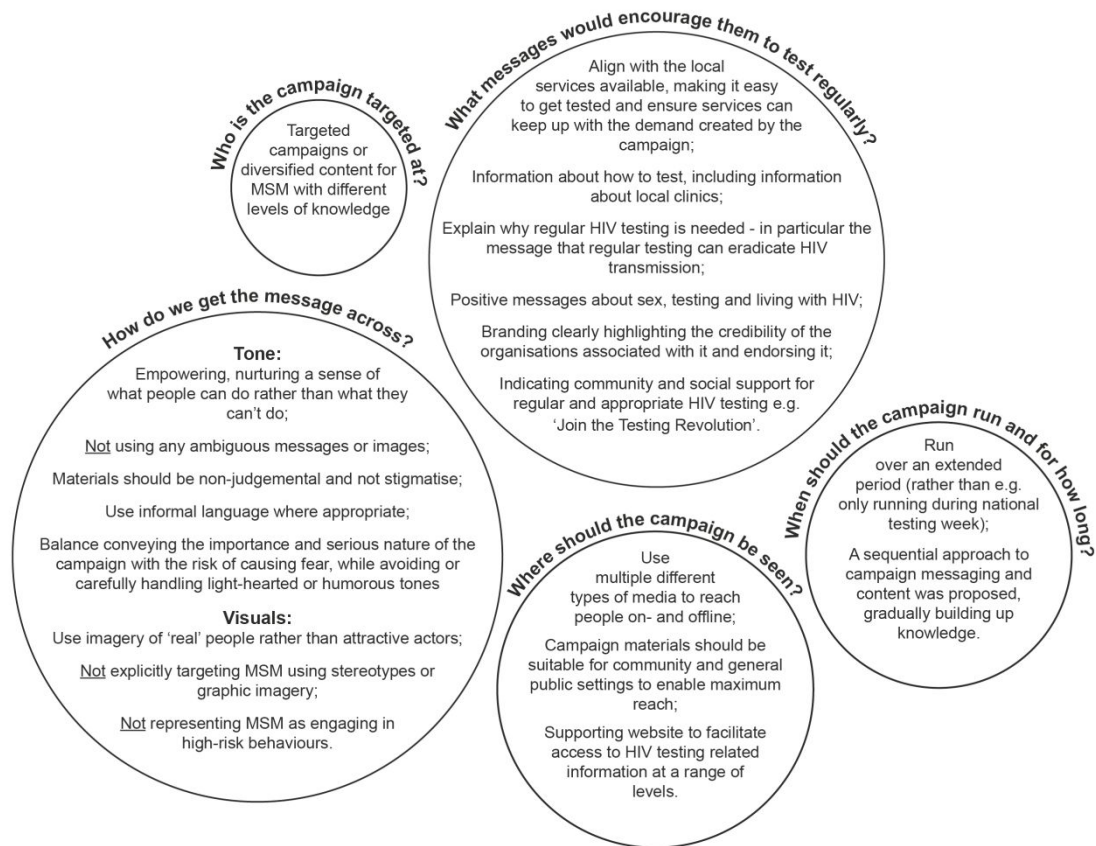
Figure 5



Peer Review Only



Figure 6



**Figure Captions**

Figure 1: Barriers and facilitators activity

Figure 2: Image of one corner of the exhibition

Figure 3: Workshop tool to structure codesign activities

Figure 4: Examples of behaviour change technique cards

Figure 5: Visual prototypes prepared for Join the Testing Revolution (left), and C'Mon Test (right)

Figure 6: Design Requirements

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