

Original citation:

Lilford, Richard J., Oyebode, Oyinlola, Satterthwaite, David, Melendez-Torres, G. J., Chen, Yen-Fu, Mberu, Blessing, Watson, Samuel I., Sartori, Jo, Ndugwa, Robert, Caiaffa, Waleska, Haregu, Tilahun, Capon, Anthony, Saith, Ruhi and Ezeh, Alex. (2016) Improving the health and welfare of people who live in slums. The Lancet .

doi: 10.1016/S0140-6736(16)31848-7

Permanent WRAP URL:

<http://wrap.warwick.ac.uk/83214>

Copyright and reuse:

The Warwick Research Archive Portal (WRAP) makes this work by researchers of the University of Warwick available open access under the following conditions. Copyright © and all moral rights to the version of the paper presented here belong to the individual author(s) and/or other copyright owners. To the extent reasonable and practicable the material made available in WRAP has been checked for eligibility before being made available.

Copies of full items can be used for personal research or study, educational, or not-for-profit purposes without prior permission or charge. Provided that the authors, title and full bibliographic details are credited, a hyperlink and/or URL is given for the original metadata page and the content is not changed in any way.

Publisher's statement:

© 2016, Elsevier. Licensed under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International <http://creativecommons.org/licenses/by-nc-nd/4.0/>

A note on versions:

The version presented here may differ from the published version or, version of record, if you wish to cite this item you are advised to consult the publisher's version. Please see the 'permanent WRAP url' above for details on accessing the published version and note that access may require a subscription.

For more information, please contact the WRAP Team at: wrap@warwick.ac.uk

1 **Improving the Health and Welfare of People who Live in Slums**

2 **Authors:**

3 Prof Richard J Lilford, DSc (Hons)¹

4 Dr Oyinlola Oyebode, PhD¹

5 Dr David Satterthwaite, PhD²

6 Dr GJ Melendez-Torres, PhD¹

7 Dr Yen-Fu Chen, PhD¹

8 Dr Blessing Mberu, PhD³

9 Dr Samuel I Watson, PhD¹

10 Jo Sartori, BA (Hons)¹

11 Dr Robert Ndugwa, PhD⁵

12 Prof Waleska Caiaffa, PhD⁶

13 Dr Dr Tilahun Haregu, PhD³

14 Prof Anthony Capon, PhD⁷

15 Dr Ruhi Saith, PhD⁸

16 Dr Alex Ezeh, PhD^{3,4}

- 17
- 18 1. Warwick Centre for Applied Health Research and Delivery, University of Warwick,
19 Coventry, CV4 7AL.
 - 20 2. International Institute for Environment and Development, London, UK.
 - 21 3. African Population and Health Research Centre, Manga CI, Nairobi, Kenya
 - 22 4. School of Public Health, University of Witwatersrand, Johannesburg, South Africa
 - 23 5. Global Urban Observatory | Research and Capacity Development Branch ,United
24 Nations Human Settlements Programme , UN Avenue Gigiri, UN Complex, Block 4,
25 South Wing, 2nd level P.O.Box 30030, GPO Nairobi 00100, Kenya.
 - 26 6. School of Medicine, Federal University of Minas Gerais, Brazil.
 - 27 7. United Nations University, Kuala Lumpur
 - 28 8. Oxford Policy Management, New Delhi

29
30 **Corresponding Author:**

31 Richard J. Lilford
32 Warwick Centre for Applied Health Research and Delivery. Warwick Medical School.
33 University of Warwick
34 Coventry. CV4 7AL United Kingdom
35 Email: R.J.Lilford@warwick.ac.uk Tel: +44 (0)24765 75884

36
37 Word count: 4,498

38

39 **Summary**

40 In the first paper in this series we examined theoretical and empirical evidence and
41 concluded that the health of people living in slums is a function not only of poverty but of
42 intimately shared physical and social environments. In this paper we extend the theory of
43 'neighbourhood effects'. Slums offer high returns on investment because beneficial effects
44 are shared across many people in densely populated neighbourhoods. Neighbourhood
45 effects also help explain how and why the benefits of interventions vary between slum and
46 non-slum spaces and between one slum and another. We build on this spatial concept of
47 slums to argue that, in all low-and-middle-income countries, census tracts should henceforth
48 be designated slum or non-slum both to inform local policy and as the basis for research
49 surveys that build on censuses. We argue that slum health should be promoted as a topic of
50 enquiry alongside poverty and health.

