

1 **Sports concussion management using Facebook: A feasibility study of an innovative** 2 **adjunct “iCon”**

3

4 Context:

5 Sports concussion is currently the focus of much international attention. Innovative methods
6 of facilitating management following this injury need to be investigated to assist athletic
7 trainers.

8 Objective:

9 The objective of this study was to investigate the feasibility of using a Facebook concussion
10 management program termed "iCon" ("interactive concussion management") to facilitate the
11 safe return to play (RTP) of young persons following a sports concussion.

12 Design:

13 This qualitative study was designed as a single-group observational feasibility study using
14 programme evaluation methodology, with the focus on gauging the suitability of the
15 Facebook management strategy for a potential larger study.

16 Setting:

17 iCon involved a Facebook group containing interactive elements, with moderation and
18 support from trained healthcare professionals.

19 Patients or Other Participants:

20 Eleven participants completed the study (n=9 males, n=2 females), and ranged from 18 to 28
21 years old.

22 Data Collection and Analysis:

23 The study was conducted over a three-month period, with participant questionnaires
24 administered pre- and post-intervention. The primary focus was on the qualitative

25 experiences of the participants in the study, and the effect of iCon on their RTP. Usage data
26 was also collected during the study.

27 **Results:**

28 At the completion of the study, all participants (100%) stated that they would recommend an
29 intervention such as iCon to others, with their supporting quotes all indicating that iCon has
30 the potential to improve the management of concussion amongst this cohort. The majority of
31 participants (n=9 or 82%) stated they were better informed with regards to their RTP because
32 of participating in iCon.

33 **Conclusions:**

34 This interactive adjunct to traditional concussion management was appreciated amongst this
35 particular participant group and indicated feasibility for a future, larger study of iCon.
36 Athletic trainers should consider the role that multimedia technologies may play in assisting
37 with the management of sports concussion.

38

39 **Keywords:** Internet, Social Media, Brain Concussion, Facebook, Programme Evaluation.

40

41 **Introduction:**

42 Sports concussion is currently considered a “hot topic”, both in the mainstream media [1, 2]
43 and in the scholarly literature [3, 4]. The impact of concussion has dominated the dialogue in
44 many professional sports [5-7], and its implications are recognised at the amateur level [8].
45 The cost of sport concussion can be defined in financial [9], and societal terms [10], as well
46 as impact on well-being (health)[11]. Due to these consequences much focus has been placed
47 on technologies which can aid the detection of concussion [12, 13], however, less attention
48 has been placed on facilitating and managing recovery following concussion. Given the
49 accepted significance of sports concussion as a leading public health concern [14], it is
50 prudent to explore a wide array of approaches in order to facilitate the recovery of individuals
51 following a sports concussion and assist the role that athletic trainers play in this process [15].
52 An area of healthcare which has not been fully explored in respect to sports concussion is
53 “eHealth” which is defined as “health services and information delivered or enhanced
54 through the Internet and related technologies” [16]. While early eHealth interventions were
55 centered around simplistic communication methods such as text messaging [17], the
56 sophisticated nature of the internet has led to more nuanced approaches being developed to
57 online health interventions [18]. The advent and widespread uptake of social media has been
58 a factor in this process [19]. Social media (including platforms such as Facebook, Twitter and
59 YouTube) are now ubiquitous throughout society and are widely used for a variety of
60 everyday purposes, including as a popular adjunct in healthcare [20-22].
61 Some exploration of the use of evolving technologies to assist the management of sports
62 concussion has recently been described in the clinical literature [23, 24], and there is also a
63 growing awareness of the role that technology can play in the detection of sports concussion
64 [25, 26]. The emergence of smartphone applications (or “apps”) in the field of health has seen
65 the development of multiple apps which are tailored towards sports concussion [27, 28]. A

66 systematic review by Lee and colleagues [25] demonstrated that the currently available
67 concussion-related apps are targeted towards a wide range of consumers (including: medical
68 professionals, the general public, and the parents of young sports persons). The content of the
69 concussion information present in these apps was shown to vary in its quality and
70 consistency, with many concussion-related apps failing to provide information to consumers
71 that adhered to best-practice concussion guidelines [25].

