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A collaborative approach to developing sustainable behaviour change interventions for childhood obesity prevention: Development of the Choosing Healthy Eating for Infant Health (CHERISH) intervention and implementation strategy

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1 **Abstract:**

2 **Objectives and Design:**

3 There is growing recognition of the need for effective behaviour change interventions to
4 prevent chronic disease that are feasible, sustainable and can be implemented within routine
5 healthcare systems. Focusing on implementation from the outset of intervention development,
6 and incorporating multiple stakeholder perspectives to achieve this, is therefore essential.
7 This study explores the development of the Choosing Healthy Eating for Infant Health
8 (CHERIsH) childhood obesity prevention intervention and implementation strategy to
9 improve infant feeding behaviours.

10 **Methods:**

11 Five qualitative and quantitative evidence syntheses, two primary qualitative studies, and
12 formal/informal consultations were conducted with practice, policy, research and parent
13 stakeholders. The Behaviour Change Wheel was used to guide the integration of findings.

14 **Results:**

15 The CHERIsH intervention targets parent-level behaviour change and comprises 1) brief
16 verbal messages and 2) trustworthy resources, to be delivered by healthcare professionals
17 (HCPs) during routine infant vaccination visits. The implementation strategy targets HCP-
18 level behaviour change and comprises 1) a local opinion leader, 2) incentivised training 3)
19 HCP resources and educational materials, 4) electronic delivery prompts, 5) awareness-
20 raising across all primary care HCPs, and 6) local technical support.

21 **Conclusions:**

22 This study provides a rigorous example of the development of an evidence-based intervention
23 aimed at improving parental infant feeding behaviours, alongside an evidence-based
24 behaviour change strategy to facilitate implementation and sustainability in primary care.
25 This approach demonstrates how to systematically incorporate multiple stakeholder

26 perspectives with existing literature and move from multiple evidence sources to clearly
27 specified intervention components for both the intervention and implementation strategy.

28

29 **Word count:** 4836

30

31 **Background:**

32 There is growing recognition of the need for effective evidence-based behaviour change
33 interventions to prevent chronic disease that are feasible, sustainable and can be implemented
34 within routine healthcare systems (Brown & Beardslee, 2016; Leslie et al., 2016;
35 Walugembe, Sibbald, Le Ber, & Kothari, 2019). It has been frequently stated that it can take
36 up to 17 years for research evidence to become embedded within routine clinical practice
37 (Grant, Green, & Mason, 2003; Green, Ottoson, García, & Hiatt, 2009; Morris, Wooding, &
38 Grant, 2011; Power et al., 2019), with many positing that this time-lag is compounded by a
39 traditional step-wise approach from intervention development and feasibility testing to
40 efficacy and effectiveness evaluations before finally moving to implementation (Brownson,
41 Jacobs, Tabak, Hoehner, & Stamatakis, 2013; Curran, Bauer, Mittman, Pyne, & Stetler, 2012;
42 Glasgow, Lichtenstein, & Marcus, 2003). As such, it is of vital importance for interventions
43 to be developed with a focus on implementation, and multiple levels of behaviours required
44 to facilitate implementation and intervention delivery, from the outset (Brownson et al.,
45 2013; Chambers & Norton, 2016; Pluye, Potvin, & Denis, 2004; Schell et al., 2013).
46 Incorporating insights from a variety of stakeholders including practice, policy and
47 patient/public enables several levels of behavioural factors influencing implementation to be
48 considered, and has been consistently acknowledged one of the most important aspects in
49 developing sustainable public health interventions (Iwelunmor et al., 2016; Proctor et al.,
50 2015; Schell et al., 2013; Stevens et al., 2017). However, incorporating multiple stakeholder
51 perspectives within intervention development is not straightforward (Cottrell et al., 2014;
52 Deverka et al., 2012). Few examples exist which explicitly detail how to integrate the
53 perspectives of different stakeholders with existing evidence regarding intervention
54 effectiveness and implementability, using a systematic and theoretically-informed approach
55 (Walugembe et al., 2019).

56

57 Incorporating stakeholder insights for developing sustainable interventions to prevent chronic
58 diseases such as childhood obesity could be particularly beneficial. Childhood obesity is an
59 urgent global concern with serious health, economic and social implications both for the
60 individual and the wider health system. Infancy and early childhood represent an optimal
61 window to establish healthy behaviours and prevent the later development of childhood
62 obesity and other chronic disease (safefood, 2018; Singh, Mulder, Twisk, van Mechelen, &
63 Chinapaw, 2008; Waters et al., 2011). In particular, ensuring optimum infant nutrition is
64 vital, as a number of potentially modifiable infant feeding behaviours have been shown to
65 predict later development of childhood overweight and obesity (Pluymen et al., 2018; Wang
66 et al., 2016; Woo Baidal et al., 2016). These behaviours include the initiation and duration of
67 breastfeeding as well as the introduction of solid foods (i.e. complementary feeding) (Birch &
68 Doub, 2014; Hurley, Cross, & Hughes, 2011; Patro-Gołąb et al., 2016; Pearce & Langley-
69 Evans, 2013; Pluymen et al., 2018; Wang et al., 2016). International guidance from the World
70 Health Organisation (WHO) recommends exclusive breastfeeding for the first six months of
71 life with complementary feeding (i.e. the introduction of nutritionally adequate and
72 appropriate solid foods) from six months onwards (World Health Organisation, 2002).
73 Despite these recommendations, a substantial proportion of infants worldwide are introduced
74 to solid foods before four months (Barrera, Hamner, Perrine, & Scanlon, 2018; Clayton, Li,
75 Perrine, & Scanlon, 2013; Inoue & Binns, 2014; Schiess et al., 2010). Additionally, infants
76 are commonly introduced to inappropriate foods which are high in energy, saturated fats, salt
77 and refined sugars or contain insufficient micronutrients (Inoue & Binns, 2014; Tarrant,
78 Younger, Sheridan-Pereira, White, & Kearney, 2010).

79

80 Childhood obesity prevention interventions delivered by healthcare professionals (HCPs) in
81 primary care settings have been identified as particularly promising (Clayton et al., 2013;
82 Matvienko-Sikar et al., 2018; McPherson, Mirkin, Heatherley, & Homer, 2012). This is
83 because primary care HCPs are a trusted source of information for parents (Bourgeois,
84 Brauer, Simpson, Kim, & Haines, 2016; Horodyski et al., 2007), and come into regular
85 contact with parents during early infancy, such as during routine vaccination visits. However,
86 the existing evidence for the effectiveness of infant feeding interventions to prevent
87 childhood obesity, including those delivered by HCPs in healthcare contexts, is inconsistent
88 (Blake-Lamb et al., 2016; Graziose, Downs, O'Brien, & Fanzo, 2017; Hesketh & Campbell,
89 2010; Laws et al., 2014; Matvienko-Sikar et al., 2018; Redsell, Edmonds, Swift, & et al.,
90 2016). Several systematic reviews have previously demonstrated variable effects of infant
91 feeding interventions on both feeding and weight outcomes (Blake-Lamb et al., 2016;
92 Graziose et al., 2017; Hesketh & Campbell, 2010; Laws et al., 2014; Matvienko-Sikar et al.,
93 2018; Redsell et al., 2016). However, these reviews identified a number of methodological
94 flaws and quality issues within existing interventions, including poor application or use of
95 behaviour change theory (Hesketh & Campbell, 2010; Matvienko-Sikar et al., 2019; Redsell
96 et al., 2016), a lack of systematic approach to intervention development (Graziose et al.,
97 2017), significant heterogeneity in outcome measurement and reporting (Laws et al., 2014;
98 Matvienko-Sikar et al., 2018), and an insufficient focus on the internal and external validity
99 of the intervention (e.g. intervention fidelity delivery and adherence) (Redsell et al., 2016;
100 Toomey et al., 2018). Overall, the findings of these reviews suggested that multi-component
101 interventions underpinned by theory that incorporate a responsive feeding focus may have the
102 most potential to impact on feeding and weight outcomes (Blake-Lamb et al., 2016; Graziose
103 et al., 2017; Hesketh & Campbell, 2010; Laws et al., 2014; Matvienko-Sikar et al., 2018;
104 Redsell et al., 2016). The reviews also highlighted a limited focus on implementation and

