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Mental Wellbeing of Health Care Workers in Lusaka, Zambia During the COVID-19 Pandemic

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Mental Wellbeing of Health Care Workers in Lusaka, Zambia During the COVID-19 Pandemic

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Keywords: Health Care Workers, Depression, COVID-19, PHQ-9

Abstract

Objectives: We sought to assess mental health among HCWs in the context of COVID-19 across 24 health facilities in Lusaka Province, Zambia.

Methods: We implemented the, well-validated, Patient Health Questionnaire (PHQ-9) to assess depression through a cross-sectional study of HCWs recruited through convenience sampling during 11 August - 15 October 2020 during the second wave of the COVID-19 epidemic in Zambia. Potential participants were invited from 24 government-funded health facilities in Lusaka Province, Zambia. We used mixed-effects, adjusted Poisson regression to estimate the marginal probability of HCW experiencing depression that may warrant intervention (PHQ-9 score ≥ 5) by healthcare facility.

Results: We collected PHQ-9 survey responses from 713 professional and lay HCWs. Overall, 334 (46.8%, 95% CI: 43.1, .50.6%) HCWs recorded a PHQ-9 score ≥ 5 , indicating the need for further screening and assessment for mental health disorders, as well as preventative interventions, to minimize the possibility of poor health outcomes. We identified significant heterogeneity across facilities and observed a greater proportion of HCWs in facilities providing COVID-19 testing and treatment services with symptoms of depression.

Conclusions: Mental wellbeing may be a concern for a large proportion of HCW in Zambia. Further work to understand the magnitude and etiologies of mental health disorders amongst HCW in the public sector is needed to design effective interventions to meet the need for mental health support.

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3 25 **BMJ Open Questions:**

4 26 *Strengths and Limitations of this study*

- 5 27
- 6 27 • These data represent important insight regarding the state of mental wellness among a large
 - 7 28 sample of healthcare workers during a public health crisis in a resource limited setting.
 - 8 28
 - 9 29 • Mental wellness, like depression, is not documented well in resource limited settings and
 - 10 30 we measure here mental wellness in a high-risk group of healthcare workers during the
 - 11 30 COVID-19 pandemic.
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 - 13 31
 - 14 32 • An important limitation is lack of data on demographics of healthcare worker respondents
 - 15 32 due to concern about stigma around mental wellness and potential to identify individuals
 - 16 33 given inclusion of clinics with small staff.
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 - 20 35 • We include a large number (N=24) of facilities to appreciate the heterogeneity in symptoms
 - 21 35 of depression among mental health in the sampled facilities in Lusaka Province of Zambia.
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38 Introduction

39 Coronavirus disease 2019 (COVID-19) has caused substantial global health hardship and
40 healthcare workers (HCWs) position on the frontlines of the public health response, places them
41 at great risk for negative effects on health and wellbeing. In addition to excess occupational hazard
42 of contracting COVID-19, their experience as care givers increases risk of developing mental
43 health disorders such as anxiety, depression, trauma, insomnia, and stress, which may lead to poor
44 physical and psychological wellbeing [1]. A healthy workforce is critical to effectively managing
45 and mitigating COVID-19, as well as providing continuity of high-quality care for other chronic
46 and acute health conditions [2, 3]. Even prior to COVID-19, countries in sub-Saharan Africa faced
47 limited medical infrastructure, supplies, and an over-burdened workforce, which challenged the
48 provision of quality healthcare [4, 5]. These challenges, along with pandemic-sensitive barriers
49 such as limited access to personal protective equipment (PPE) further exacerbated HCW stress and
50 vulnerability. While HCWs in resource limited settings have demonstrated resilience, poor mental
51 health is likely to compromise their ability to make decisions, as well as impact patient interactions
52 [6]. Mental health services, like other health resources, are limited, with few trained mental health
53 providers[7]. Understanding mental health and wellbeing among HCWs can catalyze interventions
54 to provide treatment and improve the healthcare facility environment for the HCWs and patients
55 [7].

56 Several studies have been conducted to assess mental wellness impact of the pandemic amongst
57 HCWs however, the majority of these studies focus on the continent of Asia and very little data is
58 available for HCWs in Africa [8, 9]. Limited data from Kenya and Ethiopia provides evidence that
59 the prevalence of mental disorders such as depression, insomnia and stress were higher among
60 those HCWs caring for patients with COVID-19, or in areas of higher infection prevalence
61 compared to those working with non-COVID-19 patients or less [1, 10-14]. The most prevalent
62 reported mental health conditions among health care workers are depression, insomnia, and
63 anxiety [15]. Characterization of the state of mental wellness during the COVID-19 pandemic in
64 Sub-Saharan African countries among HCWs, specifically in Zambia remains incomplete [10, 16].

65
66 As part of a larger patient-centered care study, we collected facility-level measures to understand
67 the context of care at 24 study sites. As a part of establishing care context we assessed mental
68 health, specifically depression, using the nine item Patient Health Questionnaire (PHQ-9) in the

69 context of COVID-19 among HCWs in Lusaka Province, Zambia from 11 August 2020 to 15
70 October 2020 [17].

72 **Methods**

73 *Setting*

74 This cross-sectional study is nested within a larger study, Person Centered Public Health for HIV
75 Treatment in Zambia (PCPH), a cluster-randomized trial to assess HIV care and outcomes running
76 from August 2018 to November 2021 across 24 government-funded health facilities in Lusaka
77 Province (Pan African Clinical Trial Registry number: PACTR202101847907585). All
78 participating facilities offered HIV care services and varied in size and location. Facilities were
79 assigned codes to protect the identity of the HCW participants. As a part of the PCPH package
80 adaptation to the COVID-19 pandemic, we implemented the PHQ-9 to screen for presence and
81 severity of depression. The PHQ-9 has been previously used in Zambia to screen for likelihood of
82 depression [20], and has been validated in Tanzania and South Africa which are similar settings
83 as Zambia [18, 19]. The PHQ-9 instrument was translated from English into Nyanja and Bemba,
84 the most commonly spoken Zambian languages in Lusaka Province, where the survey was
85 conducted [20].

87 *Study Population*

88 We developed a cohort of HCWs that primarily provide HIV care at one of the 24 health facilities
89 in the PCPH study. This was done by compiling all HCW's contact details from the HCWs who
90 had, at the time of the introduction of the PHQ-9 measure to the study, participated in the HCW
91 survey component of the PCPH study. The PCPH sample was comprised of both professional and
92 lay HCWs including nurses, pharmacists, treatment supporters, midwives, medical doctors,
93 radiographers, and general workers. To augment participation in the PHQ-9 data collection, we
94 expanded the PHQ-9 sample to include any HCW willing to participate and had ≥ 6 months
95 working experience at the study facility. We informed the facility in-charge of the PHQ-9 study
96 opportunity who communicated it to staff members.

98 *Measurements*

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3 99 Trained study research assistants then visited the facility and discussed the study opportunity in-
4 person with available staff members. Those who expressed interest were screened for eligibility,
5 100 offered the opportunity to verbally consent and with immediate participation. Depending on the
6 101 participant preference, the standard PHQ-9 survey was self-administered on paper or surveyor-
7 102 administered by trained study research assistants in the participant's preferred language.
8 103 Potentially identifying information such as age, sex, and HCW cadre were not collected from
9 104 respondents to protect privacy.
10 105
11 106

17 107 *Analysis*

18 108 We followed the standard, 27-point scoring system for the PHQ-9 to identify participants with
19 109 scores consistent with minimal (0-4), mild (5-9), moderate (10-14), moderately severe (15-19),
20 110 and severe depression (20-27) [18]. Our main outcome was mild depression or great (PHQ-9 score
21 111 ≥ 5) as this level of depression warrants additional clinical follow-up. We developed frequency
22 112 tables and used a bar graphs to illustrate the distribution of PHQ-9 scores by healthcare facility.
23 113 We developed scatter plots of adjusted marginal probability with 95% confidence intervals to
24 114 illustrate the probability that a HCW will have a PHQ-9 score ≥ 5 by healthcare facility. We used
25 115 mixed effects Poisson regression to estimate prevalence ratios for those with mild depression
26 116 allowing random effects at the facility level and measured fixed effects for month of survey and
27 117 clinic size category. Facilities were categorized by client population estimates as small (<40,000
28 118 clients), medium (40,000-100,000 clients), and large (>100,000 clients).
29 119

39 120 *Patient and Public Involvement*

40 121 The parent study, focused primarily on improving the patient experience at routine clinic visits
41 122 through HCW mentorship and support including assessments of mental wellness through
42 123 administration of the PHQ-9 tool, the results of which are captured here. The research approach
43 124 and content is based on previous research, human-centered design workshops, and stakeholder
44 125 collaborations [21-27]. We invited HCWs from each of the study facilities to attend a human-
45 126 centered design workshop with expert direction from a professional consulting group in
46 127 Washington DC. The results of this workshop were incorporated into the patient experience
47 128 feedback summary design for the study clinics and the implementation of trained patient
48 129 assessment was modified to improve transparency and acceptability. Patients were not directly
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involved in the design, nor the recruitment of this sub-study assessing the mental wellness of HCWs. The findings of this study as well as the parent study will be shared with the Zambian Ministry of Health as well as the study facilities.

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134 *Ethics*

135 This study was approved as part of the larger PCPH study by the University of Zambia Biomedical
136 Ethics Committee and the University of Alabama at Birmingham Institution Review Board, and
137 the National Health Research Authority in Zambia. We obtained waiver of written informed
138 consent and obtained verbal consent from participants prior to administering the survey.

139

140 **Results**

141 A total of 713 HCWs from 24 facilities across Lusaka and Chongwe districts in the Lusaka
142 Province were included in the analysis dataset (**Table 1**). Of the 713 responses, 231 (32.4%)
143 reported mild depression (PHQ-9 score 5-9) and 81 (11.4%) reported moderate depression of
144 (PHQ-9 score 10-14). The majority (69.6%) of the PHQ-9 survey responses were collected in
145 September 2020 (**Table 1**). Responses for PHQ-9 questions were largely complete with <1%
146 responses missing.