51

52 **Introduction**

53 The first paper in this series was concerned with health in slums and with the determinants
54 of health. Now we consider what can be done to improve health and healthcare in slums. In
55 paper one we showed that the intimately shared physical and social environment in slums is
56 likely to generate strong neighbourhood effects. In this paper we show that neighbourhood
57 effects have a potential up-side. First, densely packed slum neighbourhoods not only provide
58 economies of scale as John Snow showed when he aborted a cholera epidemic by
59 disabling a water pump in Soho, London in 1854. Second, densely packed and unhealthy
60 slum neighbourhoods may provide situations where escalating intervention 'dose' yields
61 particularly rapidly accelerating health returns to scale. This idea is further explicated in
62 Panel A.

63 The rest of this paper is organised as follows. First, we describe an intellectual framework to
64 organise evidence on interventions. Second, we present the reviewed evidence according to

65 this intellectual framework. Third, we discuss the implications of the findings across both
66 papers for policy and research. Finally we conclude.

67

68 **Panel A. Neighbourhood effects and the effectiveness of interventions: non-linear**
69 **returns to scale**

70 As stated in paper one, a person's risk of disease is affected by both personal factors, such
71 as diet and genetic constitution, and factors in the local environment, such as faecal
72 contamination, vectors of disease, and pollution. The latter results in neighbourhood effects.
73 Also stated in paper one, slums are not homogenous and individual slums present very
74 different scenarios in which a neighbourhood level intervention will play out. Two major
75 influences determine how this happens. First, there are both within and between
76 neighbourhood differences in the extent to which the prevalence of a disease is affected by
77 exposure to a risk factor. Second, the dose response may vary and can be non-linear. The
78 latter is particularly likely in dynamic scenarios where one person's risk affects another
79 person's risk, either because the disease is infectious, or because one person's behaviour
80 influences another person's risk. We have modelled the way that these two influences
81 interact in the left hand panel of the Figure below. The model shows how interventions
82 designed to reduce the prevalence of a target disease will demonstrate differing levels of
83 effectiveness in different areas and within the same area over time, depending on the
84 conditions prevailing when the intervention is adopted, or whether there is a sufficient 'dose'
85 of the intervention. The shape of the response curve may yield scenarios of increasing
86 returns to investment. The right hand panel illustrates the wide range of possible intervention
87 effects that may be measured in a study depending on these factors. A model such as this
88 can aid in specifying theories for future testing. For example, providing sanitation is likely to
89 exhibit increasing returns to scale as faecal contamination is progressively reduced. Failure
90 to realise the steep part of the curve by supplying sanitation at insufficient scale or intensity
91 may explain why many sanitation improvement projects have yielded disappointing results

92 as described later, and point the way for development and evaluation of more intense
93 interventions.

94 **[Figure Panel A]**

95

96 **Framework for review**

97 We organise our material using a generic three level causal model ^{1,2} that has been applied
98 in previous research to slum upgrading ³ and in a Cochrane Review concerned with this
99 topic.⁴ The three levels, shown in Figure 2.1, are as follows:

- 100 1. Macro-level institutions and policies affecting all citizens, including press freedom, an
101 independent judiciary, monetary and fiscal policy, and other national/supranational
102 influences.
- 103 2. A middle or 'meso-level' relating to slum specific policies. These policies, such as
104 those for land zoning and provision of tenure, set the context where targeted
105 interventions, such as improved sanitation, play-out. It is therefore referred to as the
106 'enabling layer' in the Cochrane Review.⁴
- 107 3. Micro-level encompassing interventions targeted at specific problems such as faecal
108 contamination of the environment; referred to as the 'direct level' in the Cochrane
109 Review.