105 long-term sustainability, and a need for future research to develop multi-level behaviour
106 change interventions that target beyond the individual/family level alone, and that can be
107 embedded into routine service delivery (Blake-Lamb et al., 2016; Graziose et al., 2017; Laws
108 et al., 2014; Redsell et al., 2016; Waters et al., 2011). As such, there is a clear need to
109 develop evidence-based behaviour change interventions that integrate research evidence with
110 multiple stakeholder views and contextual information to facilitate implementation and
111 sustainability within existing healthcare settings.

112

113 The aim of this study was to systematically develop an evidence-based intervention to
114 improve parental infant feeding behaviours, and a concurrent evidence-based implementation
115 strategy targeting HCP behaviours to support and sustain intervention delivery during routine
116 vaccination visits. The Behaviour Change Wheel (BCW) intervention development
117 framework (Michie, van Stralen, & West, 2011) was used to structure this approach and to
118 incorporate evidence and insights from practice, policy and parents.

119

120 **Methods:**

121 **Intervention context**

122 In Ireland, vaccinations are delivered at five standardised time-points (2, 4, 6, 12 and 13
123 months) within the Health Service Executive (HSE) National Healthy Childhood Programme,
124 a free universal child health service that is available from pregnancy through to adolescence
125 ("HSE Healthy Childhood Programme, "). The Nurture Programme is a recently-established
126 quality improvement initiative within the National Healthy Childhood Programme that aims
127 to support, empower and educate parents and practitioners on a variety of infant health and
128 well-being topics, including nutrition ("HSE Nurture Programme - Infant Health and
129 Wellbeing, ").

130

131 **Sources of evidence**

132 The Choosing Healthy Eating for Infant Health (CHERISH) team comprises researchers with
133 expertise in a variety of areas including childhood obesity, population/public health, infant
134 nutrition, developmental psychology, epidemiology, health psychology, health promotion,
135 health services research, behaviour change, primary care, health economics and
136 implementation science (ET, KMS, JMS, SMH, PK, ED, JH, CH, CHe, MH, CK, JOH, MQ,
137 TH, MB). We (the CHERISH team) conducted five evidence syntheses and two primary
138 qualitative studies with HCPs and parents, as well as formal and informal consultations with
139 policy, practice and researcher stakeholders (full details of sources in Table 1). We combined
140 findings from these sources in an iterative process to inform each step of the BCW
141 framework and guide final decision-making made by our interdisciplinary research team.

142

143

144 [INSERT TABLE 1 HERE]

145 **Applying the Behaviour Change Wheel approach**

146 The BCW approach (Michie, Atkins, & West, 2014) outlines three phases with eight specific
147 steps across these phases.

148

149 **Phase 1: Understanding the behaviour**

150 Phase 1 comprises: Step 1 (defining the problem in behavioural terms), Step 2 (selecting the
151 target behaviour(s)), Step 3 (specifying the target behaviour(s)) and Step 4 (identifying what
152 needs to change). Specifically, this phase involves identifying components of the target
153 behaviour (*who, what, where, when and how often*) to be addressed through the intervention
154 using the COM-B (Capability, Opportunity, Motivation-Behaviour) model. The COM-B
155 model recognises that for a person to change their behaviour, they must have the physical and
156 psychological capability, social and physical opportunity and reflective and automatic
157 motivation (Michie et al., 2011).

158

159 We used existing data regarding current infant feeding practices and introduction of solid
160 foods (Bennett, 2017; Castro, Kearney, & Layte, 2015; safefood, 2018; Tarrant et al., 2010)
161 to understand and define the problem in behavioural terms. Selection and specification of the
162 parental behaviours relevant to improving infant feeding, as well as the HCP behaviours
163 needed to facilitate these behaviours in the intended primary care vaccination visit setting,
164 were achieved by exploring national and international infant feeding recommendations
165 (Fewtrell et al., 2017; Food Safety Authority of Ireland, 2011; Health Service Executive,
166 2016; Healthy Ireland, 2015; World Health Organisation, 2002) in conjunction with findings
167 from our evidence sources (Table 1). Our informal consultations with local and national
168 infant feeding policy and practice representatives provided valuable insight in terms of which
169 particular behaviours might be best to target within the current Irish primary care context.

170

171 Specific barriers and enablers to the targeted parent-level behaviours and HCP/practice-level
172 behaviours were extracted from our parent focus groups (FG) and HCP interviews (QI) and
173 subsequently triangulated with findings of the evidence syntheses (SR1, SR2, SR3, QES1,
174 QES2) by two authors. One author conducted initial coding, with 100% of this coding
175 double-checked and verified separately by a second author. Specifically, parent-level
176 barriers/enablers were coded according to the COM-B by KMS and HCP-level
177 barriers/enablers were coded by ET, with each analysis verified by the other coder.

178

179 **Phase 2: Identify intervention options**

180 Phase 2 applies the BCW framework guidance (Michie et al., 2014) to choose potential
181 intervention options based on the findings of Phase 1. Specifically, Step 5 identifies
182 intervention functions or the ‘broad categories of means by which an intervention can change
183 behaviour’ (Michie et al., 2014) (e.g. Education, Training), which map onto the relevant
184 COM-B components identified in Phase 1. Where multiple options for intervention functions
185 exist, the APEASE (Affordability, Practicability, Effectiveness/cost-effectiveness,
186 Acceptability, Side-effects/Safety, Equity) criteria (Michie et al., 2014) can be used to
187 determine the most appropriate option. Step 6 involves identifying specific policy-related
188 areas to target (Michie et al., 2011). This project focused on parent and practitioner-level
189 change, and changing policy was deemed outside of the scope; therefore, this step was not
190 included within our project.

191

192 For Step 5, two authors used a template to facilitate application of the APEASE criteria in a
193 standardised manner for both the parent behaviours and the targeted HCP behaviours
194 (Supplementary File 1). Using information from four of our evidence syntheses (QES1,

195 QES2, SR1, SR3) and qualitative data collection with parents and HCPs (QI, FG), ET and
196 KMS collectively applied the APEASE criteria to each BCW intervention function via
197 consensus discussion, with rationale for each decision documented on the template. Functions
198 that met all APEASE criteria were included.

199

200 **Phase 3: Identify content and implementation options**

201 Phase 3 involves explicit identification of the intervention content in terms of behaviour
202 change techniques (BCTs) (Step 7). BCTs are observable, replicable and irreducible active
203 ingredients of an intervention designed to change behaviour, and are listed and defined within
204 the BCT Taxonomy v1 (BCTTv1) (Michie et al., 2013). Finally, Step 8 involves
205 operationalising each BCT, i.e. translating the BCT from its taxonomy definition into a
206 concrete application of what it would look like within an intervention.