72 Prior research has described the use of websites and social media for the dissemination of
73 concussion-related information. An earlier study by Ahmed et al (2010) described a content
74 evaluation of concussion-related Facebook groups, and used the term “iSupport” to describe
75 the process by which persons with a concussion were communicating with each other and
76 seeking support via Facebook [29]. The same authors also analyzed concussion-related
77 websites and found that the standard of online information available for consumers was
78 inconsistent [30], while further investigations have been conducted into the content of
79 concussion-related information on Twitter [31, 32]. Facebook support groups have been
80 shown to be beneficial for a range of conditions including breast cancer [33], diabetes [34],
81 and for the parents of preterm infants [35]. The use of innovative strategies and technologies
82 to assist the diagnosis and management of concussion has been recognized and recommended
83 in the concussion in sport (CIS) consensus statement [3] and the National Athletic Trainer’s
84 Association position statement [15]. Furthermore, the use of social media has been
85 mentioned as a means of facilitating concussion education [36].

86 With the widespread use of social media (in particular Facebook), allied with the high
87 prevalence of sports concussion in the younger population, an exploration of the use of
88 Facebook to assist an individual in managing the recovery process was indicated. Therefore,
89 the aim of this study was to establish the feasibility of a Facebook concussion management
90 strategy termed “iCon” (“interactive concussion management”) to facilitate the management

91 and safe return to play of young persons with a sports concussion. The successful
92 implementation of a concussion management adjunct such as iCon could lead to a range of
93 benefits including; providing the patient with interactive and real-time feedback, giving ATs
94 an additional tool to help manage their player's return to play, and potentially easing some of
95 the burden from the patient's medical provider.

96

97

98 **Methods**

99 **Study design**

100 This qualitative study was designed as a single-group observational feasibility study, with the
101 focus on gauging the suitability of the Facebook management strategy for a potential larger
102 study [37]. Programme Evaluation methodology [38] was adopted to help assess its
103 feasibility, and this methodology was selected to provide a comprehensive approach which
104 extended beyond outcome measures. By using this approach, it was anticipated that the
105 multiple facets of the study (including the participant satisfaction and dynamics within the
106 intervention) could be evaluated. Data were collected prior to, during, and following the
107 introduction of iCon. The study began after the first participant was entered into the group,
108 and ended 90 days after this point.

109 **Ethical approval:**

110 Ethical approval was obtained from the University of XXXX Human Ethics Committee,
111 XXXXX, prior to commencing this study.

112

113 **Design of iCon:**

114 Previous related studies [29, 30] indicated that online resources were a potentially valuable
115 means of assisting an individual with a concussion. Prior to the creation of iCon, consultation

116 was undertaken with different key stakeholder groups; namely young persons with a sports
117 concussion [39] and the primary care physicians responsible for their care [40]. These
118 primary stakeholders were supportive of Facebook to be used in this manner. An explorative
119 study was also undertaken of the ethical issues related to the use of Facebook to deliver a
120 concussion intervention [41], and these issues helped to shape the creation of the iCon
121 content and operation.

122 iCon was designed to augment the face-to-face interactions individuals had with their primary
123 care physician. iCon was a Facebook group that was specifically designed for the purposes of
124 this trial, and contained the following key features (see Table 1):

125

- 126 • Best-practice concussion information at the time of the study;
- 127 • The ability to obtain real-time feedback from experienced medical personnel;
- 128 • A vehicle for peer support via interaction with other individuals who had sustained a
129 concussion in iCon.

130

131 For the purposes of privacy and confidentiality, iCon was established as a “secret” Facebook
132 group. This ensured that only the participants in iCon would be able to see the information
133 posted within the group, and that individuals external to iCon would not be able to view its
134 contents. Given that elite sportspersons would typically have access to high-level medical
135 services and have different needs to those of recreational athletes, iCon was targeted as a
136 community based intervention for non-professional athletes.

