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1 Title: The impact of a clinical prediction tool (BuRN-Tool) for child maltreatment on social care  
2 outcomes for children attending hospital with a burn or scald injury

3

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11

12 Declarations of interest: none

13

14

15 Highlights:

16 The impact of a clinical prediction tool (BuRN-Tool), designed to calculate a score for likelihood of child  
17 abuse or neglect in children attending hospital, was evaluated using data from 17 local authorities.

18 Overall, the introduction of the BuRN-Tool in hospital did not increase the percentage of children  
19 receiving social care interventions.

20 A BuRN-Tool-score of  $\geq 3$  was associated with a greater likelihood of social care taking action, either at  
21 the time or within 6 months of a burn injury.

22

23

## 24 **Abstract**

25 Burns are common childhood injuries and 10-20% are associated with maltreatment. This prospective  
26 before/after study investigated the impact of introducing the BuRN-Tool (a child maltreatment clinical  
27 prediction tool), on actions taken by children's social care department (CSC). Before introduction (pre-  
28 intervention): we collected standardised data on cause and characteristics of burns, in four regional  
29 hospitals. A BuRN-Tool-score was calculated retrospectively pre-intervention and by the attending  
30 clinician post-intervention. CSC involvement and actions taken relative to BuRN-Tool-score were  
31 compared pre- and post-BuRN-Tool.

32 Data were collected for 1688 children from 17 local authorities. The percentage that received a CSC  
33 action decreased post-BuRN-Tool (pre: 58.0%, 51/88; post: 37.5%, 33/88,  $p=0.007$ ). A greater  
34 percentage of cases with a BuRN-Tool-score of  $\geq 3$  had a CSC action, than those with a BuRN-Tool-score  
35  $< 3$ , pre-intervention ( $\geq 3$  70.0%, 35/50;  $< 3$  45.8%, 11/24,  $p= 0.04$ ) and post-intervention ( $\geq 3$  50.0%,  
36 21/42;  $< 3$  19.2%, 5/26,  $p=0.01$ ). Children with a BuRN-Tool-score  $\geq 3$  but no contact/referral recorded  
37 by CSC for the burn, and those who had a contact/referral but no action taken, were significantly more  
38 likely than those scoring  $< 3$  to have new CSC involvement within six months following the burn.

39 The BuRN-Tool-score  $\geq 3$  has the potential to alert clinicians to maltreatment concerns.

40 Key words: neglect; abuse; safeguarding; child protection; clinical prediction tool; children's burns.

41

## 42 Introduction

43 Maltreatment of children is a serious problem. The Crime Survey for England and Wales [1] estimated  
44 that 20% of adults experienced at least one form of child abuse before the age of 16 years, including  
45 emotional abuse, physical abuse, sexual abuse, or witnessing domestic violence. In the UK, when  
46 professionals have concerns about child maltreatment, they should make a referral to their local  
47 authority children's social care (CSC) department, which may result in an assessment and further  
48 intervention to protect the child. In England, and other parts of the UK, more and more children are  
49 having contact with children's services. One recent study estimated that as many as 1 in 4 children will  
50 have contact with statutory children's services before their 16<sup>th</sup> birthday.[1] The number of children  
51 subject to assessment following a referral has increased by 21% since 2014/15, while the number of  
52 child protection investigations has increased by 129% since 2010.[2] The number of children subject  
53 to child protection plans has also increased by 32% over a similar period (2009 – 2020; [2]), while the  
54 number of children in care has gone up by 24%.[3]

55 One of the ways in which child maltreatment may come to the attention of health services is when a  
56 child with an injury attends a hospital emergency department (ED). Identifying maltreatment in young  
57 children presenting to busy EDs can be a challenge given the high volume of patients, pressure to  
58 manage and discharge patients quickly, and a high staff turnover with variable paediatric experience.  
59 This could be improved by a standardised injury assessment and the use of a clinical prediction tool to  
60 identify child maltreatment, so that health (and CSC workers) can intervene to prevent future  
61 maltreatment and optimise the health and wellbeing of these children.