147

148 **Table 1: Participant characteristics**

Factor	Level	n (%)
N		713
Facility	1	30 (4.2)
	2	30 (4.2)
	3	30 (4.2)
	4	30 (4.2)
	5	30 (4.2)
	6	30 (4.2)
	7	30 (4.2)
	8	30 (4.2)
	9	30 (4.2)
	10	30 (4.2)
	11	30 (4.2)
	12	27 (3.8)

	13	27 (3.8)
	14	30 (4.2)
	15	30 (4.2)
	16	30 (4.2)
	17	30 (4.2)
	18	30 (4.2)
	19	30 (4.2)
	20	30 (4.2)
	21	30 (4.2)
	22	30 (4.2)
	23	29 (4.1)
	24	30 (4.2)
Clinic Population (category)	Small	147 (20.6)
	Medium	269 (37.7)
	Large	297 (41.7)
PHQ-9 Score Category	minimal	379 (53.2)
	mild	231 (32.4)
	moderate	81 (11.4)
	moderately severe	17 (2.4)
	severe	5 (0.7)
Month of Survey	August 2020	205 (28.8)
	September 2020	496 (69.6)
	October 2020	12 (1.7)

149 Note: PHQ-9 – nine-item patient health questionnaire.

150
151 A total of 81 (11.4) respondents had a PHQ-9 score corresponding to moderate depression across
152 all but one facility, 17 (2.4%) respondents had PHQ-9 scores consistent with moderately severe
153 depression across four facilities and five (0.7%) HCWs had PHQ-9 scores consistent with severe
154 depression across five different facilities (**Fig 1, Table 2**).

155
156 **Table 2: Proportion of the analysis population by PHQ-9 score category with 95% confidence**
157 **intervals (N=713)**

<i>Variable</i>	<i>n</i>	<i>Proportion (%)</i>	<i>95% CI</i>
≥5 PHQ-9 score	334	46.8	(43.1, 50.6)
Mild	231	32.4	(29.0, 36.0)
Moderate	81	11.4	(9.1, 13.9)
Moderate-severe	17	2.4	(1.4, 3.8)
Severe	5	0.7	(0.2, 1.6)

158 Note: CI – confidence interval; PHQ-9 – nine-item patient health questionnaire.

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6 160 Though we observed facility-level mental health heterogeneity in proportion of minimal and
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8 161 mild depression scores across clinics, the proportion of scores consistent with moderate
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10 162 depression remain relatively stable across facilities (**Fig 1A**).

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14 164 **Figure 1: A) Stacked bar chart of proportion population by PHQ-9 score category by**
15 165 **healthcare facility B) Stacked bar chart of proportion population by PHQ-9 score by**
16 166 **facility population size category**
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19
20 169 Mixed effects adjusted Poisson regression model did not reveal clinic size or month of survey as
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22
23 170 a significant predictor of PHQ-9 score ≥ 5 (**Table 3**).

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26 172 **Table 3: Adjusted Poisson regression results (N=713)**

<i>Covariate</i>	<i>level</i>	<i>aPR</i>	<i>95% CI</i>	<i>p-value</i>
Clinic Population (category)	small	1.12	(0.95, 1.33)	0.170
	medium	1.00 (ref)	ref	ref
	large	1.04	(0.81, 1.33)	0.763
Month of Survey	August	1.00 (ref)	ref	ref
	September	1.14	(0.94, 1.38)	0.193
	October	0.98	(0.54, 1.79)	0.945

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37 173 Note: adjusted for survey week and facility
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40 175 We illustrate significant heterogeneity in the marginal probability of experiencing greater than
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42 176 minimal depression across facilities (**Fig 2**). Notably higher marginal probability of HCWs with
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44 177 PHQ-9 score ≥ 5 was observed in both COVID-19 treatment centers and non-COVID-19 treatment
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46 178 centers, facilities 4 and 16.

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49 180 **Figure 2: Marginal probability of healthcare worker with >minimal depression per PHQ-9**
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51 181 **score by clinic.**

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54 183 Note: PHQ-9 – nine-item patient health questionnaire.
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185 Discussion

186 We found that a large proportion of the HCW population had a PHQ-9 score ≥ 5 indicating need
187 for some level of mental wellness follow-up 46.8% (95% CI: 43.1, 50.6%). Variation in depression
188 outcomes ranged from 82.7% (95% CI: 68.5, 96.9%) at one of the two large COVID-19 treatment
189 facilities to 28.4% (95% CI: 13.0, 43.9%) at a medium-sized healthcare facility. Differences in
190 clinic characteristics, such as size of catchment population and location could contribute to the
191 variations in depression outcomes among the facilities.

192
193 Past studies show that frontline HCW working in clinics, considered to be highly infectious, such
194 as COVID-19 treatment centers, were more prone to developing depression and other mental
195 disorders than their counterparts in other departments [10]. This is in consistent with the results of
196 our study, which shows that HCWs working at COVID-19 treatment facilities had a marginal
197 probability of experiencing mild to moderately severe depression. In addition, results of our study
198 demonstrate that HCWs have experienced symptoms of depression during the onset of the COVID-
199 19 pandemic in Zambia, which is consistent with the findings of similar studies using the PHQ-9
200 in other parts of the world where a pooled prevalence of mild depression was found to be 36.1%
201 (95% confidence interval [CI], 31.3%-41.0%) [28]. Studies conducted in Zambia among nurses
202 and midwives, and in Ethiopia among different cadres of HCWs shows that mental disorders which
203 include depression are prevalent among HCWs during the COVID-19 pandemic [29]. Similarly,
204 globally studies, indicate, that the risk of HCWs developing mental health disorders during the
205 pandemic exist [3, 28, 29]. The difficult conditions to which HCWs may be exposed including
206 extended working hours, risk of exposure to the disease, increased workload exposure to the
207 disease, concerns about transmitting the infection to their family members, limited resources to
208 care for their patients, may exacerbate or initialize mental wellbeing issues leading to symptoms
209 of depression [30, 31].

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211 The heterogeneity in proportions of HCWs with depression may be driven by facility size, where
212 reduced resources at smaller facilities including, but not limited to, personal protective equipment
213 (PPE), hand hygiene station/station supplies at clinic entrance, and less access to knowledge about
214 the COVID-19 response in Zambia compared to larger facilities in urban Lusaka. While the
215 response to the COVID-19 pandemic was standardized, to a certain extent, by guidance from the

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3 216 provincial and zonal levels, the culture and leadership unique to each facility might have played a
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5 217 key role in the healthcare worker experience, contributing to PHQ-9 score distribution differences
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7 218 across facilities.

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10 220 As we continue to recognize the mental health services gap across many populations in resource-
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12 221 limited settings we give evidence here to support prioritization of healthcare workers, especially
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14 222 during public health shocks/emergencies like that presented by COVID-19. Mental wellness
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16 223 challenges among HCWs could lead to poor health outcomes for the HCW workforce and have a
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18 224 sort of “knock-on” effect negatively impacting the quality of care provided to patients [32, 33].
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20 225 Interventions like Friendship Bench piloted in neighboring Zimbabwe designed to encourage
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22 226 positive coping mechanism among HCWs and build a working environment that provides empathy
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24 227 and compassion towards staff may be an efficient option to provide mental wellness support [34,
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26 228 35]. Furthermore, system-based interventions should also be encouraged such as change in
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28 229 working culture and reduction in possible system contributors to HCW stress that could lead to
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30 230 depression. Increasing mobile technology availability may further allow for the use of mobile
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32 231 health (mHealth) based mental wellness services leveraging the framework presented by Osei for
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34 232 low- and middle-income countries [36, 37]. Low-cost intervention packages used for patients can
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36 233 be adapted for HCWs and integrated into system-based interventions. They include routine
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38 234 screening for early detection, mental wellness education, problem solving and use of anti-
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40 235 depressants, cognitive behavior therapy which can be delivered successfully by trained lay HCWs
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42 236 [38, 39].

43 237

44 238 **Limitations**

45 239 This study had some potential limitations. Firstly, we did not collect participants demographics
46
47 240 such as age, sex, marital status, and sex. As such we were not able to adjust for these co- founders.
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49 241 Accounting for these would help make associations in outcomes of depression. Secondly, we
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51 242 employed convenience sampling in selecting participants, this sampling approach may limit
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53 243 representativeness of study the results to the wider population of HCWs. Finally, without pre-
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55 244 COVID 19 estimates of depression among healthcare workers in Lusaka, we are not able to show
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57 245 association between mild-severe depression with the pandemic however, we show that during the
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59 246 pandemic that depression was high and attention to this population is justified to ensure a healthy

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3 247 HCW workforce. Additionally, though potentially highest than a non-pandemic baseline, these
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5 248 results may be useful as subsequent measures of depression and mental wellness are collected
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7 249 among HCWs.

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9
10 251 **Conclusions**

11 252 Depression is a common public health problem; our study demonstrates that HCWs in Zambia
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13 253 may suffer from a high prevalence of depressive symptoms. Routine mental health wellness is
14
15 254 important to better understand the role that the COVID-19 pandemic may have had on depression
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17 255 among HCWS in Zambia. Furthermore, support for HCW mental wellness can serve to accelerate
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19 256 destigmatizing mental health issues and improve the quality of care provided across healthcare
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21 257 centers in Zambia.