137

138 **iCon content**

139 All advice and recommendations in iCon were based on the most up-to- date concussion
140 information at the time the study was conducted, namely the 2008 international consensus

141 statement [42]. Since this study was completed these guidelines have been superseded by the
142 2012 international consensus statement [3] however the main premise relating to concussion
143 management is unchanged. The key content features of iCon are outlined in Table 1.

144

145 **iCon Staff**

146 Two individuals were responsible for providing input during iCon- the iCon Facilitator (iCF)
147 and the iCon Physician. The iCon Facilitator (XXX) was the person responsible for the day-
148 to-day management of iCon, and posted information relating to concussion and answered any
149 questions that were raised by the participants. The iCF was a sports physical therapist trained
150 to postgraduate level, who at the time of the study had 9 years of clinical experience
151 (including 5 years of working in elite sport). The iCF recorded details relating to participant
152 interaction during the pilot study, and monitored iCon on a daily basis (minimum x3/day, 7
153 days/week, for the 90-day period of the trial). A Facebook profile was created for the iCF
154 specifically for the purposes of this study. This profile contained information relating to their
155 professional/academic credentials, but no information relating to their personal life, hobbies,
156 interests etc. The iCF used this profile solely for the study. Any medical questions which
157 were outside of the iCF's scope of practice were referred to the iCon Physician. The iCon
158 Physician served in a consultancy capacity. Queries were forwarded to the iCon Physician by
159 email, and his reply would be posted on iCon by the iCF. The iCon Physician was a primary
160 care clinician at a university health center, had significant experience in working with sports
161 teams, young person's health, and had frequently encountered sports persons presenting with
162 concussion as part of his clinical caseload.

163

164 **Participants**

165 The target population was males and females between the ages of 16 and 30 years who had
166 sustained a recent concussion [44] while playing recreational or competitive sport.
167 Participants included those with a medical diagnosis or self-reported symptoms of
168 concussion, following an injury mechanism as defined in the 2008 consensus statement [42].
169 Individuals were not required to have a medically confirmed diagnosis of concussion prior to
170 registering for the study, nor were they required to be cleared prior to return to play (although
171 this was strongly encouraged through their participation in iCon). All participants in the study
172 were advised to seek medical review following their concussion if they had not already done
173 so. Individuals could not enroll into the study less than 3 days after their injury in order to
174 provide them with cognitive rest after their injury, and had to be able to consent to
175 participation. In order to participate in iCon all individuals had to either have a Facebook
176 account or be willing to create one for the purposes of the study, and had to have regular
177 access to the internet for the duration of their participation.

178

179 Sports concussions were the sole focus of this study, and individuals with a concussion
180 originating from other causes (e.g. road traffic accidents) were excluded. This was due to the
181 particular needs (specifically in return to play) associated with a sports-related concussion.

182 The age (16-30 years) reflected the demographic group who are at the highest risk of
183 concussion due to their participation in contact/collision sports [45, 46], and participants were
184 excluded if they were outside this age range. Participants were also excluded if their injury
185 involved hospitalisation for greater than 48 hours (suggesting more serious brain injury), if
186 they were unable to communicate verbally or in written English, or if they had concussion-
187 like symptoms due to other reported neurological conditions.

188

189 **Participant recruitment:**

190 Participants were able to enter iCon as soon as they had been identified and consented. A
191 comprehensive recruitment strategy in a provincial region of XXXXXX was used which
192 included: Referral from clinical staff members at medical practices and local sports injury
193 clinics; Poster advertisements at: medical practices/supermarkets/sports centers/residential
194 university residential colleges; postings on Facebook groups relevant to the target population;
195 emails to mailing lists for University students and staff; and by word of mouth.