62 Burns are common childhood injuries, with an estimated 40,000 children in the UK,[4] and 500,000  
63 children in the USA,[5] attending ED with burn every year. The majority of these injuries are  
64 unintentional, however international studies have estimated the proportion of children's burns due  
65 to maltreatment at 10 – 25%.[6,7,8,9,10]

66 The 'BuRN-Tool' is a clinical prediction tool to identify burns suspected to have arisen from  
67 maltreatment.[11] This tool was developed by a multi-disciplinary team of child health clinicians and  
68 researchers from a review of the scientific evidence [12] and an epidemiological study that compared  
69 childhood burns from maltreatment with accidental burns (2008-2010).[13] The BuRN-Tool gives a  
70 composite score (BT-score) derived from several risk factors in the child's history and examination  
71 recorded on a specific proforma, the BaSAT (Burns and Scalds Assessment Template: S1 Fig). A  
72 prospective validation study was conducted in 2014-2015 from 1327 children with burns and a cut off  
73 score of three or above was identified as indicating concern for maltreatment.[11] We have previously  
74 described the impact of the BuRN-Tool in EDs on the identification of safeguarding concerns in  
75 children presenting with burns [14] and the potential value of the BuRN-Tool to clinicians in busy ED  
76 departments.[15] The principal findings were that 82% of clinicians surveyed found the standardised  
77 data collection format of the BaSAT and the BuRN-Tool a useful adjunct to clinical practice [15] and a  
78 BT-score of three or more encouraged discussion of cases of concern with senior colleagues, and  
79 increased the referral of children younger than five years with safeguarding concerns to CSC.[14] We  
80 now present the impact of the BuRN-Tool on Child Protection assessments and Child Protection  
81 interventions undertaken by CSC for children who had attended ED with a burn injury. CSC are located  
82 in local authority offices, not in the ED or Burns Units, but hospital-based social workers did attend  
83 review meetings to discuss cases of concern referred from hospital settings.

84 The aim of this study was to investigate the impact of the BuRN-Tool on the CSC outcomes for children  
85 attending ED with a burn. The objectives were to measure contact/referrals recorded by CSC and the  
86 resulting assessments or interventions taken by CSC, CSC involvement in the six months following the  
87 burn injury, and to explore the relationship between BT-score and CSC involvement pre and post  
88 introduction of the BuRN-Tool in clinical practice.

89 We hypothesise firstly that a greater percentage of the cases scoring  $\geq 3$  would be recorded by CSC,  
90 secondly that a greater percentage of the children with a score  $\geq 3$  would receive a CSC action following  
91 introduction of the BuRN-Tool in clinical practice.

## 92 **Material and methods**

### 93 **Study design**

94 This study used a prospective multicentre before and after design to compare the CSC outcomes for  
95 children with a burn injury before and after the introduction of the BuRN-Tool intervention.

### 96 **Population**

97 Children <16 years of age presenting with a burn injury at four EDs and two regional burns units at  
98 four hospitals across England and Wales over a period of three years from April 2015 to March 2018  
99 were recruited to the study, herein referred to as centres A-D. In the two centres with burns units  
100 there are emergency attendance units where children may be seen on first attending with their burn.  
101 Burns Units can accept direct admissions, especially when transferred from a district hospital (where  
102 the BuRN-Tool may not have been used). Burn injury information was collected throughout the study  
103 using a structured proforma (the BaSAT: S1 Fig). Victims of household fires were excluded, as they  
104 were for the original BuRN-Tool validation, because it is difficult to show associations with child abuse  
105 and neglect from the injuries caused. Burns from housefires are a clinically different group, often with  
106 smoke inhalation as the major problem.

### 107 **Intervention**

108 The intervention, a clinical prediction tool (BuRN-Tool: Fig 1) designed to identify potential cases of  
109 child abuse or neglect,[13,14] was added to the BaSAT once a minimum of 200 children had entered  
110 the study from each hospital site. Based on previous research [13] sample size calculations were  
111 carried out during the study planning stage and both this and medical attendance data from PERUKI  
112 (Paediatric Emergency Research in the United Kingdom & Ireland) suggested that 200 cases from each  
113 study centre would both provide enough power and be feasible in the time frame available for data  
114 collection. The BuRN-Tool was used by clinicians to manually calculate a BT-score depending on

115 answers to seven elements within the BaSAT. In one centre the BT-score was automatically calculated  
116 from fields in the BaSAT which was incorporated into the child's electronic clinical record. Each of the  
117 seven elements within the BuRN-Tool received a weighted numerical score. If the total BT-score  
118 reached a threshold of three or above, the BuRN-Tool recommended that local safeguarding pathways  
119 were followed. The CSC department was not informed about the BT-score if a referral was made.