207

208 To inform the selection of final BCTs, using a similar process as outlined for identifying
209 intervention functions, two authors (ET, KMS) collectively applied the APEASE criteria to
210 each possible BCT via consensus discussion. Guided by the findings of our evidence
211 syntheses (SR1, SR2, SR3, QES1, QES2) and qualitative data collection with parents and
212 HCPs (FG, QI), we (ET, KMS) brainstormed potential intervention components and modes
213 of delivery. We then presented the options to our international expert steering committee,
214 practice and policy representatives for feedback to guide final decision-making by the
215 CHerIsH team. Key recommendations arising from the international steering committee were
216 documented and subsequently reviewed by the CHerIsH team at a follow-up meeting. As
217 with each previous step of the process, consensus was reached on the finalised intervention
218 and implementation strategy via discussion within the CHerIsH study team.

219

220 **Results:**

221 **Phase 1: Understanding the behaviour**

222 *Step 1: Define the problem in behavioural terms*

223 As outlined in the introduction, a substantial proportion of infants internationally are
224 introduced to inappropriate foods before the recommended time (Castro et al., 2015; Inoue &
225 Binns, 2014; O'Donovan et al., 2015; Tarrant et al., 2010). We therefore defined the problem
226 in behavioural terms as the practice of suboptimal infant feeding behaviours by parents of
227 infants aged 0-2.

228

229 *Step 2: Selecting the target behaviour(s)*

230 A number of specific parental behaviours relevant to the broader target of improving healthy
231 infant feeding behaviours were identified from existing infant feeding recommendations
232 (Food Safety Authority of Ireland, 2011; Healthy Ireland, 2015; World Health Organisation,
233 2002), which included guidance on maternal nutrition and physical activity-related
234 behaviours before and during pregnancy, breastfeeding and formula-feeding behaviours, as
235 well as the timing of introduction of solid foods, the types and stages of solid foods
236 introduced, and the ways in which parents feed their babies in response to infant cues (i.e.
237 responsive feeding). Although several behaviours were relevant to our area of interest, we
238 decided to focus predominantly on the introduction and provision of solid foods to children
239 aged between 0-2, and in particular to select three core behaviours relating to 1) the timing of
240 solid food introduction, 2) progression through the stages and textures of solid foods and 3)
241 responsive feeding behaviours. This decision was influenced by findings from our evidence
242 sources (Table 1). Specifically, our systematic review of effectiveness (SR1) identified that
243 interventions based on responsive feeding theory demonstrated greater improvements in
244 feeding approaches and weight outcomes. Our qualitative data collection (FG, QI) also

245 reinforced the importance of developing parental skills such as responding to infant cues. In
246 addition, our qualitative evidence synthesis of parents' experiences of complementary
247 feeding (QES1) and our focus groups (FG) both emphasised the importance of considering
248 infant feeding as a changing process over time involving different stages.

249

250 In terms of selecting HCP behaviours for our implementation strategy, the findings of our
251 systematic review of intervention fidelity (SR2) identified the importance of an explicit focus
252 on HCP training and behaviour change within these types of interventions. In addition, our
253 interviews with healthcare professionals (QI) and our qualitative evidence synthesis of
254 parents' and HCPs' perspectives of infant feeding interventions (QES2) emphasised issues
255 relating to capacity and resources for HCPs. Drawing on this evidence, in conjunction with
256 informal consultations with our policy and practice-based representatives, we decided to
257 select the provision of guideline-based information and support for introduction of solid
258 foods in primary care by HCPs involved in the vaccination visits as the HCP-level
259 behavioural target.

260

261 ***Step 3: Specifying the target behaviour(s):***

262 We specified our parent-level behaviours to be that parents (*who*) would 1) wait until as close
263 to 26 weeks as possible to introduce solids and not before 17 weeks, 2) feed nutritious and
264 developmentally appropriate foods and 3) respond appropriately to the infant's hunger and
265 satiety cues (*what*) each and every time they fed their infant (*when, where and how often*).

266 This specification was informed by integrating national and international guidelines (Fewtrell
267 et al., 2017; Food Safety Authority of Ireland, 2011; Health Service Executive, 2016; Healthy
268 Ireland, 2015; World Health Organisation, 2002) with findings from our qualitative evidence
269 synthesis of parents' views of infant feeding (QES1), our systematic reviews of effectiveness

270 (SR1) and behaviour change theory and techniques (SR3) and our focus groups with parents
271 (FG) in conjunction with consultation with the policy representatives.

272

273 For the HCP-level behaviour, i.e. the provision of guideline-based information and support
274 for introduction of solid foods at vaccination visits, our HCP interviews (QI), in addition to
275 our informal policy and practice consultations, provided us with the contextual knowledge
276 needed to identify the specifics of this behaviour. For example, both sources informed us that
277 vaccinations in Ireland are typically delivered by practice nurses, but may occasionally be
278 delivered by general practitioners in certain circumstances. Our interviews with HCPs also
279 informed us that potentially the most acceptable time to deliver information alongside
280 vaccination visits, would be before the vaccine itself was administered. We therefore
281 specified our HCP-level behaviour to be that practice nurses and/or general practitioners
282 (*who*) would provide guideline-based information and support for introduction of solid foods
283 (*what*) just before the delivery of vaccinations (*when*) in the practice vaccination room
284 (*where*), at the 2, 4, 6, 12 and 13-month vaccination visits (*how often*).

285

286 ***Step 4: Identify what needs to change:***

287 The identified barriers and enablers to the target behaviours and to conducting the
288 intervention within vaccination visits, analysed according to the COM-B model, are
289 presented in Table 2.

290

291

292 [INSERT TABLE 2 HERE]

293 **Phase 2: Identify intervention options**

294 *Step 5: Identify intervention functions*

295 All nine BCW intervention functions were potentially relevant to the COM-B components
296 identified in Step 4 for both the parent behaviour and the targeted HCP behaviour. By using
297 our evidence sources to inform how we applied the APEASE criteria, we selected three
298 intervention functions (Education, Environmental restructuring and Persuasion) to address the
299 parent-level targeted behaviour. For example, 'Education' was identified as relevant within
300 four of our evidence syntheses (QES1, QES2, SR1, SR3) and our qualitative data collection
301 with parents and HCPs (QI, FG). Using the information gleaned from these studies, we
302 deemed the provision of education for parents to be Affordable, Practicable, potentially
303 Effective and Cost-effective, Acceptable, Safe, and Equitable. In a similar manner, we
304 selected Training, Education, Environmental restructuring, Persuasion, Incentivisation and
305 Modelling as the intervention functions to address the HCP-level targeted behaviour (Table
306 2). The APEASE criteria ratings and the rationale for each intervention function selected for
307 both the intervention and implementation strategy are provided in Supplementary File 1.