196

197 Once a participant had consented to the study (using an online information form and consent
198 sheet) and was enrolled in iCon, they were sent an introductory Facebook message
199 welcoming them to the group. This message outlined the “house rules” for the group on
200 topics including: Uploading and sharing links/videos/photos; communicating with the iCF
201 and iCon Physician; and interactions with other iCon participants. Participants were invited to
202 contribute to iCon as often as they felt comfortable, and no pressure was placed on them to
203 contribute. Throughout the study, participants were informed that cognitive rest was a key
204 component of early concussion management. They were therefore instructed to use iCon for
205 short periods of time (no more than a few minutes at a time) in the early stages of their
206 recovery from concussion, and to increase their time spent participating in iCon as their
207 symptoms subsided or they felt this necessary/helpful.

208

209 Participants were told on their entry to the study that although iCon was likely to be of most
210 value to them in the first 3 weeks after their concussion, they were welcome to stay in iCon
211 after their symptoms resolved or diminished. Rationale for staying in the group was to allow
212 those with experience and advice to serve as a support group and help newer participants, in
213 keeping with previous work of online support groups [47]. The 90-day period for iCon was
214 chosen to coincide with the winter sports season, when a significant number of concussions

215 are generally reported due to the prevalence of the scheduling of collision sports [48].

216 Although the intention was that participants would remain in the study until its conclusion,
217 they were free to leave at any time.

218

219 **Pre iCon interview**

220 The purpose of the pre iCon interview was to obtain information regarding user familiarity
221 with Facebook, as well as injury information. The Pre-iCon interview and post-iCon
222 interview questions were generated by three members of the research team (XXX, XXX,
223 XXX), following exhaustive discussions regarding the major factors associated with the
224 concussive injury, its management, and subsequent return to play. The structured pre-iCon
225 interview was conducted by telephone by the iCF immediately prior to the participant
226 entering iCon. This interview collected demographic data and other information relating to
227 the participants and its content is outlined in Table 2. Data was collected related to
228 concussion symptoms and severity of symptoms as per the Sports Concussion Assessment
229 Tool 2 [44], and concussion knowledge was collected as a self-reported score. Following the
230 collection of data from the pre-and post-iCon interviews, relevant, verbatim quotes were
231 extracted from the interviews which best illustrated the content theme. Irrelevant comments
232 (e.g. “you know”, and “well, umm”) were also removed; samples of the verbatim quotes are
233 included in the results section.

234

235 At the conclusion of the interview, the responses to all questions were read back to the
236 participants for verification. Once the pre-iCon interview was concluded, the participant then
237 provided the iCF with their Facebook username (i.e. “Ed Knock”) and the email address
238 associated with their Facebook account (e.g. “edknock@hotmail.com”) to enable the

239 facilitator to identify their Facebook account. Once their Facebook account was identified,
240 they were added to the iCon group.

241

242 **Post-iCon interview**

243 Participants were asked to inform (via Facebook message, email or telephone) the iCF once
244 they had left the group, so that the iCF could then arrange for the post-iCon interview to be
245 conducted. For those participants who remained in the group until the 90-day study
246 concluded, the follow-up interview was conducted after this time. The post-iCon interview
247 was conducted by telephone within one week of their exit from iCon (regardless of their
248 mode of exit) and some of the content from this interview is outlined in Table 2. As per the
249 pre-iCon interview, verbatim quotes were extracted from the post-iCon interview. At the
250 conclusion of the study, all participants were prompted to seek any further medical assistance
251 relating to their concussion from their medical practitioner, if required.

252

253 ***Data organization:***

254 In keeping with the theoretical underpinning of the study, it was important to gather data on
255 several elements of the intervention in order to obtain a holistic understanding of how iCon
256 functioned. Table 3 shows the participant demographic data, whilst the remaining data were
257 classified into three broad categories:

- 258 • **Outcome data:** Included to show changes in the symptoms and knowledge of the
259 participants (Tables 4 and 5);
- 260 • **Operational data:** Gathered to show how participants used iCon (Table 6);
- 261 • **Evaluation data:** Used to gauge the opinions of the participants towards iCon and
262 their satisfaction with the support received in iCon (Table 7).