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3 **260 Competing interests**
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5 261 Authors do not have competing interests to report.
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7 262

8 **263 Authors' contributions**
9

10 264 SS: Data Collection, Data Framing, Manuscript Writing

11 265 JM: Data Collection, Data Curation, Data Analysis

12 266 MM: Data Collection, Data Curation

13 267 LJ: Data Framing

14 268 CB: Data Framing

15 269 KS: Conceptualization

16 270 IS: Conceptualization

17 271 CBM: Conceptualization

18 272 AM: Analysis Review, Manuscript Review/Editing

19 273 EHG: Conceptualization

20 274 AS: Conceptualization, Manuscript Review/Editing

21 275 LKB: Conceptualization, Data Analysis, Data Framing, Manuscript Writing

22 276 JMP: Data Analysis Lead, Data Framing, Manuscript Writing
23
24 277

25 **278 Author information**
26

27 279 [not aware of anything needed here]
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10 294

11
12 295 **Disclaimer**

13 296 None

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17 298 **List of abbreviations** [Optional]

18 299 ART: antiretroviral therapy

19 300 CI- Confidence Interval

20 301 COVID-19: Coronavirus Disease 2019

21 302 HCW: Health Care Worker

22 303 PCPH: Person- Centered Public Health for HIV Treatment in Zambia

23 304 PHQ-9: Patient Health Questionnaire 9

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27 306 **Data Sharing**

28 307 Data used for this analysis is available through Dryad data repository (doi:10.25338/B8S646)

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436 Supplement:

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438 Figure S1: Histogram of total PHQ-9 scores among study participants
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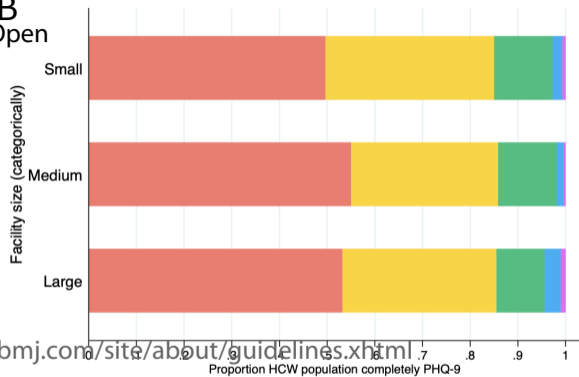
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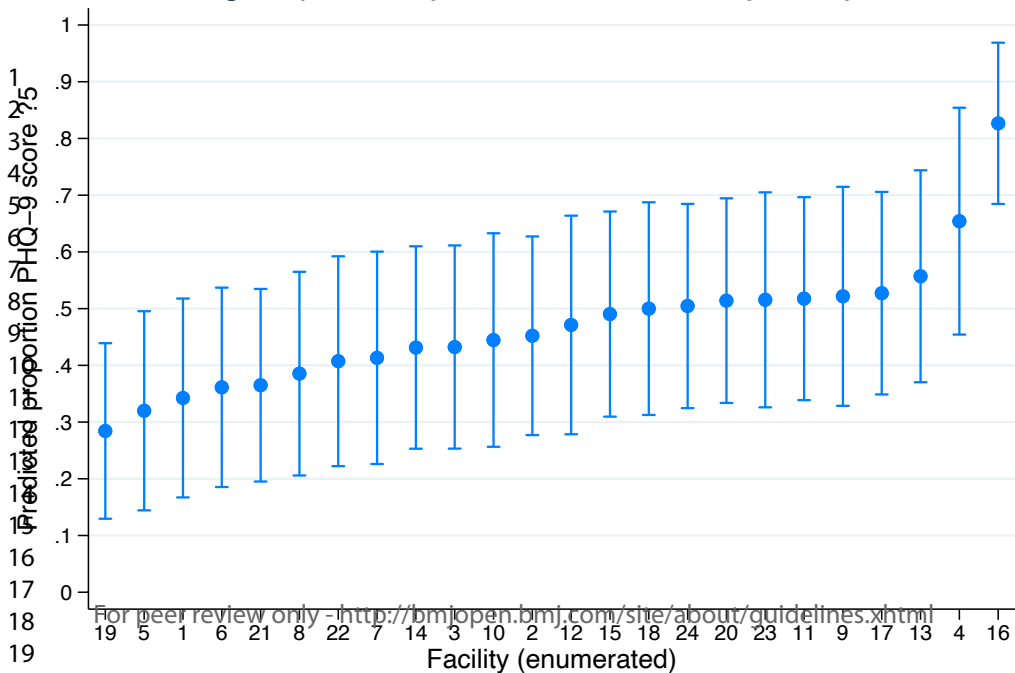


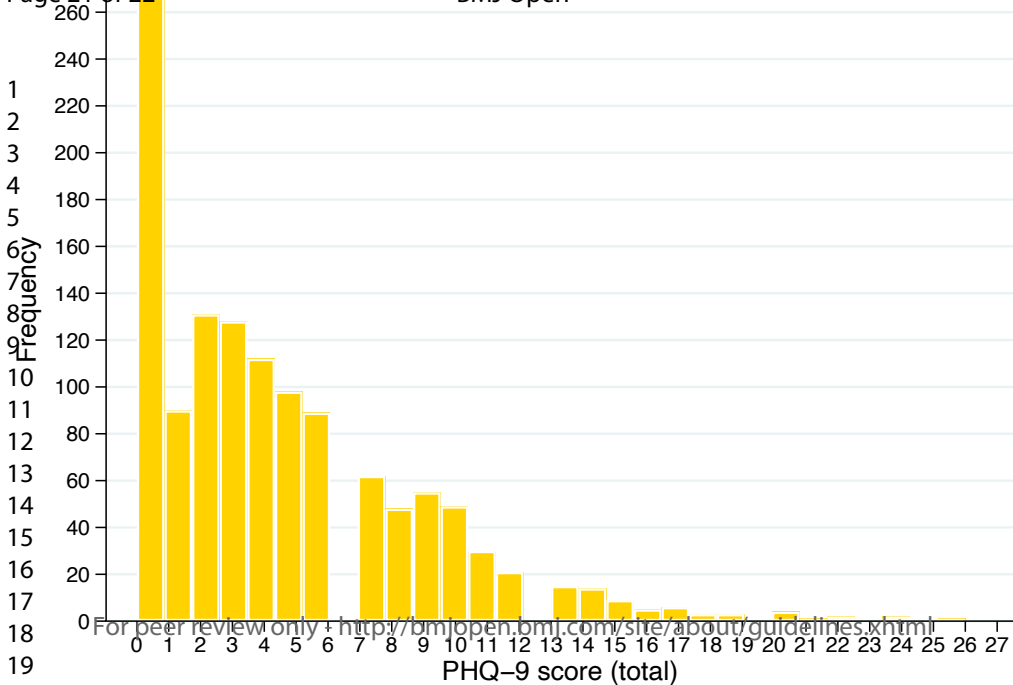
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BMJ Open



Minimal Mild Moderate Moderate-Severe Severe





STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4, 5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5, 6
		(b) For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5, 6
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5, 6
Bias	9	Describe any efforts to address potential sources of bias	5, 6
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5, 6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	6
		(b) Describe any methods used to examine subgroups and interactions	6
		(c) Explain how missing data were addressed	6
		(d) If applicable, explain how loss to follow-up was addressed	NA
		(e) Describe any sensitivity analyses	6
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7, 8
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7, 8
		(b) Indicate number of participants with missing data for each variable of interest	7, 8
		(c) Summarise follow-up time (eg, average and total amount)	NA
Outcome data	15*	Report numbers of outcome events or summary measures over time	7, 8

1	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7, 8
2			(b) Report category boundaries when continuous variables were categorized	7, 8
3			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
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5	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9
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11	Discussion			
12	Key results	18	Summarise key results with reference to study objectives	10
13	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11, 12
14	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9, 10
15	Generalisability	21	Discuss the generalisability (external validity) of the study results	9, 10
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17	Other information			
18	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13, 14
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*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

BMJ Open

A cross-sectional study to assess depression among health care workers in Lusaka, Zambia during the COVID-19 pandemic

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Primary Subject Heading:	Mental health
Secondary Subject Heading:	HIV/AIDS, Health services research, Haematology (incl blood transfusion), Epidemiology, Global health
Keywords:	COVID-19, EPIDEMIOLOGY, HIV & AIDS < INFECTIOUS DISEASES, MENTAL HEALTH

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3 **A cross-sectional study to assess depression among health care workers in Lusaka, Zambia**
4 **during the COVID-19 pandemic.**
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39 Keywords: Health Care Workers, Depression, COVID-19, PHQ-9
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Abstract

Objectives: We sought to assess depression among health care workers (HCWs) in the context of COVID-19 in Lusaka Province, Zambia.

Design: This cross-sectional study is nested within a larger study, Person Centered Public Health for HIV Treatment in Zambia (PCPH), a cluster-randomized trial to assess HIV care and outcomes.

Setting: The research was conducted in 24 government-run health facilities during 11 August - 15 October 2020 during the second wave of the COVID-19 epidemic in Lusaka, Zambia.

Participants: We used convenience sampling to recruit HCW participants who were previously enrolled in the PCPH study, had more than 6 months experience working at the facility and were voluntarily willing to participate.

Primary outcome measures: We implemented the well-validated Patient Health Questionnaire (PHQ-9) to assess HCW depression. We used mixed-effects, adjusted Poisson regression to estimate the marginal probability of HCW experiencing depression that may warrant intervention (PHQ-9 score ≥ 5) by health care facility.

Results: We collected PHQ-9 survey responses from 713 professional and lay HCWs. Overall, 334 (46.8%, 95% CI: 43.1, .50.6%) HCWs recorded a PHQ-9 score ≥ 5 , indicating the need for further assessment and potential intervention for depression. We identified significant heterogeneity across facilities and observed a greater proportion of HCWs with symptoms of depression in facilities providing COVID-19 testing and treatment services.

Conclusions: Depression may be a concern for a large proportion of HCW in Zambia. Further work to understand the magnitude and etiologies of depression amongst HCW in the public sector is needed to design effective preventative and treatment interventions to meet the need for mental health support and to minimize poor health outcomes.

BMJ Open Questions:*Strengths and Limitations of this study*

- These data represent important insight regarding the state of mental wellness among a large sample of health care workers during a public health crisis in a resource limited setting.
- Mental wellness, like depression, is not documented well in resource limited settings and we measure here mental wellness in a high-risk group of health care workers during the COVID-19 pandemic.
- We include a large number (N=24) of facilities to appreciate the heterogeneity in symptoms of depression among mental health in the sampled facilities in Lusaka Province of Zambia.
- An important limitation is lack of data on demographics of health care worker respondents due to concern about stigma around mental wellness and potential to identify individuals given inclusion of clinics with small staff.
- Without pre-COVID 19 estimates of depression among health care workers in Lusaka, we are not able to show association between mild-severe depression with the pandemic; however, we show that during the pandemic that depression was high and attention to this population is justified to ensure a healthy HCW workforce.

47 **Introduction**

48 Coronavirus disease 2019 (COVID-19) has caused substantial global health hardship and health
49 care workers (HCWs) position on the frontlines of the public health response places them at great
50 risk for negative effects on health and wellbeing[1,[1]. In addition to excess occupational hazard
51 of contracting COVID-19, their experience as care givers increases their risk of developing mental
52 health disorders such as anxiety, depression, trauma, insomnia, and stress, which may lead to poor
53 physical and psychological wellbeing [2]. A healthy workforce is critical to effectively managing
54 and mitigating COVID-19, as well as providing continuity of high-quality care for other chronic
55 and acute health conditions [3, 4]. Even prior to COVID-19, countries in sub-Saharan Africa faced
56 limited medical infrastructure, supplies, and an over-burdened workforce, which challenged HCW
57 wellbeing and the provision of quality health care [5, 6]. These challenges, along with pandemic-
58 sensitive barriers such as limited access to personal protective equipment (PPE) further
59 exacerbated HCW stress and vulnerability. While HCWs in resource limited settings have
60 demonstrated resilience, poor mental health is likely to compromise their ability to make decisions,
61 as well as impact patient interactions [7]. Mental health services, like other health resources, are
62 limited, with few trained mental health providers[8]. Understanding mental health and wellbeing
63 among HCWs can catalyze interventions to provide treatment and improve the health care facility
64 environment for the HCWs and patients [8].