308

309 **Phase 3: Identify content and implementation options**

310 *Step 7: Identify BCTS*

311 Using the BCW guidance (Michie et al., 2011), 11 potential BCTs were linked with
312 intervention functions for the parent-level behaviour, and 15 potential BCTs were linked with
313 the HCP-level behaviour (for full list of BCTs identified see Supplementary File 3). For the
314 parent-level behaviour, we judged seven BCTs to meet the APEASE criteria which were
315 selected for the intervention. For the HCP-level behaviour, we selected 10 BCTs which met
316 the APEASE criteria. Selected BCTs for both parent and HCP-level behaviours are provided

317 in Table 2. Full details regarding the application of the APEASE criteria and rationale for
318 decision-making regarding selection of BCTs are provided in Supplementary File 2.

319

320 ***Step 8: Identify mode of delivery***

321 Lastly, we integrated information from our evidence syntheses (SR1, SR2, SR3, QES1,
322 QES2) and qualitative data collection (FG, QI) with recommendations from our practice and
323 policy representatives (IC) and our international expert steering group (ISC). This guided our
324 final decision-making on the operationalisation and modes of delivery of BCTs within the
325 CHERIsH intervention and implementation strategy. Full details are provided in Table 3.

326

327 For example, our informal consultations with policy representatives (IC) identified a number
328 of existing resources that had been recently developed by the National Healthy Childhood
329 Programme. These included a list of brief evidence-based infant feeding messages linked to
330 all health service contact points between the ages of 0-2 (including vaccination visits) to
331 ensure consistency of messages across healthcare providers, a child health website ("HSE
332 MyChild.ie,") and a number of online training modules for HCPs in relation to infant feeding.
333 We decided to use content from these resources within our intervention to operationalise
334 some of the BCTs identified in Step 7. For instance, we decided that the BCT 'Instruction on
335 how to perform the behaviour' would be operationalised by having HCPs deliver brief infant
336 feeding messages to parents on how to perform the behaviour (e.g. responding to infant cues)
337 at each vaccination time-point, in addition to signposting them to the child health website
338 which provided further information, resources and reinforcement of the verbal messages. The
339 exact wording and mode of delivery of the brief messages were informed by the findings of
340 our systematic reviews of effectiveness (SR1) and theory use (SR3), our qualitative evidence
341 syntheses (QES1, QES2) and qualitative data collection (FG, QI) in consultation with the

342 practice and policy representatives (IC) to ensure alignment with existing National Healthy
343 Childhood Programme messages. Likewise, we used content from existing National Healthy
344 Childhood Programme training modules for HCPs relevant to our intervention to develop
345 training and resources for HCPs as part of our implementation strategy, with the mode of
346 delivery informed by findings of our systematic review of fidelity (SR2), qualitative evidence
347 synthesis of HCP experiences of infant feeding interventions (QES2) and HCP interviews
348 (QI).

349

350 The international steering committee expert meeting (ISC) identified three main
351 recommendations for further consideration in finalising the intervention components and
352 mode of delivery. These related to 1) the involvement of primary care HCPs beyond the
353 practice nurses and general practitioners who would be delivering the intervention, 2) the
354 need for augmented HCP training beyond the existing National Healthy Childhood
355 Programme online modules and 3) the degree of flexibility/tailoring permitted regarding the
356 brief verbal messages. We reviewed these issues during a subsequent CHERIsH team meeting
357 and decided to 1) ensure that all primary care and community-based HCPs within the relevant
358 area were made aware of the intervention, 2) develop a group-based face-to-face training for
359 HCPs utilising the content from the existing online modules and 3) ensure that the core
360 intervention messages were kept consistent, but that the training would facilitate HCPs to
361 deliver them in a flexible manner.

362

363 [INSERT TABLE 3 HERE]

364 **The finalised CHERIsH intervention and implementation strategy:**

365 In brief, the finalised CHERIsH parent-level intervention consists of 1) verbally-delivered
366 brief infant feeding messages and 2) provision of additional infant-feeding resources
367 including an information leaflet, a magnet, an infant bib and signposting to the National
368 Healthy Childhood Programme child health information website. The intervention is to be
369 delivered by the HCP providing the vaccination (i.e. practice nurse or GP) at the 2, 4, 6, 12
370 and 13-month vaccination visits, just before the delivery of the vaccination. The finalised
371 HCP-level implementation strategy to support delivery of the parent-level intervention
372 consists of 1) A local opinion leader, 2) Incentivised HCP training 3) Distribution of
373 supporting HCP resources and educational materials, 4) Electronic delivery prompts for
374 HCPs, 5) Awareness raising across all HCPs within the clinical practice and local primary
375 care community, and 6) Provision of local technical support and assistance. Further details of
376 the finalised intervention and implementation strategy including the brief messages and
377 leaflet content are provided in Supplementary File 3, and described using the TIDieR
378 checklist in Supplementary File 4. Figure 1 depicts the logic model for the intervention as
379 recommended by Davidoff et al. (Davidoff, Dixon-Woods, Leviton, & Michie, 2015) to
380 articulate and graphically represent the intervention structures, processes and contextual
381 factors intended to achieve the targeted aims and objectives.

382

383 [INSERT FIGURE 1 HERE]

384

385 **Discussion:**

386 This study provides a unique example of the development of an empirically-based brief
387 intervention aimed at improving parental infant feeding behaviours to prevent childhood
388 obesity, alongside the concurrent development of an implementation strategy to support and

389 sustain intervention delivery by HCPs within routine primary care settings. The study
390 describes the use of the Behaviour Change Wheel approach to comprehensively and
391 systematically integrate multiple sources of evidence to incorporate perspectives from policy,
392 practice, research and parent stakeholders.

393

394 It has been estimated that only approximately 14% of healthcare research gets implemented
395 into practice (Gitlin, 2013; Green et al., 2009). As such, an earlier focus on sustainability, and
396 development of interventions that are designed to be implementable and put into practice on a
397 larger scale is warranted (Brownson et al., 2013; Curran et al., 2012; Glasgow et al., 2003). In
398 order to do this, it is important to explicitly consider behavioural changes needed across
399 multiple levels, and in particular those of the HCPs needed to deliver interventions in
400 healthcare settings. However, despite the importance of this, many interventions do not
401 consider the broader implementation requirements from the outset, nor the specific HCP
402 behaviours needed to facilitate the behaviour change at patient/individual level (Brownson et
403 al., 2013; Toomey et al., 2018). A key strength of our study is its explicit focus on the
404 behaviour change needed at a HCP-level, and the strategies required to enable this, in order to
405 facilitate the delivery of the intervention to parents. If the intervention proves to be feasible
406 and effective, the development of a multi-faceted implementation strategy to be tested
407 alongside the intervention itself provides us with a thorough, evidence-based strategy that
408 will enable the translation of research findings into practice more rapidly.

409

410 The development of the CHERISH intervention and implementation strategy was informed by
411 a substantial number and variety of sources from multiple perspectives. This enabled a
412 comprehensive approach to intervention development; however, integrating the findings from
413 each of the sources was complicated, as was disentangling evidence from particular sources

414 to determine exactly where they contributed. This process was further complicated by the fact
415 that sources were often conducted in parallel due to time constraints, with findings combined
416 iteratively throughout the course of the intervention development. However, the breadth and
417 depth of sources used has resulted in an intervention and implementation strategy that is
418 based on existing international evidence, but is also cognisant of local stakeholder needs and
419 in alignment with national programmes and policy. The use of international experts from a
420 variety of disciplines was also an important step and enabled us to develop an intervention
421 that is informed by international learning and best practice; such that while developed in an
422 Irish context, this study has broader international relevance. A CHERISH patient and public
423 involvement (PPI) group was also established and is described in the feasibility study
424 protocol (Matvienko-Sikar et al., 2019). The purpose of this group was to advise on study
425 design and data collection procedures including study questionnaires. This decision was taken
426 to avoid overburdening the PPI group and minimize duplication of effort across the PPI group
427 and parent focus groups detailed in this study, as these focus groups specifically explored
428 parents' opinions of the proposed intervention to incorporate parent perspectives within the
429 intervention development. However, it is acknowledged that the finalised intervention may
430 have benefitted further from additional insights from the PPI group.