263

264 **Results**

265

266 **Participant demographic information:**

267 A total of 11 participants participated in the study (Table 3). The majority of participants
268 (N=7) identified themselves as XXXXX, while the other reported participant ethnicities
269 included XXXXX (N=1), XXXXX (N=2), and XXXXX (N=1). Playing Rugby Union was
270 the most common cause of concussion amongst the participants (N=6); the other sports which
271 led to injury were soccer (N=2), basketball (N=1), netball (N=1), and skiing (N=1). All
272 participants had a Facebook account and were familiar with the use of Facebook.

273

274 **Outcome data:**

275 Tables 4 and 5 contain a summary of the “cleaned”, verbatim quotes from the pre- and post-
276 iCon interviews. As shown in Table 4 almost all of the participants (10/11) reported that their
277 concussion knowledge had increased during iCon, with only one participant (#04) stating no
278 change. Key learning points highlighted by the participants following iCon included: the need
279 to rest following concussion (including allowing undisturbed sleep); the importance of a
280 graded RTP; and the need to be symptom-free prior to returning to sport. Table 5 also
281 demonstrates that iCon had a notable effect on the RTP decisions, with 9/11 participants
282 stating they were better informed with their RTP because of participating in iCon. However,
283 of these 9 participants, only 2 followed the advice provided by iCon regarding seeking
284 medical clearance prior to RTP.

285

286 **Operational data:**

287 To show the extent of their interaction with content in iCon, activity data for all of the
288 participants in iCon was also recorded. It was not possible to see when participants had

289 logged in, and therefore this was determined by the visible contributions that participants had
290 made to the group or to the iCF. Three participants (#03, #04, and #11) had no activity
291 recorded for their time in iCon. Of the remaining participants only one participant (#01) sent
292 private messages to the iCF, with all of the other participants (with the exception of #06)
293 making one or more public posts in iCon. The option of “liking” content on Facebook was
294 used by three participants (#01, #02, and #05), and a total of 5 topics from four participants
295 (#01, #02, #05, and #07) were considered outside of the scope of practice of the iCF and were
296 therefore referred onto the iCon Physician.

297 In addition to these activity data, the post-iCon interview contained questions relating to the
298 participants’ usage of iCon and the quotes from these interviews are summarized in Table 6.
299 Participants reported visiting iCon for varying durations, with 5 participants stating that they
300 interacted with iCon “3-4 times each day” and all participants spending between 2 minutes
301 and 30 minutes on iCon during each visit. Almost all of the participants (10/11) stated that
302 they did not use Facebook during the study period more than they would usually, with the
303 majority of these (N=9) suggesting that their similar usage patterns of Facebook during the
304 study period was not related to any worsening of symptoms. One participant (#02) stated that
305 they did use Facebook more than usual because of iCon during the duration of the study “to
306 check for new information daily”.

307

308 **Evaluation data:**

309 One of the key measures of the study was the participant’s satisfaction with iCon. To better
310 understand the participant’s satisfaction with the different elements of support in iCon, they
311 were questioned with regards to their satisfaction with the iCF/iCon Physician and their
312 satisfaction with the other participants. Table 7 shows both the satisfaction scores and
313 accompanying quotes demonstrating that the participants felt supported through iCon.

314 Maximum satisfaction scores (5/5) were reported by 8/11 participants for the support from
315 the iCF/iCon Physician. Fewer participants scored the support from the other participants as
316 highly beneficial, while 4/11 participants also stated that they felt “very satisfied” with the
317 support from their peers. The quotes accompanying the satisfaction scores for support from
318 the other participants highlighted the lack of interaction between participants as a potential
319 explanation for this. All of the participants stated that they felt secure in sharing information
320 in iCon, and no concerns were raised by participants regarding security. The final question of
321 the post-iCon interview asked if the participants would recommend iCon, and all participants
322 (N=11) stated that they would.