#### 120 **Fig 1. Burns Risk assessment of Neglect and maltreatment in children Tool (BuRN-Tool)**

121 Prior to the introduction of the BuRN-Tool, each of the seven elements were recorded on the BaSAT  
122 as part of the clinicians' standardised assessment, and a derived BT-score was calculated  
123 retrospectively by the research team for each case entering the study.

124 The clinical teams were provided with standardised training on the use of the BaSAT and BuRN-Tool.  
125 This training was provided online for new staff joining clinical teams following the introduction of the  
126 BuRN-Tool.

#### 127 **Social care data collection**

128 CSC outcomes were collected from the local authorities in which the children were resident. The local  
129 authority for each child was identified using postcode information held in hospital electronic records  
130 and an Office for National Statistics look-up table.[16] All local authorities were approached  
131 individually by email and telephone to seek their permission to access their data and access  
132 arrangements were made to ensure anonymity of cases and to suit preferences of each organisation.  
133 Data sharing agreements were drafted for those hospital centres and local authorities who requested  
134 them.

135 For each child within the study, information was sought on any Child Protection CSC involvement  
136 during the six months before or six months following the burn injury (including any record of domestic  
137 violence), and any CSC involvement as a direct result of a contact/referral for the burn were recorded  
138 on the project proforma (S1 File). These data were collected to enable the research team to

139 corroborate CSC involvement prior to or at the time of the burn, to ensure that any CSC assessment  
140 or intervention outcome recorded was due to the burn and not ongoing interventions. Six months  
141 was considered appropriate as a follow up period as a proxy measure for 'missed Child Protection  
142 cases' and a time frame that was close to the burn incident. Safeguarding issues beyond that time  
143 frame were assumed to be more likely to be related to changing circumstances for the child and family.  
144 Data for Child in Need activities related to disabilities or asylum seeking were not collected.

145 Whether a contact/referral from an external agency was recorded in CSC records for the burn injury,  
146 who this came from and any assessments or interventions (referred to as 'CSC actions' herein) arising  
147 as a result, were recorded in detail as follows: if there was any assessment undertaken (i.e. a Child in  
148 Need assessment, a Child Protection enquiry or child protection meeting held (i.e. a strategy meeting  
149 or Child Protection conference (as defined by UK legislation, Child Protection Act 1989, section 47)  
150 [17]), or any intervention: i.e. support actions including any contact made with the family by a social  
151 worker (home visit, telephone call or letter), whether other community support services or other  
152 health services were recommended, a new Child in Need (or Child in Need of Care and Support, in  
153 Wales) plan, a new Child Protection plan (or Child Protection Registration, in Wales), or whether there  
154 was a decision that the child should be looked after. A *looked after child* is a child living in any out-of-  
155 home placement organised by the local authority with the parent's agreement or via a court order or  
156 (in some cases) still living at home while subject to a court order.

## 157 **Data cleaning**

158 There were a number of children who were treated at an ED in one centre and a burns unit in another,  
159 and hence had two BaSATs completed for the same injury. If the safeguarding referral decision did not  
160 match between these two records but one record recorded a safeguarding referral to CSC or Hospital  
161 Safeguarding team (HSG) this record was retained together with the BuRN-Tool score that reflected  
162 child maltreatment concern for that record. If the centres were at different points in the study cycle



163 and children had one record completed pre and one post BuRN-Tool intervention, both records were  
164 excluded from the study.

## 165 **Analysis**

### 166 **Data ascertainment**

167 The number of local authorities from which CSC data were obtained and the percentage of eligible  
168 cases that these data represent were calculated for each hospital centre.

### 169 **Demographics**

170 The characteristics of the population for which CSC outcomes were collected was described before  
171 and after the BuRN-Tool was introduced. Demographic characteristics included the child's age and BT-  
172 score, gender, burn type, and CSC involvement for Child Protection reasons during the six months  
173 preceding the injury.

### 174 **Contact/referrals received by CSC**

175 The percentage of burn injuries with a contact/referral documented in the CSC records was described  
176 according to whether a referral was recorded on the BaSAT and the nature of the referral.