431

432 The Behaviour Change Wheel was used within this study to guide the development of both
433 the parent-level intervention and the implementation strategy targeting HCP behaviour
434 change in a thorough, transparent and systematic way (Michie et al., 2011). Use of the BCW
435 also enabled us to make the programme theory underlying both aspects of our intervention
436 explicit, by facilitating our development of a logic model linking specific intervention
437 components to study outcomes, via the intended mechanisms of change. While several other
438 implementation frameworks or models could have used to develop the HCP-level

439 implementation strategy (Nilsen, 2015), the BCW was specifically developed to improve the
440 design and implementation of evidence-based practice (Michie et al., 2011), and has
441 previously been used to develop implementation strategies to support the delivery of patient-
442 level interventions (Gould et al., 2017; Mc Sharry, Murphy, & Byrne, 2016; Sinnott et al.,
443 2015). However, examples of studies that have used the Behaviour Change Wheel approach
444 with this amount of evidence sources from such varied perspectives are rare; our study
445 showcases the transparent and systematic development of a thorough and extremely
446 comprehensive evidence-based intervention and associated implementation strategy. The
447 transparency of this process will enable better testing of hypothesised causal pathways, and
448 facilitate future replication and/or refinement of the developed intervention.

449

450 *Implications for future research*

451 Childhood overweight and obesity is an extremely challenging public health issue, the
452 aetiology of which is influenced by a complex interplay of multiple genetic, environmental
453 and lifestyle factors (Lytle, 2009; Sahoo et al., 2015). While there are a large number of
454 factors which impact childhood obesity, the CHERISH intervention provides an example of an
455 evidence-based approach towards addressing one of these factors, and if successful will
456 contribute an important piece to the overall puzzle. The next stages of this research are to
457 evaluate the acceptability and feasibility of both the parent intervention and the HCP
458 implementation strategy in a feasibility study (Matvienko-Sikar et al., 2019). This will
459 facilitate the refinement of the intervention and its implementation strategy, and inform the
460 next stages of the CHERISH study, which will explore the effectiveness of both aspects.

461

462 **Conclusions:**

463 This study provides a rigorous example of the development of an implementation strategy to
464 facilitate HCP behaviour change, to support the implementation of an intervention aimed at
465 improving parental adherence to recommended infant feeding behaviours. In addition, this
466 study provides a unique example of integrating multiple different sources of evidence to
467 guide the use of the BCW approach for multi-level behaviour change. As such, the
468 transparency of the processes detailed in this paper will be of significant value for other
469 researchers looking to accelerate findings into practice by planning for implementation from
470 the outset, in a comprehensive and systematic manner.

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688

689 **Table 1: CHERIsH sources of evidence for intervention development**

Source code: Source title (reference)	Type of activity	Overview of source aims and findings	Behaviour Change Wheel phase(s) and step(s) informed
<p>SR1: ‘Effects of healthcare professional delivered early feeding interventions on feeding practices and dietary intake: A systematic review’ (Matvienko-Sikar et al., 2018)</p>	<p>Systematic review</p>	<ul style="list-style-type: none"> • Aimed to evaluate the effects of healthcare professional (HCP) delivered infant feeding interventions, delivered in the first two years postpartum on parental feeding practices, dietary intake, and weight outcomes for children. • 10 trials of interventions demonstrated inconsistent effects on feeding practices, dietary intake, and weight outcomes. Findings showed some reductions in pressure to eat and infant consumption of non-core beverages. • Responsive feeding-based interventions demonstrated greater improvements in feeding approaches, and weight outcomes 	<p>Phase 1: Steps 2, 3, 4 Phase 2: Step 5 Phase 3: Step 8</p>
<p>SR2: ‘Intervention Fidelity Within Trials of Infant Feeding Behavioural Interventions to Prevent Childhood Obesity: A Systematic Review’ (Toomey et al., 2018)</p>	<p>Systematic review</p>	<ul style="list-style-type: none"> • Aimed to explore the use and/or reporting of strategies to enhance and assess intervention fidelity within 10 trials (identified in SR1) of HCP-delivered infant feeding interventions, using the National Institutes of Health Behaviour Change Consortium (Borrelli et al., 2005) fidelity checklist. • Average use/reporting of fidelity strategies was moderate 	<p>Phase 1: Steps 2, 4 Phase 2: Step 5 Phase 3: Step 8</p>

		<ul style="list-style-type: none"> Highlighted the need to improve reporting of intervention fidelity strategies and ensure focus on HCP-level behaviour change. 	
SR3: 'Behaviour Change Techniques and Theory Use in Healthcare Professional-Delivered Early Feeding Interventions to Prevent Childhood Obesity: A Systematic Review' (Matvienko-Sikar et al., 2019)	Systematic review	<ul style="list-style-type: none"> Aimed to evaluate the use of behaviour change techniques and psychological theory in HCP-delivered infant feeding interventions for children ≤ 2 years. 12 trials were examined using the Behaviour Change Technique (BCT) Taxonomy v1 (Michie et al., 2013) and the Theory Coding Scheme (Michie & Prestwich, 2010). Theory use was poor; most commonly used theories were social cognitive theory (SCT) (n=4 studies) and responsive feeding (n=4). Studies that incorporated theory in intervention development and evaluation demonstrated better child weight outcomes. Highlighted need for adequate integration of theory in intervention development, and identified BCTs that had been used in more effective interventions. 	Phase 1: Steps 3, 4 Phase 2: Step 5 Phase 3: Steps 7, 8
QES1: 'Parental experiences and perceptions of infant complementary feeding: a qualitative evidence synthesis' (Matvienko-Sikar et al., 2018)	Qualitative evidence synthesis	<ul style="list-style-type: none"> Aimed to explore parents' perceptions and experiences of infant feeding and complementary feeding recommendations. 25 qualitative studies included Four key themes were identified: 1) 'Guidelines and advice' related to the variety and inconsistencies between sources of feeding information, 2) 'Stage of weaning' related to infant feeding as a 	Phase 1: Steps 2, 3, 4 Phase 2: Step 5 Phase 3: Steps 7, 8

		<p>process involving different stages, 3) ‘Knowing and trying’ related to parents' feeding approaches being based on instinct, prior experience or trial and error and 4) ‘Daily life’ related to problematic cost and time constraints for parents.</p> <ul style="list-style-type: none"> • Emphasised the importance of considering infant feeding as a changing process over time, and the need for clear, consistent information from trusted sources. 	
<p>QES2: ‘Health-care professional and parental views and experiences of implementing infant feeding interventions: a qualitative evidence synthesis’ (Toomey et al., in preparation)</p>	<p>Qualitative evidence synthesis</p>	<ul style="list-style-type: none"> • Aimed to explore parents’ and HCPs’ views and experiences of participating in infant feeding interventions. • 13 qualitative studies included • Findings identified the importance of positive relationships between parents and HCPs and a supportive intervention environment. Issues with capacity (time and resources) and unclear roles and responsibilities negatively influenced implementation of the intervention by HCPs; for parents, a focus on practical elements and sustainability beyond the intervention was important to facilitate participation. • Highlighted the importance of positive communication between HCP and parents and identified a number of key barriers and enablers to participating in infant feeding interventions for both parents and HCPs. 	<p>Phase 1: Steps 2, 4 Phase 2: Step 5 Phase 3: Step 8</p>