323

324 **Discussion:**

325 The primary goal of this study was to evaluate the feasibility of a novel and innovative
326 approach to concussion management, and in doing so to drive and inform future research.
327 This innovative program is one of the first examples of using a social media approach to
328 facilitate safe return-to-play following a sports concussion. One of the key findings that
329 emerged was that all participants (N=11) stated that “they would” recommend iCon to others
330 The post-iCon interview data indicated that iCon showed potential to be successful on a
331 larger scale, with supporting quotes such as “*All questions asked were answered really quick,
332 and it was easier than phoning the physician and asking for advice*” (Participant #05)
333 suggesting that the use of Facebook as an adjunct for concussion management was appealing
334 to this cohort of individuals. Another indication of the success of the iCon were the
335 satisfaction scores and accompanying quotes, which indicated that the participants were
336 predominantly “very satisfied” with the support they were given in iCon, both from the
337 iCF/iCon Physician and from the other participants.

338 A notable aspect of the intervention was that the majority (8/11, 73%) of participants stated
339 that their return to play decisions were influenced by iCon. Education is recognized as being
340 crucial in the management of sports-related concussion [50], and the importance of this
341 knowledge transfer process related specifically to concussion has been highlighted in the
342 literature [51, 52]. The post-iCon questionnaire data indicated that using iCon directly
343 affected their decision making in this regard in seeking a more conservative return to play,
344 and it is inferred that the participants would also be better informed of the need to seek
345 medical review in the event that they were concussed in the future. This study was not
346 designed to analyze the long-term behavioral changes of the participants; thus there is no way
347 of knowing if there were any long term changes in this behavior or retained concussion
348 knowledge[53].

349 It was anticipated that the majority of participants in the study would see a reduction in their
350 symptom scores regardless of their participation on iCon, and this was confirmed in the data.
351 Although it is assumed that the symptom self-reporting by telephone in the pre and post-iCon
352 interviews was accurate, it must be acknowledged that differences have been reported in
353 concussion symptom reporting between interviews and from self-reporting questionnaires
354 [54]. Participant activity in iCon was not expected to be uniform, and it was thus
355 unsurprising that three participants (#3, #4, and #11) had no activity at all recorded for their
356 time in Facebook. This does not mean that these individuals did not use iCon during the
357 period of the study, but rather that they did not make any public postings in the group. It may
358 have been that these participants demonstrated the behaviour of “lurkers” (passive
359 participants in online groups), with studies showing that lurkers may gain as much benefit
360 from online groups as active posters [55]. Although the post-iCon interview did not question
361 this explicitly, the satisfaction scores for these three participants were high (4/5 or 5/5) and
362 indicate that they still obtained some benefit from participating in iCon. Earlier work has

363 identified individuals with concussion supporting each other in Facebook concussion groups
364 [56], however in iCon there was relatively little iSupport (“interactive support”) witnessed
365 between participants in terms of offering messages of support relating to concussion. It may
366 have been that interaction occurred through private messages between participants in iCon,
367 although it was not possible to measure this as these private messages are only visible to the
368 sender and recipient.

369 Although the utilisation of Facebook for social support by individuals with both traumatic
370 brain injury [57] and concussion [29] has been previously investigated, the use of Facebook
371 by healthcare professionals to assist the recovery following a sports concussion is a new
372 concept. This innovative method of interacting with individuals with a sports concussion is
373 associated with a myriad of associated ethical issues [41], with a major consideration being
374 the concept of cognitive rest [58]. The 2008 CIS consensus statement [44], which constituted
375 the guiding principles at the time of this study discusses the importance of cognitive rest
376 following concussion, and this has been further reinforced in the most recent consensus
377 statement [3]. It could be argued that using Facebook when recovering from concussion is
378 contrary to this advice. However the authors are in agreement with others [59] that total
379 cognitive rest is impractical, and that using social media for concussion management in a
380 controlled manner could be beneficial to the recovery process. The 2012 CIS consensus
381 statement [3] does not advocate total cognitive rest, with Gibson et al [59] also suggesting
382 that prolonged cognitive rest following concussion is not entirely advisable and should be
383 approached cautiously. Steps were taken to address this factor; at the time of joining iCon
384 participants were clearly instructed to cease using Facebook if their symptoms worsened, and
385 to only use iCon for limited periods in the early stages following their injury.