177 The percentage of burn injuries that had a contact/referral before and after the BuRN-Tool was  
178 introduced was compared by age (for children less than five years or older than five years), by

179 BT-score: i)  $<3$  (below the threshold of concern), ii) BT-score  $\geq 3$  (above the threshold of concern), or  
180 iii) where the score was missing / incomplete. The sensitivity and specificity for contact/referral to CSC  
181 were calculated for a BT-score  $\geq 3$ .

### 182 **CSC actions taken**

183 The percentage of contact/referrals that resulted in CSC actions were compared before and after the  
184 introduction of the BuRN-Tool and were compared for i) those scoring  $<3$  and  $\geq 3$ , ii) between those

185 <5 and  $\geq 5$  years of age and iii) between those with a previous CSC involvement for child protection  
186 concerns in the six months prior to the burn and those without.

187 To gain an understanding of whether cases of maltreatment had potentially been missed we analysed  
188 the contact/referrals recorded by CSC and CSC actions taken in the six months after the burn incident  
189 according to the BT-score in two groups of children, namely; for the children who were referred to  
190 CSC but no CSC assessment or intervention was implemented and for the cases that were not referred  
191 to CSC.

## 192 **Statistical methods**

193 Numerical demographic variables were described using means and were compared before and after  
194 the BuRN-Tool introduction using two-tailed t-tests. All comparisons of percentages were conducted  
195 using non-parametric Chi-square tests. Multivariable logistic regressions were conducted on  
196 demographic differences pre and post intervention, and the effect of the BuRN-Tool score and  
197 demographic characteristics on contact/referrals recorded by CSC. Odds ratios and 95% confidence  
198 intervals are reported in S1 Table. Significance level was set to  $P < 0.05$ . All analyses were conducted in  
199 Stata v 15.1.[918] Sensitivity and specificity calculations of contact/referral and BT-score of  $\geq 3$  was  
200 calculated using MedCalc online software.[19]

## 201 **Ethical and Study Approvals**

202 This was an unconsented study. Ethical approval for the study was obtained for data collected  
203 between April 2015 and March 2016 (MREC 13/WA/0003) and from April 2016 to March 2018 (MREC  
204 15/WA/0259). Approval from Confidentiality Advisory Group (CAG 1-06(PR7)/2013 and 15/CAG0203)  
205 was received to enable data collection from case notes for research with waived consent. Study  
206 approval was gained from the Association of Directors of Children's Services in England, and Local  
207 Safeguarding Children Boards in Wales. SOCSCI ethical approval SREC/1878 May 2016, ADCS ref.  
208 RGE180123:18/03/2018)

## 209 **Results**

### 210 **Data ascertainment**

211 After exclusions there were 2406 eligible burn incidents and 1688 (70.2%) were followed up with CSC  
212 (Table 1). Two centres included regional burns units and children came from a wide geographical area,  
213 and there were often small numbers of children from many of the local authorities. We prioritised the  
214 follow-up of children from the local authorities that served the main catchment area of each hospital  
215 centre, as many of the peripheral local authorities were unable to participate in the study. The  
216 percentage of children with burns for whom it was possible to follow-up in CSC records ranged from  
217 86.7% in Centre B to 41.7% in Centre D (Table 1).

### 218 **Demographics**

219 Age, gender, burn type, previous CSC involvement and BT-score of the population followed up by CSC  
220 were not significantly different pre- and post-introduction of the BuRN-Tool (Table 2). These lack of  
221 differences pre and post remain in multivariable analysis adjusting for all other variables (see S1 Table  
222 A).

### 223 **Contact/referrals received by CSC**

224 Overall, 11.0% (88/802) of burn incidents had a contact/referral documented in CSC records before  
225 the BuRN-Tool was introduced, and this did not change afterwards: 9.9% (88/886) ( $p=0.48$ ) (Table 3).  
226 The source of the contact/referral documented in CSC records varied. Contact/referrals from the study  
227 centres were recorded for 62 incidents before and 64 incidents after the BuRN-Tool was introduced  
228 (Table 3), but of these only 59.7% (37/62) pre- and 48.4% (31/64) post-BuRN-Tool were marked on  
229 the BaSAT as having been referred to CSC or HSG (Fig 2).