<p>FG: ‘Experience and perceptions of infant feeding and delivery of an infant feeding intervention in primary care in Ireland’ (Matvienko-Sikar et al., in preparation)</p>	<p>Qualitative focus groups</p>	<ul style="list-style-type: none"> • Aimed to explore views on engaging in healthy infant feeding practices, participation in infant feeding interventions and opinions of proposed intervention • Six focus groups with 30 parents (mothers and fathers) • Findings identified that importance of clear and consistent messages, and practical guidance and support delivered at the right time, and the importance of trustworthiness of the intervention and associated resources, and relationships with HCPs • Parents have different preferences in terms of the format of intervention and information delivery, but were mostly positive about the potential for using the vaccination visits as a potential time-point 	<p>Phase 1: Steps 2, 3, 4 Phase 2: Step 5 Phase 3: Steps 7, 8</p>
<p>QI: ‘Exploring infant feeding interventions in primary care with healthcare professionals: a qualitative interview study’(Toomey et al., in preparation)</p>	<p>Qualitative semi-structured interviews</p>	<ul style="list-style-type: none"> • Aimed to explore HCP views on addressing infant feeding in primary care, and the potential barriers and enablers to the use of brief vaccination visits as a time-point for intervention delivery • 21 semi-structured interviews with primary care HCPs (5 practice nurses, 7 general practitioners, 3 public health nurses, 3 community dieticians and 3 community medical officers) • Highlighted importance of consistency regarding infant feeding messages, trustworthy resources for both parents and HCPs and a need to support practical skill development for parents 	<p>Phase 1: Steps 2, 3, 4 Phase 2: Step 5 Phase 3: Steps 7, 8</p>

		<ul style="list-style-type: none"> • Barriers included a lack of time/capacity, resources, insufficient clarity regarding HCP roles and potential parent/child stress at the time of vaccinations • Enablers included the importance of the topic, good relationships between parents and primary care HCPs, and the fact that children presenting for vaccination visits are typically medically well • Vaccination visits were found to be potentially feasible if those barriers and enablers were taken into consideration 	
IC: Informal consultations with local and national infant feeding policy and practice representatives	Informal consultations	<ul style="list-style-type: none"> • Aimed to provide insight and information about the intervention context from a policy and practice perspective • Separate informal consultations were held with policy representatives from the Health Service Executive National Healthy Childhood Programme (3 face-to-face meetings and ongoing email/telephone contact) and a practice-based general practitioner (TH) (6 face-to-face meetings and ongoing telephone contacts) • Provided guidance around what resources and opportunities existed both locally and nationally that could be used to operationalise intervention components e.g. a parent and child health website (www.mychild.ie), online infant feeding training modules for HCPs and a number of infant health brief messages developed for healthcare contact points 	Phase 1: Steps 2, 3 Phase 2: Step 5 Phase 3: Steps 7, 8

ISC: International steering committee expert meeting	International steering committee meeting	<ul style="list-style-type: none"> • Aimed to get international expert input and guidance into the intervention development, particularly around the operationalisation and mode of delivery of intervention components • Two-day meeting with international steering committee (participants included 10 members of the immediate CHERISH interdisciplinary research team, two minute-keepers and 21 representatives from a variety of policy, practice and funding backgrounds including primary care (n=4), nursing (n=2), medical (n=4), health psychology (n=4), public health (n=8), health economics (n=2), nutrition (n=5), maternal and child health (n=8), childhood obesity (n=6), epidemiology (n=3) and implementation science (n=4). Representatives had been identified from the list of original project application collaborators and also through word of mouth or existing networks. Local practice and national policy representatives (IC) were also present. • Three recommendations were made regarding: 1) the involvement of primary care HCPs beyond those who would be delivering the intervention, 2) the need for HCP training and 3) the degree of flexibility/tailoring permitted regarding intervention content 	Phase 3: Step 8
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690 *SR = systematic review, QES = qualitative evidence synthesis, FG = focus groups, QI = qualitative interviews, IC = informal consultations, ISC*
691 *= international steering committee, HCP = healthcare professional*
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693 **Table 2: Mapping of COM-B components to selected intervention functions and BCTs**

BCW Step 1-3	BCW Step 4		BCW Step 5	BCW Step 7
Target behaviour	Barriers and enablers identified (sources)	COM-B component identified	Intervention functions selected	BCTs selected
Parents to adhere to guideline-based early infant feeding practices between 0-2 years: <ul style="list-style-type: none"> • Wait until as close to 26 weeks as possible to introduce solids (not 	Enabler <ul style="list-style-type: none"> • Focusing on practical skills including responsive-feeding (responding to infant cues, feeding behaviours) (QES1, QES2, SR1, SR3, QI, FG) 	Capability: Physical ¹	Education	4.1 Instruction on how to perform the behaviour
	Barriers <ul style="list-style-type: none"> • Conflicting information and lack of consistent messages regarding infant feeding (QES1, FG, QI, QES2) • Lack of trustworthy resources regarding infant feeding (FG, QI) • Misconceptions and lack of knowledge regarding infant feeding (QES1, FG) Enablers <ul style="list-style-type: none"> • Focus on practical information including responsive-feeding (responding to infant cues, feeding behaviours) (QES1, QES2, SR1, SR3, QI, FG) 	Capability: Psychological ²	Education	5.3 Information about social and environmental consequences 5.1 Information about health consequences 7.1 Prompts, cues

<ul style="list-style-type: none"> before 17 weeks); Feed nutritious and developmentally suitable foods; Respond appropriately to child's hunger & satiety cues 	<ul style="list-style-type: none"> Awareness of infant feeding as a changing process – appropriate timing of intervention (QES1, QES2, FG) 			
	<p>Enabler</p> <ul style="list-style-type: none"> Inclusion/acknowledgement of behaviours/advice from family/friends (FG, QES1) 	Opportunity: Social ³	Environmental Restructuring	12.5 Adding objects to the environment 7.1 Prompts/cues
	<p>Barrier</p> <ul style="list-style-type: none"> Time and cost restraints (FG, QES1) <p>Enabler</p> <ul style="list-style-type: none"> Availability of suitable, trustworthy resources in variety of formats (FG, QES1) 	Opportunity: Physical ⁴	Environmental Restructuring	12.1 Restructuring the physical environment
	<p>Barrier/Enabler</p> <ul style="list-style-type: none"> Parents prior positive or negative experience of infant feeding influencing their behaviours (QES1, FG) 	Motivation: Reflective ⁵	Education Persuasion	5.3 Information about social and environmental consequences 5.1 Information about health consequences 9.1 Credible source
	<p>Barrier</p> <ul style="list-style-type: none"> Mothers engaging in behaviours irrespective of guidelines based on 'maternal instinct' (QES1, FG) <p>Enablers</p>	Motivation: Automatic ⁶	Persuasion Environmental restructuring	9.1 Credible source 5.3 Information about social and