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66 Several studies have been conducted to assess mental wellness impact of the pandemic amongst
67 HCWs however, the majority of these studies focus on the continent of Asia and very little data is
68 available for HCWs in Africa [9-11]. Limited data from Kenya and Ethiopia provides evidence
69 that the prevalence of mental disorders such as depression, insomnia and stress were higher among
70 those HCWs caring for patients with COVID-19, or in areas of higher infection prevalence
71 compared to those working with non-COVID-19 patients or less [2, 12-16]. The most prevalent
72 reported mental health conditions among health care workers are depression, insomnia, and
73 anxiety [17]. Characterization of the state of mental wellness during the COVID-19 pandemic in
74 Sub-Saharan African countries among HCWs, specifically in Zambia remains incomplete [12, 18].

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76 As part of a larger patient-centered care study, we collected facility-level measures to understand
77 the context of care at 24 study sites. As a part of establishing care context we assessed mental

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3 78 health, specifically depression, using the nine item Patient Health Questionnaire (PHQ-9) in the
4 79 context of COVID-19 among HCWs in Lusaka Province, Zambia from 11 August 2020 to 15
5 80 October 2020 [19].
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10 82 **Methods**

11 83 *Setting*

12 84 This cross-sectional study of HCW depression is nested within a larger study, Person Centered
13 85 Public Health for HIV Treatment in Zambia (PCPH), a cluster-randomized trial to assess HIV care
14 86 and outcomes running from August 2018 to November 2021 across 24 government-funded health
15 87 facilities in Lusaka Province (Pan African Clinical Trial Registry number:
16 88 PACTR202101847907585). All PHQ-9 responses were collected between 11 August 2020 and 15
17 89 October 2020 among participating facilities that offered HIV care services and varied in size and
18 90 location. Facilities were assigned codes to protect the identity of the HCW participants.
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27 92 *Study Population*

28 93 We developed a cohort of HCWs that primarily provide HIV care at one of the 24 health facilities
29 94 in the PCPH study. This was done by compiling all HCW's contact details from the HCWs who
30 95 had, at the time of the introduction of the depression study, participated in the HCW survey
31 96 component of the original PCPH study. The PCPH sample was comprised of both professional
32 97 HCWs including nurses, pharmacists, midwives, medical doctors, radiographers, and lay HCWS
33 98 including treatment supporters and general workers. To augment participation in the PHQ-9 data
34 99 collection, we expanded the PHQ-9 sample to include any HCW willing to participate and had ≥ 6
35 100 months working experience at the study facility. We informed the facility in-charge of the PHQ-9
36 101 study opportunity who communicated it to staff members.
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46 103 *Measurements*

47 104 Trained study research assistants visited health care facilities and discussed the study opportunity
48 105 in-person with available staff members. Those who expressed interest were screened for eligibility,
49 106 offered the opportunity to verbally consent and with immediate participation. As a part of the
50 107 PCPH adaptation to the COVID-19 pandemic, we implemented the nine-question Patient Health
51 108 Questionnaire (PHQ-9) to screen for presence and severity of depression. The PHQ-9 has been
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3 109 previously used in Zambia to screen for likelihood of depression [20], and has been validated in
4 110 Tanzania and South Africa which are similar settings as Zambia [20, 21]. The PHQ-9 instrument
5 111 was translated from English into Nyanja and Bemba, the most commonly spoken Zambian
6 112 languages in Lusaka Province, where the survey was conducted [22]. Depending on the participant
7 113 preference, the standard PHQ-9 survey was self-administered on paper or surveyor-administered
8 114 by trained study research assistants in the participant's preferred language. Potentially identifying
9 115 information such as age, sex, and HCW cadre were not collected from respondents to protect
10 116 privacy. Facility populations were categorized as small (<40,000 clients/year), medium (40,000-
11 117 99,999 visits/year), and large ($\geq 100,000$ visits/year) as recorded in 2019.
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21 119 *Analysis*
22 120 We followed the standard, 27-point scoring system for the PHQ-9 to identify participants with
23 121 scores consistent with minimal (0-4), mild (5-9), moderate (10-14), moderately severe (15-19),
24 122 and severe depression (20-27) [19]. Our main outcome was mild depression or greater (PHQ-9
25 123 score ≥ 5) as this level of depression warrants additional clinical follow-up [19]. We developed
26 124 frequency tables and used a bar graphs to illustrate the distribution of PHQ-9 scores by health care
27 125 facility. We developed scatter plots of adjusted marginal probability with 95% confidence intervals
28 126 to illustrate the probability that a HCW will have a PHQ-9 score ≥ 5 by health care facility. We
29 127 used mixed effects Poisson regression to estimate prevalence ratios for those with mild depression
30 128 allowing random effects at the facility level and measured fixed effects for month of survey and
31 129 clinic size category. Facilities were categorized by client population estimates as: small (<40,000
32 130 clients), medium (40,000-100,000 clients), and large (>100,000 clients).
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43 132 *Patient and Public Involvement*
44 133 The parent study, focused primarily on improving the patient experience at routine clinic visits
45 134 through HCW training, mentorship, and audit and feedback The research approach and content is
46 135 based on participatory research with HCWs, human-centered design workshops, and stakeholder
47 136 collaborations [23-29]. This research guided us to include measures of HCW satisfaction and
48 137 wellbeing. In addition to a HCW experience measure throughout PCPH, the advent of COVID-19
49 138 led us to include an assessment of HCW depression. Patients were not directly involved in the
50 139 design, nor the recruitment of this sub-study assessing the depression levels of HCWs. The
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140 findings of this study as well as the parent study will be shared with the Zambian Ministry of
 141 Health as well as the study facilities.

142

143 *Ethics*

144 This study was approved as part of the larger PCPH study by the University of Zambia Biomedical
 145 Ethics Committee and the University of Alabama at Birmingham Institution Review Board, and
 146 the National Health Research Authority in Zambia. We obtained waiver of written informed
 147 consent and obtained verbal consent from participants prior to administering the survey.

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149 **Results**

150 A total of 713 HCWs from 24 facilities across Lusaka and Chongwe districts in the Lusaka
 151 Province were included in the analysis dataset (**Table 1**). The majority (69.6%) of the PHQ-9
 152 survey responses were collected in September 2020 (**Table 1**). The largest proportion of the
 153 responses were collected at facilities serving a large client population (41.7%) followed closely by
 154 facilities serving a medium-sized client population (37.7%) (**Table 1**). Responses for PHQ-9
 155 questions were largely complete with <1% responses missing.

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157 **Table 1: Participant characteristics**

Factor	Level	n (%)
N		713
Facility	1	30 (4.2)
	2	30 (4.2)
	3	30 (4.2)
	4	30 (4.2)
	5	30 (4.2)
	6	30 (4.2)
	7	30 (4.2)
	8	30 (4.2)
	9	30 (4.2)
	10	30 (4.2)
	11	30 (4.2)
	12	27 (3.8)
	13	27 (3.8)

	14	30 (4.2)
	15	30 (4.2)
	16	30 (4.2)
	17	30 (4.2)
	18	30 (4.2)
	19	30 (4.2)
	20	30 (4.2)
	21	30 (4.2)
	22	30 (4.2)
	23	29 (4.1)
	24	30 (4.2)
Clinic Population (category)	Small	147 (20.6)
	Medium	269 (37.7)
	Large	297 (41.7)
Month of Survey	August 2020	205 (28.8)
	September 2020	496 (69.6)
	October 2020	12 (1.7)

Note:

Of the 713 responses, 231 (32.4%, 95%CI: 29.0-36.0) reported mild depression (PHQ-9 score 5-9), 81 (11.4% 95%CI: 9.1-13.9) reported moderate depression (PHQ-9 score 10-14). A total of 81 (11.4) respondents had a PHQ-9 score corresponding to moderate depression across all but one facility, 17 (2.4%, 95%CI: 1.4-3.8) respondents had PHQ-9 scores consistent with moderately severe depression across four facilities, and five (0.7%, 95%CI: 0.2-1.6) HCWs had PHQ-9 scores consistent with severe depression across five different facilities (**Fig 1, Fig S1, Table 2**).

Table 2: Proportion of the analysis population by PHQ-9 score category with 95% confidence intervals (N=713)

<i>Variable</i>	<i>n</i>	<i>Proportion (%)</i>	<i>95% CI</i>
≥5 PHQ-9 score	334	46.8	(43.1, 50.6)
Mild	231	32.4	(29.0, 36.0)
Moderate	81	11.4	(9.1, 13.9)
Moderate-severe	17	2.4	(1.4, 3.8)
Severe	5	0.7	(0.2, 1.6)

Note: CI – confidence interval; PHQ-9 – nine-item patient health questionnaire.

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3 171 Though we observed facility-level mental health heterogeneity in the proportion of minimal and
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5 172 mild depression scores across clinics, the proportion of scores consistent with moderate
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8 173 depression remain relatively stable across facilities (**Fig 1A**).

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11 175 **Figure 1: A) Stacked bar chart of proportion population by PHQ-9 score category by**
12 **health care facility B) Stacked bar chart of proportion population by PHQ-9 score by**
13 **facility population size category**
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16 179 Mixed effects adjusted Poisson regression model did not reveal clinic size or month of survey as
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18 180 a significant predictor of PHQ-9 score ≥ 5 (**Table 3**).