110 We will not consider the first (macro) level because it lies in the province of
111 politics/economics and because, while these are crucially important influences, much can be
112 done to improve health pending an improved macro-economic environment.^{5,6} Massive
113 gains in health have been recorded even in countries with poor national governance ⁷ and it
114 is worth reflecting that infant mortality in slums is currently about 46 per thousand,⁸ whereas
115 in Victorian England the *upper* class infant mortality rate in 1899 was three times higher (136
116 per thousand).⁹ We now turn our attention to interventions to improve slum health,
117 supplementing the knowledge of the authors with a wide-ranging literature review (Panel B).

118 **[Figure 2.1]**

119

120 **Panel B: Search strategy and selection criteria**

121 In order to identify key literature for the diffuse topic of slum health, we conducted a
122 systematic overview of reviews covering determinants of health in slum settings and/or
123 interventions that aim to improve the health of slum dwellers. We also identified randomised
124 controlled trials (RCTs) conducted in a slum setting as part of a bibliometric analysis
125 examining the relative volume of research studies concerning rural, urban and slum settings
126 (Web Appendix 1.2.1 – paper one of this series). Acknowledging the important roles that
127 international, governmental and non-governmental organisations play in this area, we
128 systematically searched the grey literature and reviewed relevant documents. Details of the
129 literature search process and study selection criteria are provided in the text below. Please
130 note, much of the text below is duplicated from the first paper in this series.

131

132 **1. Systematic overview of reviews concerned with slum health**

133 We searched the following eight databases in January 2016: MEDLINE, including in-process
134 and non-indexed citations, Embase, PsycINFO, LILACS, SciELO, WHO Global Health
135 Library, Database of Abstracts of Reviews of Effects, maintained by the NHS Centre for
136 Reviews and Dissemination, and CINAHL (all but two of the reviews detailed here were
137 found in MEDLINE or Embase). We put no limits on dates covered. In order to make the
138 search as sensitive as possible we included a wide range of synonyms for slums, derived
139 from a list in a UN-Habitat report ¹¹ and augmented by other terms we have encountered:
140 (see the companion paper for a full list of terms). We further broadened our search by
141 combining free-text synonyms with controlled vocabulary for slums and, where supported in
142 the database, filters for systematic reviews. No language restrictions were applied. We
143 examined the titles and abstracts of unique records and selected reviews (both systematic

144 and narrative reviews) that: 1) specifically provided results for people who live in slums; 2)
145 specifically included people who live in slums but did not provide specific results for the sub-
146 group; and 3) included the urban poor and hence were likely to have included slum dwellers
147 but this was not specified. We selected reviews dealing with primarily: a) the distribution and
148 determinants of health relevant to slum settings; and b) interventions for slum populations,
149 reporting health outcomes. Some of the identified reviews reported both on the epidemiology
150 of health conditions, *and* interventions to improve these health conditions, in which case they
151 are included in the evidence base for both papers. A flow diagram for study retrieval and
152 selection is available in Web Appendix 1.3.1 – paper one.

153

154 **2. Identifying randomised controlled trials in a slum setting**

155 As part of a bibliometric analysis (see Web Appendix 1.2.1 of the companion paper), we
156 searched MEDLINE and Embase 2001-2015 for studies recorded as being conducted in an
157 urban, rural or slum locations. Search filters and key words related to various study
158 designs, including RCTs, were applied in order to retrieve studies of a particular design.
159 Retrieved records related to RCTs conducted in a slum setting were reviewed by the
160 authors. Forty-eight RCTs were identified and included in the evidence base for this paper.
161 Many (especially vaccine trial and trials of micro-nutrients) used slums to provide a
162 'convenience' sample.

163

164 **3. Systematic review of the grey literature**

165 We searched the grey literature by reviewing official reports from the publication databases
166 of the World Bank, World Health Organization, and UN-Habitat on the basis of expert advice
167 from the authors. We covered the literature from January 2010 to February 2016. Our search
168 terms included synonyms for slums in searches one and two above. Eight hundred and
169 eighty-four results were returned, and after examining the titles, abstracts, and text of these

170 studies and reports we selected 245 publications that dealt partially or wholly with issues
171 arising in slums. For a breakdown of publications see Web Appendix 1.3.2 of the companion
172 paper. Many important articles were found in this literature, including those relating to the
173 economics of slum formation, system level interventions (such as the effect of providing
174 tenure/title), and certain notable large scale studies, including a randomised trial of home
175 improvement.