	<ul style="list-style-type: none"> • Support around stressful aspects of feeding and promotion of awareness that feeding can be enjoyable (QES1, FG) • Trusting, positive and non-judgemental relationships between HCPs & parents (QES1, QES2, QI, FG) 			<p>environmental consequences</p> <p>5.1 Information about health consequences</p> <p>12.5 Adding objects to the environment</p> <p>7.1 Prompts/cues</p> <p>12.1 Restructuring the physical environment</p>
HCPs to provide guideline-based information and support regarding infant feeding and introduction of solid foods (0-2 years) in primary care during	<p>Barrier</p> <ul style="list-style-type: none"> • Increasing complexity of vaccination visits due to recent changes in vaccination visit schedule (QI) <p>Enabler</p> <ul style="list-style-type: none"> • Clear, consistent messages regarding infant feeding (QI, QES2) 	Capability: Psychological	Education Training	<p>5.3 Information about social and environmental consequences</p> <p>5.1 Information about health consequences</p> <p>7.1 Prompts, cues</p> <p>6.1 Demonstration of the behaviour</p> <p>4.1 Instruction on how to perform the behaviour</p>

vaccination visits at 2,4,6,12,13mo				8.1 Behavioural practice/rehearsal
	<p>Barrier</p> <ul style="list-style-type: none"> Lack of time, capacity and funding for addressing infant feeding (QI, QES2) Lack of suitable, trustworthy resources and training for primary care HCPs (QI, QES2, SR2) 	<p>Opportunity:</p> <p>Physical</p>	<p>Training</p> <p>Environmental restructuring</p>	<p>12.5 Adding objects to the environment</p> <p>7.1 Prompts/cues</p> <p>12.1 Restructuring the physical environment</p> <p>12.2 Restructuring the social environment</p> <p>6.1 Demonstration of the behaviour</p> <p>4.1 Instruction on how to perform the behaviour</p> <p>8.1 Behavioural practice/rehearsal</p>
	<p>Barriers</p> <ul style="list-style-type: none"> Competing priorities of infant feeding within core GP/PN role/responsibilities (QI) Lack of clarity regarding HCP roles (QES2) 	<p>Motivation:</p> <p>Reflective</p>	<p>Education</p> <p>Persuasion</p> <p>Incentivisation</p>	<p>5. 3 Information about social and environmental consequences</p> <p>5.1 Information about health consequences</p>

				7.1 Prompts, cues 9.1 Credible source
	<p>Barrier/Enabler</p> <ul style="list-style-type: none"> Potential parental or child stress/anxiety due to vaccination but attendance at clinic for non-medical issue (QI) <p>Enabler</p> <ul style="list-style-type: none"> Trusting, positive and non-judgemental relationships between HCPs & parents (QES1, QES2, QI, FG) 	Motivation: Automatic	<p>Environmental restructuring</p> <p>Persuasion</p> <p>Incentivisation</p> <p>Training</p> <p>Modelling</p>	<p>12.5 Adding objects to the environment</p> <p>7.1 Prompts/cues</p> <p>12.1 Restructuring the physical environment</p> <p>12.2 Restructuring the social environment</p> <p>6.1 Demonstration of the behaviour</p> <p>4.1 Instruction on how to perform the behaviour</p> <p>8.1 Behavioural practice/rehearsal</p> <p>5.3 Information about social and environmental consequences</p> <p>5.1 Information about health consequences</p>

				9.1 Credible source
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BCW = Behaviour Change Wheel; ¹Physical Capability refers to the physical ability to engage in a behaviour, e.g. physical skills/strength; ²Psychological Capability refers to the ability to engage in the necessary mental processes needed for the behaviour e.g., knowledge/understanding; ³Social Opportunity refers to the social environment and the interpersonal influences, social cues and cultural norms that influence the way we think about things e.g. social norms; ⁴Physical Opportunity refers to the opportunities afforded by the physical environment e.g. time, resources, affordability etc; ⁵Reflective Motivation refers to conscious reflective processes involving plans (self-conscious intentions) and evaluations e.g. goals; ⁶Automatic Motivation refers to automatic processes involving emotional reactions, wants and needs, impulses, and reflex responses e.g. habits

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696 **Table 3: Operationalisation of selected BCTs and modes of delivery within CHERIsH intervention**

BCT selected in Step 7	Operationalisation of BCTs and modes of delivery within CHERIsH
Parent behaviour¹	
Instruction on how to perform behaviour (4.1)	<ul style="list-style-type: none"> • HCP to advise parents on how to perform the behaviour using brief verbal messages tailored for each vaccination time-point (2, 4, 6, 12 and 13 months) <ul style="list-style-type: none"> ○ Brief verbal messages to be developed using existing HSE National Healthy Childhood Programme (NHCP)/Nurture resources to ensure message consistency

	<ul style="list-style-type: none"> ○ Brief verbal messages to be delivered in non-judgemental and positive communication style, and in consideration of differing individual parent needs • HCP to provide parent with intervention resources (CHERIsH leaflet, signposting to child health website, magnet with reminder of verbal messages and infant bib signposting to child health website) which provide further reinforcement regarding how to perform behaviour <ul style="list-style-type: none"> ○ Parent intervention resources to be developed using existing HSE National Healthy Childhood Programme (NHCP)/Nurture resources to ensure message consistency
Information about health consequences (5.1)	<ul style="list-style-type: none"> • HCP to provide parent with CHERIsH leaflet and child health website (parent intervention resources) which will emphasise health consequences of healthy infant feeding behaviours including long-term health benefits
Information about social and environmental consequences (5.3)	<ul style="list-style-type: none"> • HCP to provide parent with CHERIsH leaflet and child health website (parent intervention resources) which will emphasise social and environmental consequences of healthy infant feeding behaviours including long-term cost and other benefits

Adding objects to the environment (12.5)	<ul style="list-style-type: none"> • HCP to provide parent with parent intervention resources including a fridge magnet and an infant bib with reminder to provide further reinforcement regarding how to perform behaviour
Restructuring the physical environment (12.1)	<ul style="list-style-type: none"> • HCP to provide parent with parent intervention resources including a fridge magnet and an infant bib with reminder to provide further reinforcement regarding how to perform behaviour
Credible source (9.1)	<ul style="list-style-type: none"> • HCP and intervention resources to emphasise credibility and trustworthiness of intervention and associated resources both verbally and through use of HSE National Healthy Childhood Programme logos and branding
Prompts, cues (7.1)	<ul style="list-style-type: none"> • HCP to provide parent with magnet with reminder of verbal messages and infant bib signposting to child health website (parent intervention resources) which will act as prompt/cue for the behaviour
HCP behaviour²	
Credible source (9.1)	<ul style="list-style-type: none"> • CHERIsH researchers to deliver HCP training alongside senior primary care dietician from the NHCP Nurture team and to emphasise credibility and trustworthiness of training providers (e.g. explicit mention of provider credentials and intervention funding) and evidence-based intervention resources (e.g. HSE Nurture website) <ul style="list-style-type: none"> ○ HCP training to be embedded within existing clinic CPD training schedule