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21 181 **Table 3: Adjusted Poisson regression results (N=713)**

<i>Covariate</i>	<i>level</i>	<i>aPR</i>	<i>95% CI</i>	<i>p-value</i>
Clinic Population (category)	small	1.12	(0.95, 1.33)	0.170
	medium	1.00 (ref)	ref	ref
	large	1.04	(0.81, 1.33)	0.763
Month of Survey	August	1.00 (ref)	ref	ref
	September	1.14	(0.94, 1.38)	0.193
	October	0.98	(0.54, 1.79)	0.945

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32 182 Note: adjusted for survey week and facility
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34 184 We illustrate significant heterogeneity in the marginal probability of experiencing greater than
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36 185 minimal depression across facilities (**Fig 2**). Notably, the highest marginal probability of HCWs
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38 186 with PHQ-9 score ≥ 5 was observed in a facility serving as a COVID-19 treatment center.
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41 188 **Figure 2: Marginal probability of health care worker with >minimal depression per PHQ-9**
42 **score by clinic.**
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47 191 Note: PHQ-9 – nine-item patient health questionnaire.
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50 193 **Discussion**

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52 194 We found that a large proportion of the HCW population had a PHQ-9 score ≥ 5 indicating a need
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54 195 for follow-up to assess and improve mental wellbeing 46.8% (95% CI: 43.1, 50.6%). Variation in
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196 depression outcomes ranged from 82.7% (95% CI: 68.5, 96.9%) at one of the two large COVID-
197 19 treatment facilities to 28.4% (95% CI: 13.0, 43.9%) at a medium-sized health care facility.

198
199 Our study shows that HCWs working at COVID-19 treatment facilities had a higher marginal
200 probability of experiencing mild to moderately severe depression. This is consistent with past
201 studies showing that frontline HCW working in clinics managing diseases considered to be highly
202 infectious, such as COVID-19 treatment centers, were more prone to developing depression and
203 other mental disorders than their counterparts in other departments [12]. In addition, results of our
204 study demonstrate that HCWs have experienced symptoms of depression during the onset of the
205 COVID-19 pandemic in Zambia, which is consistent with the findings of similar studies using the
206 PHQ-9 in other parts of the world where a pooled prevalence of mild depression was found to be
207 36.1% (95% confidence interval [CI], 31.3%-41.0%) [30]. Studies conducted in Zambia among
208 nurses and midwives, and in Ethiopia among different cadres of HCWs show that mental disorders
209 which include depression are prevalent among HCWs during the COVID-19 pandemic [31].
210 Similarly, globally studies indicate that there is a risk of HCWs developing mental health disorders
211 during the pandemic [4, 30, 31]. The difficult conditions to which HCWs may be exposed
212 including extended working hours, risk of exposure to the disease, increased workload, concerns
213 about transmitting the infection to their family members, reduced social connectedness, and
214 limited resources to care for their patients may amplify poor mental wellbeing [1, 32-34].

215
216 Further research is needed to understand heterogeneity in proportions of HCWs with depression.
217 It may be associated variation in HCW access to resources such as, personal protective equipment
218 (PPE), hand hygiene station/station supplies at clinic entrance, and knowledge about the COVID-
219 19 response in Zambia. While the response to the COVID-19 pandemic was standardized, to a
220 certain extent, by guidance from the provincial and zonal levels, the culture and leadership unique
221 to each facility might have played a key role in the health care worker experience, contributing to
222 PHQ-9 score distribution differences across facilities.

223
224 As we continue to recognize the mental health services gap across many populations in resource-
225 limited settings we give evidence here to support prioritization of health care workers, especially
226 during public health shocks/emergencies like that presented by COVID-19. Presence of depression

227 among HCWs could lead to poor health outcomes for the HCW workforce and have a sort of
228 “knock-on” effect negatively impacting the quality of care provided to patients [35, 36].
229 Interventions like Friendship Bench piloted in neighboring Zimbabwe designed to encourage
230 positive coping mechanism among HCWs and build a working environment that provides empathy
231 and compassion towards staff may be an efficient option to provide mental wellness support [37,
232 38]. Furthermore, system-based interventions should also be encouraged such as change in
233 working culture and reduction in possible system contributors to HCW stress that could lead to
234 depression. Increasing mobile technology availability may further allow for the use of mobile
235 health (mHealth) based mental wellness services leveraging the framework presented by Osei for
236 low- and middle-income countries [39, 40]. Low-cost intervention packages used for patients can
237 be adapted for HCWs and integrated into system-based interventions. They include routine
238 screening for early detection, mental wellness education, problem solving and use of anti-
239 depressants, cognitive behavior therapy which can be delivered successfully by trained lay HCWs
240 [41, 42].

241
242 **Limitations**
243 This study had some potential limitations. Firstly, we did not collect participants demographics
244 such as age, sex, marital status, and sex. As such we were not able to adjust for these co- founders.
245 Accounting for these would help make associations in outcomes of depression. Secondly, we
246 employed convenience sampling in selecting participants, this sampling approach may limit
247 representativeness of study the results to the wider population of HCWs. Finally, without pre-
248 COVID 19 estimates of depression among health care workers in Lusaka, we are not able to show
249 association between mild-severe depression with the pandemic however, we show that during the
250 pandemic that depression was high and attention to this population is justified to ensure a healthy
251 HCW workforce. Additionally, though potentially highest than a non-pandemic baseline, these
252 results may be useful as subsequent measures of depression and mental wellness are collected
253 among HCWs.

254
255 **Conclusions**
256 Depression is a common public health problem; our study demonstrates that HCWs in Zambia
257 may suffer from a high prevalence of depressive symptoms that will require additional clinical

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3 258 follow up. Routine mental health wellness is important to better understand the role that the
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5 259 COVID-19 pandemic may have had on depression among HCWS in Zambia. Furthermore, support
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7 260 for HCW mental wellness can serve to accelerate destigmatizing mental health issues and improve
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9 261 the quality of care provided across health care centers in Zambia.

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For peer review only

264 **Contributorship**

265 SS: data collection, data Framing, and manuscript writing, JM, KS, and MM: data collection and
266 data curation, LJ and CB: data framing, IS, CBM and EHG: conceptualization, AM: manuscript
267 review/editing, AS: conceptualization and manuscript review/editing LKB: conceptualization,
268 data analysis, data framing, and manuscript writing, JMP: data analysis lead, data framing, and
269 manuscript writing. The corresponding author attests that all listed authors meet authorship criteria
270 and that no others meeting the criteria have been omitted.

271

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277

278 **Competing of Interests**

279 None

280

281 **Ethical Approval**

282 This study was approved as part of the larger PCPH study by the University of Zambia Biomedical
283 Ethics Committee and the University of Alabama at Birmingham Institution Review Board, and
284 the National Health Research Authority in Zambia. We obtained waiver of written informed
285 consent and obtained verbal consent from participants prior to administering the survey.

286

287 **Data Sharing**

288 Data used for all analyses will be made available for public use through Dryad data repository:
289 Pry, Jake et al. (2022), PHQ-9_PCPH-19aug2022, <https://doi.org/10.25338/B8S646>.

290

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298

299 **List of abbreviations** [Optional]

300 ART: antiretroviral therapy

301 CI- Confidence Interval

302 COVID-19: Coronavirus Disease 2019

303 HCW: Health Care Worker

304 PCPH: Person- Centered Public Health for HIV Treatment in Zambia

305 PHQ-9: Patient Health Questionnaire 9

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307 **Data Sharing**

308 Data used for this analysis is available through Dryad data repository (doi:10.25338/B8S646)

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449 Supplement:

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451 Figure S1: Histogram of total PHQ-9 scores among study participants
452

A

Page 19 of 22



B

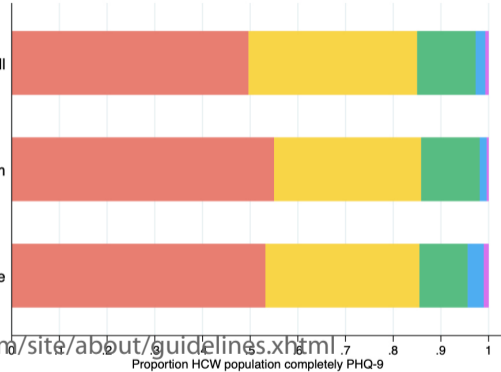
BMJ Open

Facility size (categorically)

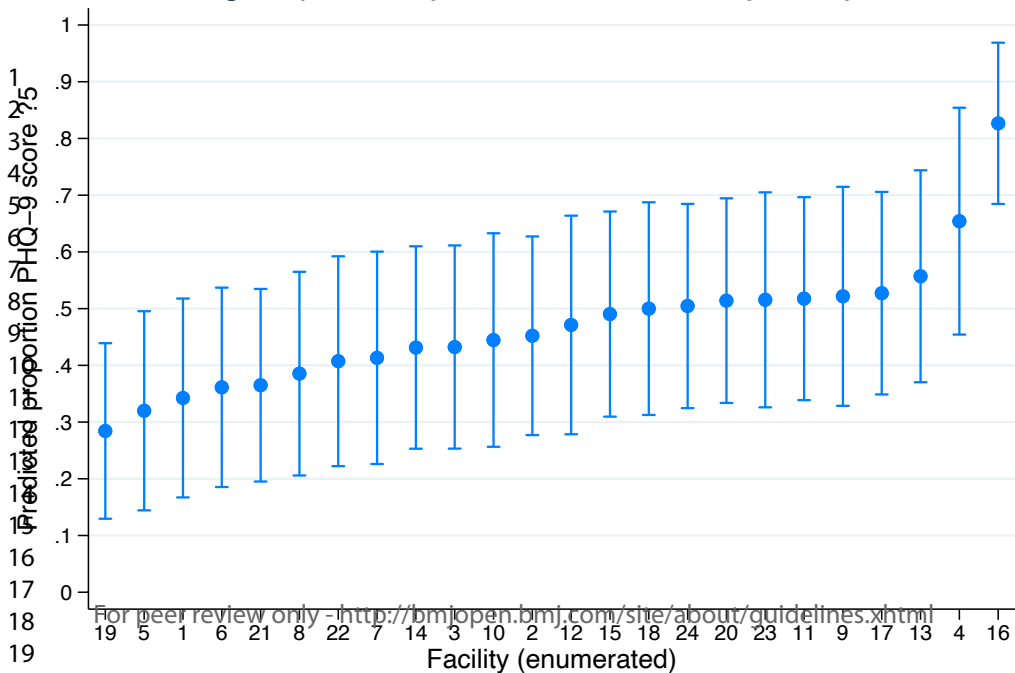
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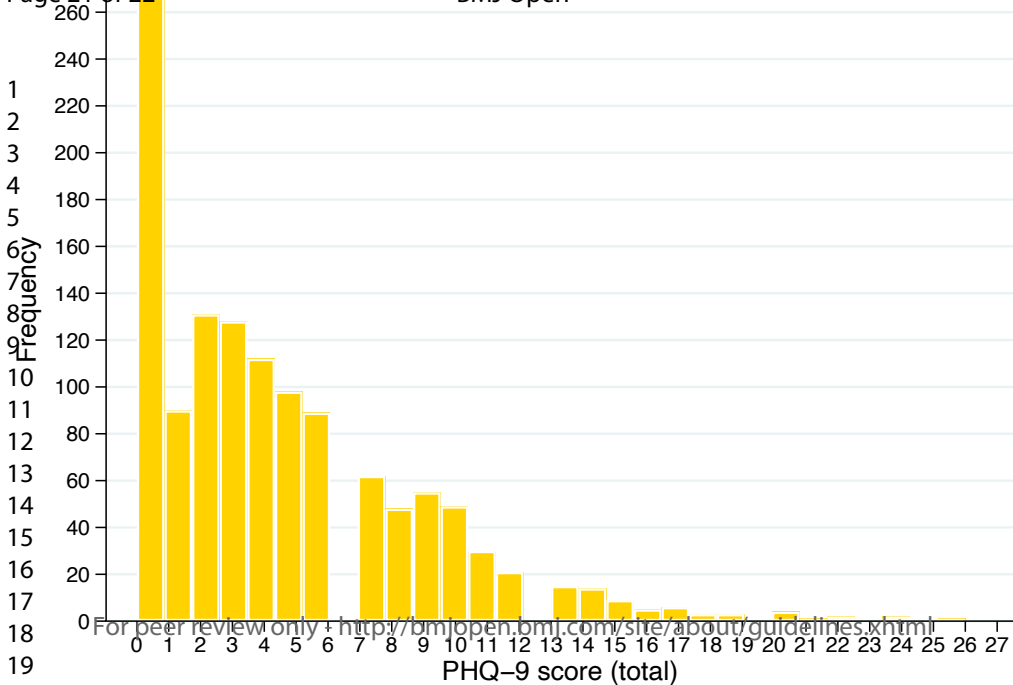
Medium