386 Despite sustained efforts and the use of an extensive recruitment process only 11 participants
387 were enrolled into the study, representing a relatively small sample size. The timing of the

388 study coincided with the winter sports season when concussion rates were highest, and as a
389 result it was expected that a larger number of participants would be recruited. Reasons for the
390 relatively small sample size could include the lack of reporting or recognition of concussion.
391 Several studies have highlighted that concussions are typically under-reported in young rugby
392 players [60-62] and in sport in general [63-65], and this lack of reporting would have limited
393 the ability of local medical personnel to alert these individuals to the study. The process of
394 knowledge transfer is only possible if individuals are keen to participate in their self-
395 management, and this lack of engagement is a barrier that needs to be overcome if concussion
396 interventions such as iCon are to be successful on a larger scale. Given the sample size in this
397 group, the guarantee of success for this approach in a larger population cannot be stated with
398 certainty. The nature of an intervention such as iCon is that the information within it is fluid,
399 and therefore the content and advice could be targeted to a specific group, organisation, or
400 sporting code. This may be beneficial for athletic trainers working with different sporting
401 populations, and could assist their efforts to manage concussion at a state level. ATs will
402 frequently have to manage sports concussion in their clinical environment, and novel
403 methods to improve compliance with concussion management should be encouraged. In some
404 instances, it is not appropriate or feasible for individuals with concussion to return to clinic
405 for follow-up, and innovations such as iCon may serve as a mechanism for ATs to utilise
406 across multiple environments.

407 Inclusion criteria for iCon did not specify that participants needed to be symptomatic upon
408 entering the group, only that they needed to have had a sports-related concussion within the
409 past 3 weeks. As a consequence, several participants reported none or very few concussion
410 symptoms upon entry to iCon. It can be speculated that these participants may have
411 benefitted more from their participation in iCon if they were enrolled in the study sooner after
412 their concussion while they were still symptomatic, as the information given to them in iCon

413 would assist in the management of their symptoms. Earlier identification and enrolment of
414 participants would enable this to be evaluated. The implications in terms of the financial costs
415 involved are difficult to predict, but it may be that rolling out a system such as iCon on a
416 larger scale may incur costs from the length of time needed for multiple clinicians to develop
417 and maintain accurate information, and review and respond to posts from participants. A final
418 consideration is that the pre-iCon interview did not ask about how participants primarily
419 accessed Facebook; namely whether they did this via a desktop computer at
420 school/work/university, through a laptop computer, or using a mobile device (a cell phone or
421 tablet device such as an iPad). Further questioning regarding this area may have provided
422 additional insight as to how participants accessed iCon, and also help to shape the design of
423 future online concussion interventions.

424 This interactive adjunct to traditional concussion management strategies was appreciated
425 amongst this particular participant group and indicated feasibility for a future, larger study of
426 iCon. Given the relatively low numbers of participants in this trial, one way of ensuring
427 larger numbers in the future would be to conduct a multi-centre trial (especially given the
428 current greater awareness of concussion). Larger participant numbers would have a
429 consequential effect on the moderation of the group, and may require more than one
430 individual to perform the roles of iCF and iCon Physician respectively. Since this study
431 ended there has been a sharp rise in the use of smartphone apps for health, including in the
432 field of sports medicine [25, 66]. It is recognised that innovations such as online health
433 interventions evolve and change over time [67], and at present the use of smartphone apps is
434 gaining attention in relation to concussion [25, 68]. In addition to a future trial of iCon,
435 further exploration of concussion-related technologies is warranted to assess their role in
436 assisting with the management of sports concussion.

437

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