	<ul style="list-style-type: none"> ○ HCP training to be developed using existing HSE National Healthy Childhood Programme (NHCP)/Nurture resources to ensure message consistency • HCP training to highlight importance of the HCP as credible source for parents and for the importance of non-judgemental trusting relationships and communication between parent and HCPs • Local practitioner representative (TH) to be used as local opinion leader to provide ongoing verbal support for the behaviour and influence other HCPs to deliver intervention
<p>Information about social and environmental consequences (5.3)</p>	<ul style="list-style-type: none"> • HCP training and training resources (Powerpoint slides and HCP training manual) to emphasise (verbally and written) health, social and environmental consequences of healthy infant feeding behaviours including long-term cost and social/environmental benefits • HCPs to also be provided with parent intervention resources (CHERISH leaflet and child health website) which will emphasise social and environmental consequences of healthy infant feeding behaviours including long-term cost and other benefits
<p>Information about health consequences (5.1)</p>	<ul style="list-style-type: none"> • HCP training and training resources to emphasise (verbally and written) health, social and environmental consequences of healthy infant feeding behaviours including long-term health benefits • HCPs to also be provided with parent intervention resources, which will emphasise health consequences of healthy infant feeding behaviours including long-term health benefits

<p>Instruction on how to perform behaviour (4.1)</p>	<ul style="list-style-type: none"> • HCP training to advise HCPs on what verbal messages to provide at each time-point and how to do this in addition to provision of parent intervention resources
<p>Demonstration of the behaviour (6.1)</p>	<ul style="list-style-type: none"> • HCP training to provide HCPs with an observable example of how to deliver brief verbal messages and intervention resources
<p>Behavioural practice/rehearsal (8.1)</p>	<ul style="list-style-type: none"> • HCP training to prompt HCPs to practice delivery of verbal messages and intervention materials during the training, in order to increase habit and skill
<p>Adding objects to the environment (12.5)</p>	<ul style="list-style-type: none"> • HCPs to be provided with training resources and CHERIsH poster with verbal messages on it for vaccination rooms as well as parent intervention resources to facilitate performance of the behaviour
<p>Restructuring the physical environment (12.1)</p>	<ul style="list-style-type: none"> • Automated computerised prompts to be used to remind HCP to deliver intervention at vaccination visits • CHERIsH poster with verbal messages on it to be given to HCPs to put up in vaccination rooms

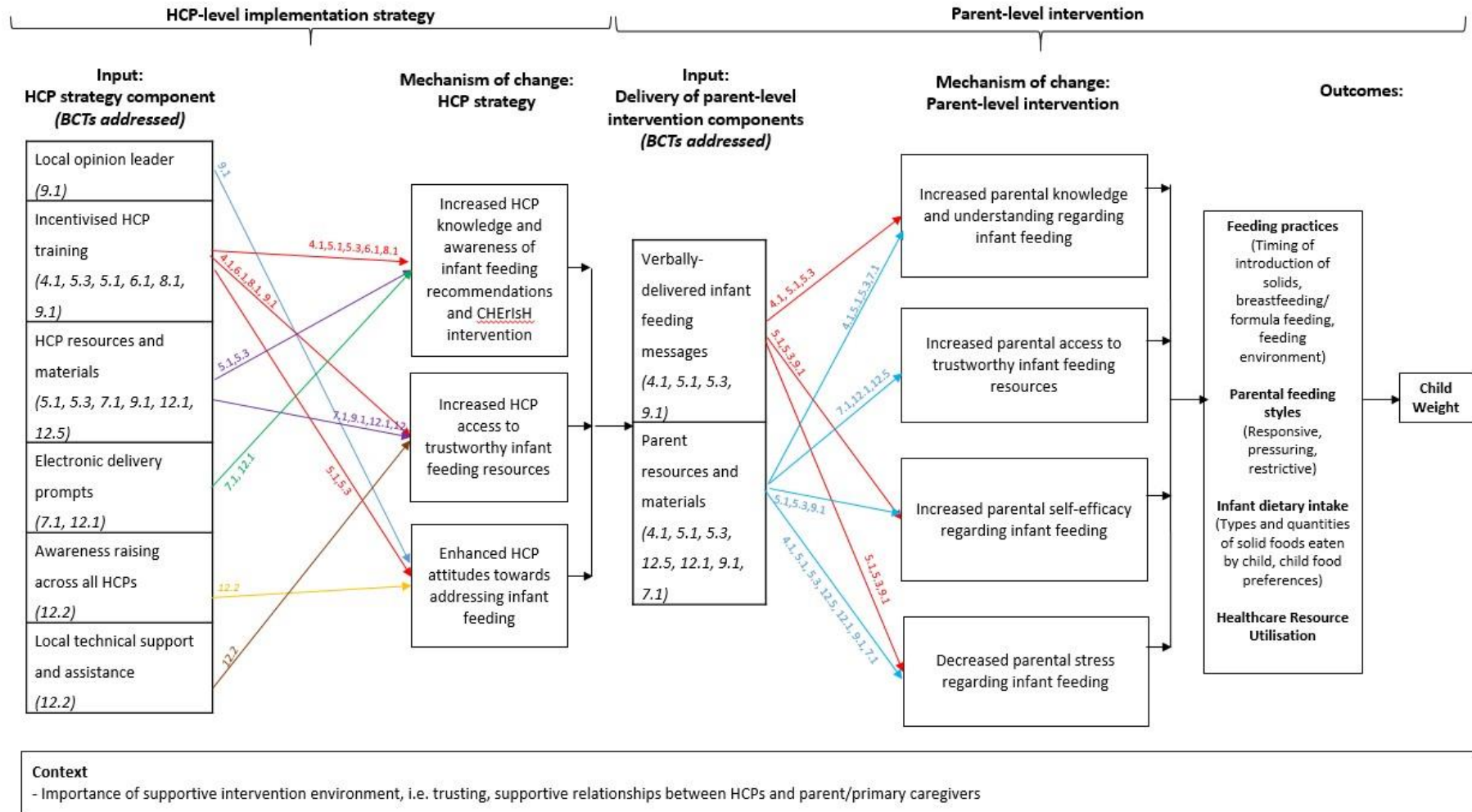
Restructuring the social environment (12.2)	<ul style="list-style-type: none"> Local primary care HCPs (e.g. PHNs, dieticians etc) beyond those delivering the intervention (GPs, PNs) to be made aware of the CHerIsH intervention to ensure clarity and consistency across HCP roles and intervention message On-site study administrator to provide ongoing technical support and assistance for HCPs via to facilitate delivery of intervention
Prompts/cues (7.1)	<ul style="list-style-type: none"> Automated computerised prompts to be used to remind HCP to deliver intervention at vaccination visits CHerIsH poster with verbal messages on it to be given to HCPs to put up in vaccination rooms to remind HCP to deliver intervention at vaccination visits

697 *NHCP = National Healthy Childhood Programme; ¹Parent behaviour = Parents to adhere to guideline-based early infant feeding practices*
698 *between 0-2 years – Wait until as close to 26 weeks as possible to introduce solids (not before 17 weeks); Feed nutritious and developmentally*
699 *suitable foods; Respond appropriately to child’s hunger & satiety cues; ²HCP behaviour = GPs/PNs to provide guideline-based information and*
700 *support regarding infant feeding and introduction of solid foods (0-2 years) in primary care during vaccination visits at 2,4,6,12,13mo.*

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703 **Figure 1: Logic model of the finalised intervention**



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Footnote: Numbers on arrows represent BCTs used to target specific mechanisms - these BCT numbers are explained in Tables 2 and 3; HCPs = healthcare professionals; BCT = behaviour change technique