Large



Minimal Mild Moderate Moderate-Severe Severe





STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4, 5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5, 6
		(b) For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5, 6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5, 6
Bias	9	Describe any efforts to address potential sources of bias	5, 6
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5, 6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	6
		(b) Describe any methods used to examine subgroups and interactions	6
		(c) Explain how missing data were addressed	6
		(d) If applicable, explain how loss to follow-up was addressed	NA
		(e) Describe any sensitivity analyses	6
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7, 8
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7, 8
		(b) Indicate number of participants with missing data for each variable of interest	7, 8
		(c) Summarise follow-up time (eg, average and total amount)	NA
Outcome data	15*	Report numbers of outcome events or summary measures over time	7, 8

1	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7, 8
2			(b) Report category boundaries when continuous variables were categorized	7, 8
3			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
4				
5	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9
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11	Discussion			
12	Key results	18	Summarise key results with reference to study objectives	10
13	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11, 12
14	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9, 10
15	Generalisability	21	Discuss the generalisability (external validity) of the study results	9, 10
16				
17	Other information			
18	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13, 14
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*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

BMJ Open

A cross-sectional study to assess depression among health care workers in Lusaka, Zambia during the COVID-19 pandemic

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Secondary Subject Heading:	HIV/AIDS, Health services research, Epidemiology, Global health
Keywords:	COVID-19, EPIDEMIOLOGY, HIV & AIDS < INFECTIOUS DISEASES, MENTAL HEALTH

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3 **A cross-sectional study to assess depression among health care workers in Lusaka, Zambia**
4 **during the COVID-19 pandemic.**
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Abstract

Objectives: We sought to assess depression among health care workers (HCWs) in the context of COVID-19 in Lusaka Province, Zambia.

Design: This cross-sectional study is nested within a larger study, Person Centered Public Health for HIV Treatment in Zambia (PCPH), a cluster-randomized trial to assess HIV care and outcomes.

Setting: The research was conducted in 24 government-run health facilities during 11 August - 15 October 2020 during the first wave of the COVID-19 epidemic in Lusaka, Zambia.

Participants: We used convenience sampling to recruit HCW participants who were previously enrolled in the PCPH study, had more than 6 months experience working at the facility and were voluntarily willing to participate.

Primary outcome measures: We implemented the well-validated Patient Health Questionnaire (PHQ-9) to assess HCW depression. We used mixed-effects, adjusted Poisson regression to estimate the marginal probability of HCW experiencing depression that may warrant intervention (PHQ-9 score ≥ 5) by health care facility.

Results: We collected PHQ-9 survey responses from 713 professional and lay HCWs. Overall, 334 (46.8%, 95% CI: 43.1, .50.6%) HCWs recorded a PHQ-9 score ≥ 5 , indicating the need for further assessment and potential intervention for depression. We identified significant heterogeneity across facilities and observed a greater proportion of HCWs with symptoms of depression in facilities providing COVID-19 testing and treatment services.

Conclusions: Depression may be a concern for a large proportion of HCW in Zambia. Further work to understand the magnitude and etiologies of depression amongst HCW in the public sector is needed to design effective preventative and treatment interventions to meet the need for mental health support and to minimize poor health outcomes.

BMJ Open Questions:*Strengths and Limitations of this study*

- These data represent important insights regarding the state of mental wellness among a large sample of health care workers during a public health crisis in a resource limited setting, where mental wellness, such as depression, is often not measured nor documented.
- We include a large number (N=24) of facilities to appreciate the heterogeneity in symptoms of depression among mental health in the sampled facilities in Lusaka Province of Zambia.
- An important limitation is lack of data on demographics of health care worker respondents due to concern about stigma around mental wellness and potential to identify individuals given inclusion of clinics with small staff.
- Without pre-COVID 19 estimates of depression among health care workers in Lusaka, we are not able to show association between mild-severe depression with the pandemic; however, we show that during the pandemic that depression was high and attention to this population is justified to ensure a healthy HCW workforce.
- We employed convenience sampling in selecting participants which may limit representativeness of study results to the wider population of HCWs.

48 Introduction

49 Coronavirus disease 2019 (COVID-19) has caused substantial global health hardship and health
50 care workers (HCWs) position on the frontlines of the public health response places them at great
51 risk for negative effects on health and wellbeing[1,[1]. In addition to excess occupational hazard
52 of contracting COVID-19, their experience as care givers increases their risk of developing mental
53 health disorders such as anxiety, depression, trauma, insomnia, and stress, which may lead to poor
54 physical and psychological wellbeing [2]. A healthy workforce is critical to effectively managing
55 and mitigating COVID-19, as well as providing continuity of high-quality care for other chronic
56 and acute health conditions [3, 4]. Even prior to COVID-19, countries in sub-Saharan Africa faced
57 limited medical infrastructure, supplies, and an over-burdened workforce, which challenged HCW
58 wellbeing and the provision of quality health care [5, 6]. These challenges, along with pandemic-
59 sensitive barriers such as limited access to personal protective equipment (PPE) further
60 exacerbated HCW stress and vulnerability. While HCWs in resource limited settings have
61 demonstrated resilience, poor mental health is likely to compromise their ability to make decisions,
62 as well as impact patient interactions [7]. Mental health services, like other health resources, are
63 limited, with few trained mental health providers[8]. Understanding mental health and wellbeing
64 among HCWs can catalyze interventions to provide treatment and improve the health care facility
65 environment for the HCWs and patients [8].

66
67 Several studies have been conducted to assess mental wellness impact of the pandemic amongst
68 HCWs however, the majority of these studies focus on the continent of Asia and very little data is
69 available for HCWs in Africa [9-11]. Limited data from Kenya and Ethiopia provides evidence
70 that the prevalence of mental disorders such as depression, insomnia and stress were higher among
71 those HCWs caring for patients with COVID-19, or in areas of higher infection prevalence
72 compared to those working with non-COVID-19 patients or less [2, 12-16]. The most prevalent
73 reported mental health conditions among health care workers are depression, insomnia, and
74 anxiety [17]. Characterization of the state of mental wellness during the COVID-19 pandemic in
75 Sub-Saharan African countries among HCWs, specifically in Zambia remains incomplete [12, 18].

76
77 As part of a larger patient-centered care study, we collected facility-level measures to understand
78 the context of care at 24 study sites. As a part of establishing care context we assessed mental

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3 79 health, specifically depression, using the nine item Patient Health Questionnaire (PHQ-9) in the
4 80 context of COVID-19 among HCWs in Lusaka Province, Zambia from 11 August 2020 to 15
5 81 October 2020 [19].
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10 83 **Methods**

11 84 *Setting*

12 85 This cross-sectional study of HCW depression is nested within a larger study, Person Centered
13 86 Public Health for HIV Treatment in Zambia (PCPH), a cluster-randomized trial to assess HIV care
14 87 and outcomes running from August 2018 to November 2021 across 24 government-funded health
15 88 facilities in Lusaka Province (Pan African Clinical Trial Registry number:
16 89 PACTR202101847907585). All PHQ-9 responses were collected between 11 August 2020 and 15
17 90 October 2020 among participating facilities that offered HIV care services and varied in size and
18 91 location. Facilities were assigned codes to protect the identity of the HCW participants.
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27 93 *Study Population*

28 94 We developed a cohort of HCWs that primarily provide HIV care at one of the 24 health facilities
29 95 in the PCPH study. This was done by compiling all HCW's contact details from the HCWs who
30 96 had, at the time of the introduction of the depression study, participated in the HCW survey
31 97 component of the original PCPH study. The PCPH sample was comprised of both professional
32 98 HCWs including nurses, pharmacists, midwives, medical doctors, radiographers, and lay HCWS
33 99 including treatment supporters and general workers. To augment participation in the PHQ-9 data
34 100 collection, we expanded the PHQ-9 sample to include any HCW willing to participate and had ≥ 6
35 101 months working experience at the study facility. We informed the facility in-charge of the PHQ-9
36 102 study opportunity who communicated it to staff members.
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46 104 *Measurements*