230 There were 26 burn incidents pre-BuRN-Tool and 24 post-BuRN-Tool that were documented as being  
231 referred from other sources (e.g. ambulance services, multi-agency safeguarding teams, members of

232 the public). Of these, three (pre) and eight (post) were also recorded on the BaSAT to have been  
233 referred to CSC or to HSG. The percentage of <5 year-olds with a contact/referral was significantly  
234 greater than for those older than 5 years both before and after the introduction of the BuRN-Tool  
235 (pre-BuRN-Tool <5 years 12.4% vs. ≥5 years 7.8%,  $p=0.05$ ; post-BuRN-Tool <5 years 11.3% vs. ≥5 years  
236 6.5%,  $p=0.04$ ).

237 **Fig 2. Number and percentage of burn injuries with contact/referral documented by Children's**  
238 **Social Care (CSC) and source of the referral.**

239 Source of referral from a study centre or from another source, recorded by CSC, according to the  
240 safeguarding referral recorded by the clinician completing the BaSAT, pre- and post-BuRN-Tool  
241 introduction.

242 A significantly greater percentage ( $p<0.001$ ) of contacts/referrals recorded by CSC had a BT-score  $\geq 3$   
243 (pre 56.8%, 50/88; post 47.7%, 42/88) than a BT-score  $< 3$  (pre 27.3%, 24/88; post 29.5%, 26/88) or  
244 had an incomplete or missing score (pre 15.9%, 14/88; post 22.7%, 20/88) (Table 4). However, there  
245 was no evidence of a difference ( $p=0.34$ ) between the percentage of cases scoring  $\geq 3$  that had a  
246 contact/referral recorded by CSC pre- (24.6%, 50/203), vs post-BuRN-Tool (20.6%, 42/203).

247 For the 1512 children who had no contact/referral recorded in CSC records, there was no evidence of  
248 a difference ( $p=0.80$ ) between the percentages of BT-scores ( $\geq 3$ ,  $< 3$  or missing) before and after the  
249 BuRN-Tool was introduced (Table 4). The effect of age, BuRN-Tool score and prior CSC involvement  
250 remained significant factors in multivariable analysis adjusting for all three factors (S1 Table B).

251 Following the introduction of the BuRN-Tool, the sensitivity of a BT-score  $\geq 3$  for CSC contact/referral  
252 was 61.8% (95% CI 49.2%-73.3%) and specificity 75.6% (95% CI 72.1%-78.8%) (missing data excluded).

253 **CSC actions taken**

254 The percentage of cases with a contact/referral recorded by CSC that had a CSC action was significantly  
255 lower ( $p=0.007$ ) post-BuRN-Tool (37.5%, 33/88), than pre-BuRN-Tool (58.0%, 51/88). Cases with a BT-

256 score  $\geq 3$  had more CSC actions taken than those scoring  $< 3$ , both before ( $\geq 3$  70.0%,  $< 3$  45.8%,  $p=$   
257 0.04) and after ( $\geq 3$  50.0%,  $< 3$  19.2%,  $p=0.01$ ) the BuRN-Tool was introduced (Table 5).

258 There was no evidence of a difference in the percentage of contact/referrals to CSC who had a CSC  
259 action when broken down by age, either pre ( $< 5$  years 60.9%, 42/69;  $\geq 5$  years 47.4%, 9/19,  $p=0.29$ ),  
260 or post ( $< 5$  years 40.3% 29/72;  $\geq 5$  years 25%, 4/16,  $p=0.25$ ) introduction of the BuRN-Tool.

261 There were 36 (18 pre- and 18 post-BuRN-Tool) children who had ongoing CSC involvement from the  
262 six months before the burn. Eight of these children had CSC involvement for child protection concerns  
263 but no plan implemented, 8 had a Child in Need plan, 15 had a Child Protection plan and five were  
264 looked after children. There was no significant evidence of a difference between the percentage of  
265 CSC actions undertaken between those who had ongoing Child Protection involvement or not either  
266 pre- (Child Protection involved 50.0%, 9/18; not involved 60.0%, 42/70,  $p=0.44$  or post-BuRN-Tool  
267 (Child Protection involved 27.8%, 5/18; not involved 40.0%, 28/70,  $p=0.34$ ).