176 We supplemented the evidence retrieved as described above with additional searches as
177 needed on the advice of experts and further extended these with authors' collections of
178 references and additional papers identified by subject experts.

179 **Meso-level policies directed at slums**

180 **Restricting migration or benign neglect**

181 Restricting free movement of citizens within a country is an illiberal policy redolent of the
182 Cultural Revolution and apartheid South Africa – the days of 'pass laws' should be
183 consigned to history.

184 The converse of authoritarian restrictions on movement is a '*laissez-faire*' policy of benign
185 neglect. Proponents of this hands-off policy adhere to 'modernisation' principles, arguing that
186 slums are a temporary phenomenon, and that intervening to improve the lives of people in
187 slums is self-defeating because it encourages inward migration – the 'Todaro effect'.¹² This
188 argument can be rejected because we have seen (paper one) that:

- 189 1. Slums in LMICs are anything but temporary and continue to enlarge even when
190 economic growth is stagnant.
- 191 2. Migration is no longer the main driver of slum growth in many countries – 86% of
192 people in South America already live in urban centres, for example.¹³

193

194 **Resettlement / relocation programmes**

195 During the reign of Napoleon III, Baron Haussman rebuilt central Paris, France, destroying
196 the medieval city but installing a massive sewerage system and creating the cityscape we
197 see today. Haussman's intervention was not evaluated scientifically but the results of
198 resettlement programs in low- and middle-income countries (LMICs) are often
199 disappointing.¹⁴⁻¹⁶ Sometimes this is because they amount to a covert form of expropriation
200 when rents on new buildings are unaffordable for displaced residents. Even when residents
201 are resettled in alternative accommodation, they are liable to find themselves 'ghettoized' on
202 the periphery of sprawling cities, where land is cheap. Commuting times are extended and in
203 some instances settlers return to their original settlement. Absent development of
204 infrastructure (transport, water, electricity, high quality housing, and sewerage) the cheaper
205 policy of *in situ* slum upgrading is generally preferable to relocation.¹⁷ Interestingly, a lottery
206 system enabling people to move to better-off neighbourhoods which worked well in the USA
207 ¹⁸ (Panel B, paper one), was not successful when tried in India largely because many
208 residents returned to their original location.¹⁹ Of course relocation is sometimes necessary
209 for the safety of residents, but should be done with as much community assent as possible,
210 high quality housing must be provided, and mixed-income destinations may give rise to
211 better outcomes than dense areas of deprivation.¹⁸

212

213 **Security of tenure**

214 It is in the nature of most slums that they tend to be informal settlements where residents do
215 not have title or secure tenure. According to economic theory, people are unlikely to invest in
216 their properties unless they feel secure against summary eviction,²⁰ a theory confirmed
217 empirically with respect to farm land.²¹ Further empirical support comes from two natural
218 experiments in slums,^{22, 23} one in Peru showing a sharp increase in investment in home
219 infrastructure, including sanitation, in the intervention slums;²² and the second in Uruguay,
220 finding statistically significant reduction in a score based on number of reported illnesses.²³
221 Title is maximally effective when financial systems that allow residents to release collateral

222 value are in place.²⁴ Furthermore, awarding title may be a longwinded and expensive legal
223 process. In such cases, systems of tenure or registration that instil confidence that homes
224 will not be bulldozed may be enough to encourage residents to invest in developments likely
225 to promote health.²⁵