47 105 Trained study research assistants visited health care facilities and discussed the study opportunity
48 106 in-person with available staff members. Those who expressed interest were screened for eligibility,
49 107 offered the opportunity to verbally consent and with immediate participation. As a part of the
50 108 PCPH adaptation to the COVID-19 pandemic, we implemented the nine-question Patient Health
51 109 Questionnaire (PHQ-9) to screen for presence and severity of depression. The PHQ-9 has been
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3 110 previously used in Zambia to screen for likelihood of depression [20], and has been validated in
4 111 Tanzania and South Africa which are similar settings as Zambia [20, 21]. The PHQ-9 instrument
5 112 was translated from English into Nyanja and Bemba, the most commonly spoken Zambian
6 113 languages in Lusaka Province, where the survey was conducted [22]. Depending on the participant
7 114 preference, the standard PHQ-9 survey was self-administered on paper or surveyor-administered
8 115 by trained study research assistants in the participant's preferred language. Potentially identifying
9 116 information such as age, sex, and HCW cadre were not collected from respondents to protect
10 117 privacy. Facility populations were categorized as small (<40,000 clients/year), medium (40,000-
11 118 99,999 visits/year), and large ($\geq 100,000$ visits/year) as recorded in 2019.
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120 *Analysis*

121 We followed the standard, 27-point scoring system for the PHQ-9 to identify participants with
122 scores consistent with minimal (0-4), mild (5-9), moderate (10-14), moderately severe (15-19),
123 and severe depression (20-27) [19]. Our main outcome was mild depression or greater (PHQ-9
124 score ≥ 5) as this level of depression warrants additional clinical follow-up [19]. We developed
125 frequency tables and used a bar graphs to illustrate the distribution of PHQ-9 scores by health care
126 facility. We developed scatter plots of adjusted marginal probability with 95% confidence intervals
127 to illustrate the probability that a HCW will have a PHQ-9 score ≥ 5 by health care facility. We
128 used mixed effects Poisson regression to estimate prevalence ratios for those with mild depression
129 allowing random effects at the facility level and measured fixed effects for month of survey and
130 clinic size category. Facilities were categorized by client population estimates as: small (<40,000
131 clients), medium (40,000-100,000 clients), and large (>100,000 clients).
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133 *Patient and Public Involvement*

134 The parent study, focused primarily on improving the patient experience at routine clinic visits
135 through HCW training, mentorship, and audit and feedback The research approach and content is
136 based on participatory research with HCWs, human-centered design workshops, and stakeholder
137 collaborations [23-29]. This research guided us to include measures of HCW satisfaction and
138 wellbeing. In addition to a HCW experience measure throughout PCPH, the advent of COVID-19
139 led us to include an assessment of HCW depression. Patients were not directly involved in the
140 design, nor the recruitment of this sub-study assessing the depression levels of HCWs. The

141 findings of this study as well as the parent study will be shared with the Zambian Ministry of
 142 Health as well as the study facilities.

143

144 *Ethics*

145 This study was approved as part of the larger PCPH study by the University of Zambia Biomedical
 146 Ethics Committee and the University of Alabama at Birmingham Institution Review Board, and
 147 the National Health Research Authority in Zambia. We obtained waiver of written informed
 148 consent and obtained verbal consent from participants prior to administering the survey.

149

150 **Results**

151 A total of 713 HCWs from 24 facilities across Lusaka and Chongwe districts in the Lusaka
 152 Province were included in the analysis dataset (**Table 1**). The majority (69.6%) of the PHQ-9
 153 survey responses were collected in September 2020 (**Table 1**). The largest proportion of the
 154 responses were collected at facilities serving a large client population (41.7%) followed closely by
 155 facilities serving a medium-sized client population (37.7%) (**Table 1**). Responses for PHQ-9
 156 questions were largely complete with <1% responses missing.

157

158 **Table 1: Participant characteristics**

Factor	Level	n (%)
N		713
Facility	1	30 (4.2)
	2	30 (4.2)
	3	30 (4.2)
	4	30 (4.2)
	5	30 (4.2)
	6	30 (4.2)
	7	30 (4.2)
	8	30 (4.2)
	9	30 (4.2)
	10	30 (4.2)
	11	30 (4.2)
	12	27 (3.8)
	13	27 (3.8)

	14	30 (4.2)
	15	30 (4.2)
	16	30 (4.2)
	17	30 (4.2)
	18	30 (4.2)
	19	30 (4.2)
	20	30 (4.2)
	21	30 (4.2)
	22	30 (4.2)
	23	29 (4.1)
	24	30 (4.2)
Clinic Population (category)	Small	147 (20.6)
	Medium	269 (37.7)
	Large	297 (41.7)
Month of Survey	August 2020	205 (28.8)
	September 2020	496 (69.6)
	October 2020	12 (1.7)

159
160 Of the 713 responses, 231 (32.4%, 95%CI: 29.0-36.0) reported mild depression (PHQ-9 score 5-
161 9), 81 (11.4% 95%CI: 9.1-13.9) reported moderate depression (PHQ-9 score 10-14). A total of 81
162 (11.4) respondents had a PHQ-9 score corresponding to moderate depression across all but one
163 facility, 17 (2.4%, 95%CI: 1.4-3.8) respondents had PHQ-9 scores consistent with moderately
164 severe depression across four facilities, and five (0.7%, 95%CI: 0.2-1.6) HCWs had PHQ-9 scores
165 consistent with severe depression across five different facilities (**Fig 1, Fig S1, Table 2**).

166
167 **Table 2: Proportion of the analysis population by PHQ-9 score category with 95% confidence**
168 **intervals (N=713)**

<i>Variable</i>	<i>n</i>	<i>Proportion (%)</i>	<i>95% CI</i>
≥5 PHQ-9 score	334	46.8	(43.1, 50.6)
Mild	231	32.4	(29.0, 36.0)
Moderate	81	11.4	(9.1, 13.9)
Moderate-severe	17	2.4	(1.4, 3.8)
Severe	5	0.7	(0.2, 1.6)

169 Note: CI – confidence interval; PHQ-9 – nine-item patient health questionnaire.

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3 171 Though we observed facility-level mental health heterogeneity in the proportion of minimal and
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5 172 mild depression scores across clinics, the proportion of scores consistent with moderate depression
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8 173 remain relatively stable across facilities (**Fig 1**).

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11 175 **Figure 1: A) Stacked bar chart of proportion population by PHQ-9 score category by**
12 **health care facility B) Stacked bar chart of proportion population by PHQ-9 score by**
13 **facility population size category.**
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16 179 Mixed effects adjusted Poisson regression model did not reveal clinic size or month of survey as
17
18 180 a significant predictor of PHQ-9 score ≥ 5 (**Table 3**).

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21 181 **Table 3: Adjusted Poisson regression results (N=713)**

<i>Covariate</i>	<i>level</i>	<i>aPR</i>	<i>95% CI</i>	<i>p-value</i>
Clinic Population (category)	small	1.12	(0.95, 1.33)	0.170
	medium	1.00 (ref)	ref	ref
	large	1.04	(0.81, 1.33)	0.763
Month of Survey	August	1.00 (ref)	ref	ref
	September	1.14	(0.94, 1.38)	0.193
	October	0.98	(0.54, 1.79)	0.945

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32 182 Note: adjusted for survey week and facility
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34 184 We illustrate significant heterogeneity in the marginal probability of experiencing greater than
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36 185 minimal depression across facilities (**Fig 2**). Notably, the highest marginal probability of HCWs
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38 186 with PHQ-9 score ≥ 5 was observed in a facility serving as a COVID-19 treatment center.
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41 188 **Figure 2: Marginal probability of health care worker with >minimal depression per PHQ-9**
42 **score by clinic.**
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47 191 Note: PHQ-9 – nine-item patient health questionnaire.
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50 193 **Discussion**

51
52 194 We found that a large proportion of the HCW population had a PHQ-9 score ≥ 5 indicating a need
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54 195 for follow-up to assess and improve mental wellbeing 46.8% (95% CI: 43.1, 50.6%). Variation in
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196 depression outcomes ranged from 82.7% (95% CI: 68.5, 96.9%) at one of the two large COVID-
197 19 treatment facilities to 28.4% (95% CI: 13.0, 43.9%) at a medium-sized health care facility.

198
199 Our study shows that HCWs working at the COVID-19 treatment facility had a higher marginal
200 probability of experiencing mild to moderately severe depression. This is consistent with past
201 studies showing that frontline HCW working in clinics managing diseases considered to be highly
202 infectious, such as COVID-19 treatment centers, were more prone to developing depression and
203 other mental disorders than their counterparts in other departments [12]. In addition, results of our
204 study demonstrate that HCWs have experienced symptoms of depression during the onset of the
205 COVID-19 pandemic in Zambia, which is consistent with the findings of similar studies using the
206 PHQ-9 in other parts of the world where a pooled prevalence of mild depression was found to be
207 36.1% (95% confidence interval [CI], 31.3%-41.0%) [30]. Studies conducted in Ethiopia among
208 different cadres of HCWs show that mental disorders which include depression are prevalent
209 among HCWs during the COVID-19 pandemic, with one study from Ethiopia identifying
210 approximately 48% prevalence of greater than minimal depression, consistent with our Zambian
211 estimates [31, 32]. Similarly, globally studies indicate that there is a risk of HCWs experiencing
212 mental health disorders during the pandemic [4, 30, 31, 33]. The difficult conditions to which
213 HCWs may be exposed including extended working hours, risk of exposure to the disease,
214 increased workload, concerns about transmitting the infection to their family members, reduced
215 social connectedness, and limited resources to care for their patients may amplify poor mental
216 wellbeing [1, 34-36].

217
218 Further research is needed to understand heterogeneity in proportions of HCWs with depression.
219 It may be associated variation in HCW access to resources such as, personal protective equipment
220 (PPE), hand hygiene station/station supplies at clinic entrance, and knowledge about the COVID-
221 19 response in Zambia. While the response to the COVID-19 pandemic was standardized, to a
222 certain extent, by guidance from the provincial and zonal levels, the culture and leadership unique
223 to each facility might have played a key role in the health care worker experience, contributing to
224 PHQ-9 score distribution differences across facilities.