268 Throughout the study there were 70 children referred to CSC who received no CSC action. In the six  
269 months following the burn injury, 38.9% (14/36) of those children who had a BT-score  $\geq 3$  were  
270 subsequently referred to CSC for safeguarding concerns, a significantly higher percentage than the  
271 14.7% (5/34) of those with a BT-score  $< 3$  that were subsequently referred ( $p=0.02$ ). Similarly, where a  
272 contact/referral for the burn had not been recorded by CSC ( $n=1512$ ), a greater percentage of children  
273 with a BT-score  $\geq 3$  had new CSC involvement in the six months following the burn injury (14.6%,  
274 46/314) compared to those who had a BT-score  $< 3$  (8.2%, 76/932) or those with missing or incomplete  
275 BT-scores (6.4%, 17/266) ( $p=0.006$ ).

## 276 Discussion

277 The BuRN-Tool intervention in hospitals did not change the percentage or characteristic of  
278 contacts/referrals recorded by CSC and, contrary to expectations, fewer cases received an assessment  
279 or intervention from CSC after the BuRN-Tool was introduced. However, the BuRN-Tool threshold (BT

280 score  $\geq 3$ ) was associated with a greater proportion of children who would, following a referral, be  
281 subject to further actions by CSC.

282 The BT-score cut off of three is supported by the finding that a contact /referral to CSC was made for  
283 significantly more children with a BT-score  $\geq 3$  than for those with a score  $< 3$  and for those who were  
284 referred; CSC assessment, support and Child Protection interventions were more likely for those with  
285 a BT-score  $\geq 3$  than  $< 3$  both before and after the BuRN-Tool was introduced. Furthermore, children  
286 with a BT-Score  $\geq 3$  who were not referred to CSC were subsequently more likely to receive a CSC  
287 assessment or child protection intervention in the six months after the burn than those with a BT score  
288  $< 3$ . It is therefore reasonable to hypothesise that the BuRN-Tool has the capability to identify children  
289 about whom CSC would be more likely to take further action post-referral. Our previous  
290 publication[14] estimated that 1 in 3 cases with a BT-score  $\geq 3$  were referred to HSG or CSC for child  
291 protection concerns and in this study cohort, CSC recorded a contact/referral for half of the cases with  
292 a BT-score  $\geq 3$ . These findings suggest that if ED clinicians had followed the recommendations for a BT-  
293 score  $\geq 3$  more closely, some children could potentially have been assessed by CSC sooner.

294 Why the CSC actions taken in response to contact/referrals reduced following the introduction of the  
295 BuRN-Tool remains unclear, but may be related to information sharing challenges between health and  
296 CSC. Referral pathways were difficult to follow directly from clinical records. Cases marked as  
297 'referred' to CSC in clinical records did not directly correlate with those cases which had a  
298 contact/referral recorded within CSC records, and it is likely that some complexity exists in the  
299 information sharing, recording and decision-making processes. The mechanism by which the BuRN-  
300 Tool might influence CSC practice and decision-making is not well understood. BT-scores were not  
301 disclosed in the contact/referrals to CSC and it is possible that, with training for CSC intake teams, and  
302 provision of a BT-score to CSC this could make a difference to prioritisation of cases for intervention.

303 Nationally, CSC services are undertaking increasing numbers of child protection investigations,  
304 without a commensurate increase in the number of child protection plans. This could suggest that

305 many families are being assessed on the basis of suspected maltreatment unnecessarily. Such actions  
306 are not 'cost-free', either for professionals, in terms of resources, or for the families, in terms of  
307 disruption to family life and emotional trauma.[20,21] Alternatively, it is possible that staffing and  
308 resources simply cannot meet the higher demand of increased referrals. However, it must also be  
309 noted that CSC budgets have been increased over the past decades, and there are more children and  
310 family social workers too.[22] Yet these increased budgets have increasingly been used for statutory  
311 services, including child protection investigations and spending on children in care, with less money  
312 available for early help and family support. Throughout the BuRN-Tool derivation, validation and  
313 impact studies the baseline and post intervention rates of referral to CSC have remained remarkably  
314 similar [14,15] in both intervention and control centres. This does not mean, of course, that the 'right  
315 children' are necessarily being referred and assessed, or that every child protection investigation is  
316 carried out fully and to the same extent. Such questions are beyond the scope of this article. What is  
317 important to highlight is that the introduction of the BuRN-Tool did not increase the number of  
318 contact/referrals made, and therefore did not contribute to the increasing workload of CSC.

319 For children already known to CSC for child protection concerns, social workers may make decisions  
320 more heavily reliant on prior contextual knowledge of the family than the detail of the current referral.  
321 Previous referrals to CSC (particularly from external agencies) have been highlighted as a key factor in  
322 CSC decision making.[23-26] The BuRN-Tool score is heavily weighted by cases with previous Child  
323 Protection concerns, which is deemed by healthcare workers as a cause for concern and as an indicator  
324 that CSC should be alerted to such cases, and it is possible that this introduces a potential bias within  
325 the tool. However, this study found no increased likelihood of an assessment or action where there  
326 had been some involvement from CSC in the six months prior to the burn.

327 Undertaking this research demonstrated the difficulties in evaluating the impact of clinical prediction  
328 tools applied in the healthcare setting on a safeguarding outcome taken by local authorities. This may  
329 explain why there is limited literature on outcomes or effectiveness of such prediction tools.[9,27]

330 The outcome measure of further involvement in term of actions taken by CSC is likely to be affected  
331 by the different thresholds for intervention applied by different safeguarding teams. Despite extensive  
332 logistic challenges in collecting CSC outcomes from the multiple local authorities, we were able to  
333 collect outcome data for 70.2% of the eligible attendances. The sample was demographically  
334 comparable to the overall population in the previously published paper [14] that analysed Child  
335 Protection referrals as recorded within clinical notes. However, we were unable to follow up all  
336 children because of lack of permission from local authorities, with anxieties about confidentiality,  
337 concurrent Ofsted (Office for Standards in Education, Children’s Services and Skills) inspections, and  
338 lack of administrative resources to facilitate data collection. The study team took the pragmatic  
339 decision to focus on the local authorities with the largest number of children attending hospital with  
340 a burn injury and found that obtaining permission and support from the local Safeguarding Board was  
341 key to gaining access to the necessary data. Some CSC teams had more available resource than others  
342 to take part in the research (e.g. available staff or computer access for a visiting researcher). Secondly,  
343 it was challenging to capture the referral pathways taken because the recording of referrals across  
344 agencies was inconsistent. It is conceivable that the referral was made by one of the multiagency  
345 partners and not recorded as arising directly from the hospital.

346 The strengths of the study were the prospective design and the large sample size from four regional  
347 hospitals. A dedicated researcher, or CSC staff member, collected the outcomes from CSC records  
348 according to a structured proforma. The limitations were the missing data from some local authorities  
349 and the low follow-up rate for one of the four centres. CSC departments, team managers and social  
350 workers were not aware of the BT-score, which had the advantage of blinding them to the relative risk  
351 of cases (BuRN-Tool score) referred to them. Co-ordination of this study across health and CSC was  
352 challenged by the number of local authorities involved, the lack of resources and coinciding work  
353 pressures on CSC that prevented their participation, and the inconsistencies between health and CSC  
354 records. The study was not powered as an equivalence or no difference trial.



355

## 356 **Conclusion**

357 A contact /referral to CSC was made for significantly more children with a BT-score  $\geq 3$  than for those  
358 with a score  $< 3$  and for those who were referred; CSC assessment, support and Child Protection  
359 interventions were more likely for those with a BT-score  $\geq 3$  than  $< 3$  both before and after the BuRN-  
360 Tool was introduced. The finding that the percentage of children who received CSC action following  
361 contact/referral for the burn injury significantly decreased post-BuRN-Tool, warrants further  
362 investigation and does not justify widening the use of the BuRN-Tool at this stage.

363 However, the BuRN-Tool has shown some potential to help identify which children with burns will  
364 likely receive a CSC response, and could help clinicians and CSC practitioners identify who these  
365 children are at an earlier stage. Further research should explore why this might be and whether a  
366 positive impact could be achieved if CSC practitioners were aware of the evidence base of the tool and  
367 the significance of a BT-score  $\geq 3$ .

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## 380 **Author contributions**

381 VB: Investigation, Data curation, Formal analysis, Writing – original draft, Writing – review & editing

382 LH: Writing – review & editing

383 DW: Writing – review & editing

384 AE: Funding Acquisition, Writing – review & editing

385 AK: Funding Acquisition, Supervision, Formal analysis, Writing – original draft, Writing – review &  
386 editing

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456 **Supporting information captions**

457 **S1 Fig. Burns and Scalds Assessment Template (BaSAT)**

458 **S1 File. Children’s Social Care (CSC) outcomes data collection pro-forma**

459 **S1 Table. Multivariate logistic regression results**