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3 226 As we continue to recognize the mental health services gap across many populations in resource-
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5 227 limited settings we give evidence here to support prioritization of health care workers, especially
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7 228 during public health shocks/emergencies like that presented by COVID-19. Presence of depression
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9 229 among HCWs could lead to poor health outcomes for the HCW workforce and have a sort of
10
11 230 “knock-on” effect negatively impacting the quality of care provided to patients [37, 38].
12
13 231 Interventions like Friendship Bench piloted in neighboring Zimbabwe designed to encourage
14
15 232 positive coping mechanism among HCWs and build a working environment that provides empathy
16
17 233 and compassion towards staff may be an efficient option to provide mental wellness support [39,
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19 234 40]. Furthermore, system-based interventions should also be encouraged such as change in
20
21 235 working culture and reduction in possible system contributors to HCW stress that could lead to
22
23 236 depression. Increasing mobile technology availability may further allow for the use of mobile
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25 237 health (mHealth) based mental wellness services leveraging the framework presented by Osei for
26
27 238 low- and middle-income countries [41, 42]. Low-cost intervention packages used for patients can
28
29 239 be adapted for HCWs and integrated into system-based interventions. They include routine
30
31 240 screening for early detection, mental wellness education, problem solving and use of anti-
32
33 241 depressants, cognitive behavior therapy which can be delivered successfully by trained lay HCWs
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35 242 [43, 44].

243

244 **Limitations**

36 245 This study had some potential limitations. Firstly, we did not collect participants demographics
37
38 246 such as age, sex, marital status, and sex. As such we were not able to adjust for these co- founders.
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40 247 Accounting for these would help make associations in outcomes of depression. Secondly, we
41
42 248 employed convenience sampling in selecting participants. This sampling approach may limit
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44 249 representativeness of study the results to the wider population of HCWs. Finally, without pre-
45
46 250 COVID 19 estimates of depression among health care workers in Lusaka, we are not able to show
47
48 251 association between mild-severe depression with the pandemic however, we show that during the
49
50 252 pandemic that depression was high and attention to this population is justified to ensure a healthy
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52 253 HCW workforce. Additionally, though potentially highest than a non-pandemic baseline, these
53
54 254 results may be useful as subsequent measures of depression and mental wellness are collected
55
56 255 among HCWs.

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3 **257 Conclusions**
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5 258 Depression is a common public health problem; our study demonstrates that HCWs in Zambia
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7 259 may suffer from a high prevalence of depressive symptoms that will require additional clinical
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9 260 follow up. Routine mental health wellness is important to better understand the role that the
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11 261 COVID-19 pandemic may have had on depression among HCWS in Zambia. Furthermore, support
12
13 262 for HCW mental wellness can serve to accelerate destigmatizing mental health issues and improve
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15 263 the quality of care provided across health care centers in Zambia.
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For peer review only

266 **Contributorship**

267 SS: data collection, data Framing, and manuscript writing, JM, KS, and MM: data collection and
268 data curation, LJ and CB: data framing, IS, CBM and EHG: conceptualization, AM: manuscript
269 review/editing, AS: conceptualization and manuscript review/editing LKB: conceptualization,
270 data analysis, data framing, and manuscript writing, JMP: data analysis lead, data framing, and
271 manuscript writing. The corresponding author attests that all listed authors meet authorship criteria
272 and that no others meeting the criteria have been omitted.

273

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278 Diseases of the National Institutes of Health under award number K24 AI134413 (E.G.).

279

280 **Competing of Interests**

281 None

282

283 **Ethical Approval**

284 This study was approved as part of the larger PCPH study by the University of Zambia Biomedical
285 Ethics Committee and the University of Alabama at Birmingham Institution Review Board, and
286 the National Health Research Authority in Zambia. We obtained waiver of written informed
287 consent and obtained verbal consent from participants prior to administering the survey.

288

289 **Data Sharing**

290 Extra data can be accessed via the Dryad data repository at <http://datadryad.org/> with the doi:
291 <https://doi.org/10.25338/B8S646>

292

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300

301 **List of abbreviations** [Optional]

302 ART: antiretroviral therapy

303 CI- Confidence Interval

304 COVID-19: Coronavirus Disease 2019

305 HCW: Health Care Worker

306 PCPH: Person- Centered Public Health for HIV Treatment in Zambia

307 PHQ-9: Patient Health Questionnaire 9

308

309 **Data Sharing**

310 Data used for this analysis is available through Dryad data repository (doi:10.25338/B8S646)

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Supplement:

Figure S1: Histogram of total PHQ-9 scores among study participants

A

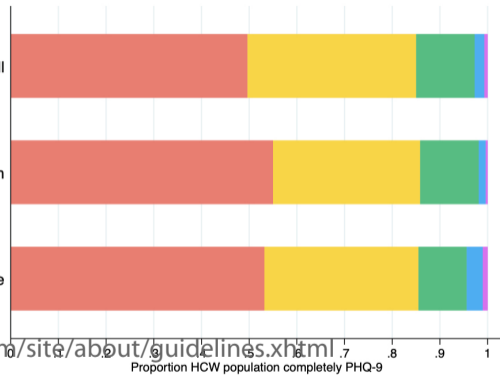
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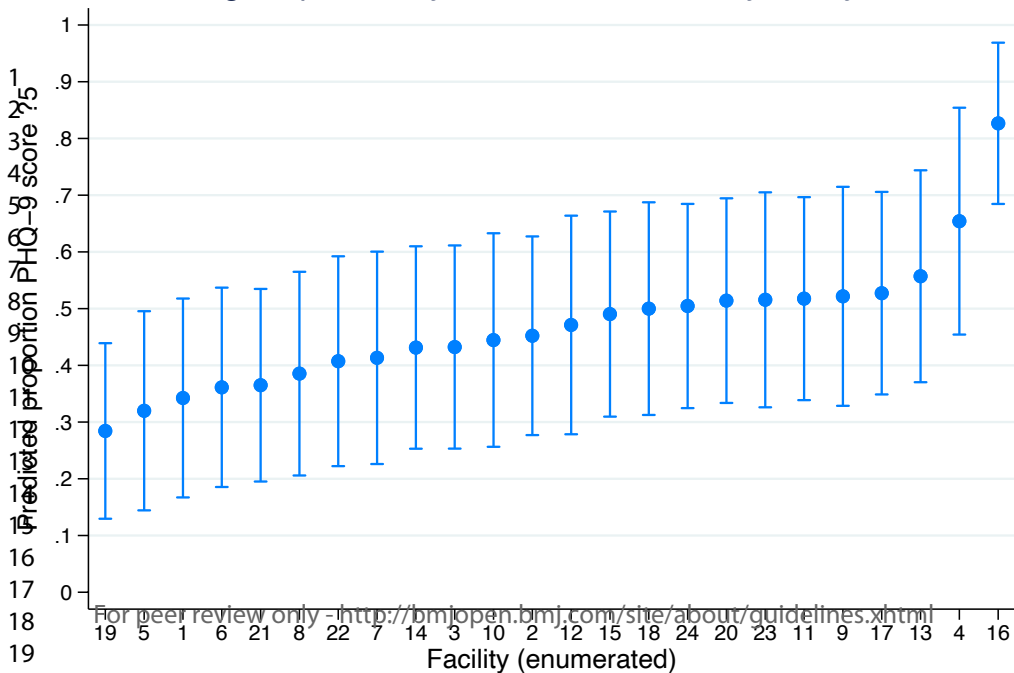
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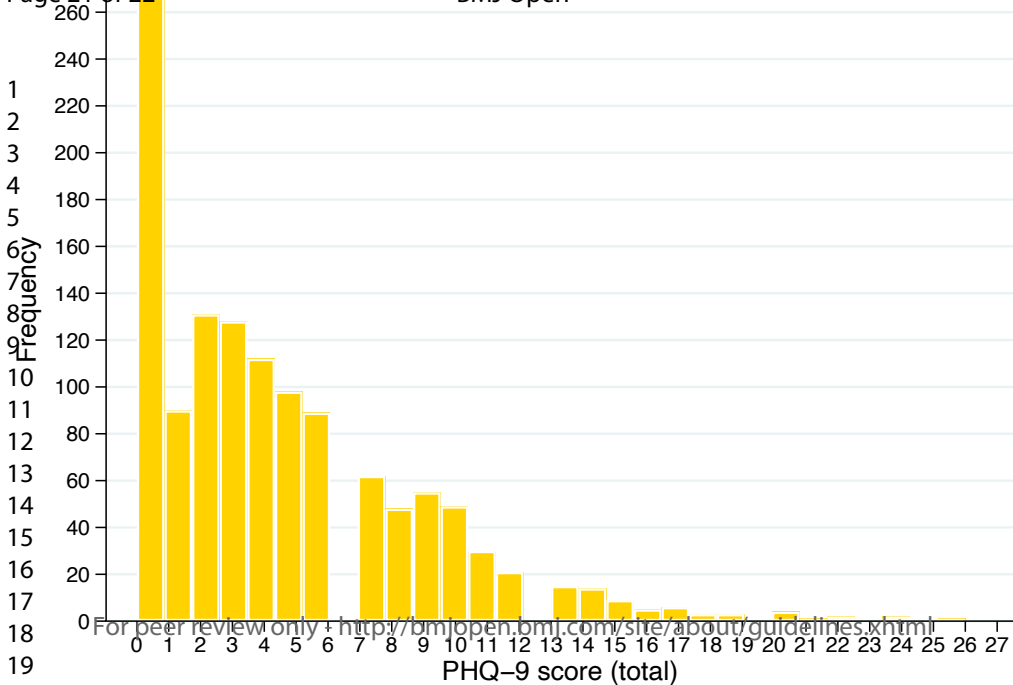
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Facility size (categorically)

Small
Medium
Large

Minimal Mild Moderate Moderate-Severe Severe





STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4, 5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5, 6
		(b) For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5, 6
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5, 6
Bias	9	Describe any efforts to address potential sources of bias	5, 6
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5, 6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	6
		(b) Describe any methods used to examine subgroups and interactions	6
		(c) Explain how missing data were addressed	6
		(d) If applicable, explain how loss to follow-up was addressed	NA
		(e) Describe any sensitivity analyses	6
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7, 8
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7, 8
		(b) Indicate number of participants with missing data for each variable of interest	7, 8
		(c) Summarise follow-up time (eg, average and total amount)	NA
Outcome data	15*	Report numbers of outcome events or summary measures over time	7, 8

1	Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7, 8
2			(b) Report category boundaries when continuous variables were categorized	7, 8
3			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
4				
5	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9
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11	Discussion			
12	Key results	18	Summarise key results with reference to study objectives	10
13	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11, 12
14	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9, 10
15	Generalisability	21	Discuss the generalisability (external validity) of the study results	9, 10
16				
17	Other information			
18	Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13, 14
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*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.