226

227 **Governance**

228 Failures in planning and governance contribute to the generation and maintenance of large
229 slums (paper one), so good local authority policies promulgated by the 'Healthy Cities
230 movement' are conducive to slum health, as discussed in a Lancet Commission.²⁶ Local
231 government can help ensure that land markets work efficiently and that the playing field is
232 not tilted in favour of powerful elites wishing to build expensive houses for the middle-class
233 and that building restrictions do not price the poorest people out of the market.²⁷ While such
234 planning processes may be corrupt or incompetent, leading to 'ghost cities',^{28, 29} they can
235 also be successful, as in Porto Alegre and Belo Horizonte in Brazil.³⁰⁻³² Formalising slum
236 areas to provide rights and entitlements³³ is associated with better education and health,
237 and this might partially explain the results of a recent Indian study where infant mortality
238 rates were 25 per 1000 live births on average in 'notified' slums versus 58 per 1000 in a non-
239 notified slum in the same city.³⁴ Yet only half of Indian slums are notified and Chinese people
240 who migrate to cities cannot gain access to basic services without registration numbers
241 (Hukou).³⁵ Access to amenities should not be made contingent on tenure.³⁶

242

243 **Community Engagement**

244 There is an expanding literature confirming the effectiveness of interventions to promote
245 local engagement, action, and innovation,^{37, 38} and the more the community drives the
246 intervention the greater the effect.³⁹ A systematic review of women's groups to improve
247 perinatal outcomes included seven RCTs.⁴⁰ While the results were positive overall, most of

248 these studies were conducted in rural settings and the effect was highly dependent on
249 participation rates. The single study conducted in a slum showed a null result plausibly
250 because participation rates were low.⁴¹ This is an example of an intervention that might need
251 to be modified to take into account the exigencies of slum life, perhaps by providing support
252 groups at places of work. There are a number of examples of successful grass-roots
253 networks in slums.^{39, 42-45} The programme in Porto Alegre mentioned above incorporated
254 participatory budgeting where communities were involved in setting priorities.^{30, 46} Such
255 groups have provided successful escort for women in labour in Nairobi slums, in Kenya⁴⁷
256 enhanced protection for sex workers in Zimbabwe,⁴⁸ and improved self-organisation of waste
257 pickers in slums who have gone on to bid successfully for municipal contracts.⁴⁹ City and
258 national slum dwellers federations have been active in conducting slum surveys using these
259 to provoke and plan action with local authorities.⁵⁰

260 **Specific (micro-level) interventions in slums**

261 Here we discuss specific physical / engineering approaches to slum upgrading and service
262 development (Figure 1.2). We augment the limited literature conducted specifically in slums
263 with studies that cover slums and other areas; the systematic reviews we rely on are listed in
264 Table A2, Web Appendix 2.2 and RCTs in Table A3 in Web Appendix 2.3.

265

266 **Physical and engineering approaches in slum upgrading**

267 *Water and sanitation*

268 The poor quality of water and inadequate sanitation in slums and the resulting high incidence
269 of diarrhoea, especially in children under the age of five, was documented in paper one. The
270 problem can be tackled with behavioural interventions (discussed in the next section) or
271 physical interventions. Physical interventions may be targeted at water provision, sanitation,
272 and point of use methods to decontaminate water (filters for example). A Cochrane Review
273 of physical / engineering interventions (Table A2, Web Appendix 2.2) in slums cited three

274 'main' studies that satisfied its quality threshold and included a health outcome.⁴ One of
275 these studies ⁵¹ found a reduced incidence of diarrhoea in households connected to a water
276 supply but confidence intervals were wide (Risk Ratio (RR) 0.53; 95% CI 0.27, 1.04). A
277 multi-component intervention ⁵² (that included piped water in homes and lavatories
278 connected to a sewer along with street paving and drainage) found a substantial reduction in
279 waterborne diseases (RR 0.64; 0.27 - 0.98). Lastly, a study of improved water and sanitation
280 ⁵³ that looked only at effect on 'sanitation related mortality' found no change (RR and CIs not
281 given). Results for case studies based in slums are given in Web Appendix 2.1. Another
282 substantial study that was not specific to slums used the Demographic Health Survey (DHS)
283 to analyse data from 70 countries and found reductions in the incidence of diarrhoea of 13%
284 and 7% respectively for improved water and sanitation.⁵⁴ The effect sizes recorded in the
285 above studies are thus highly variable and some are disappointing given the theoretical
286 headroom for improvement and the results credited to the 19th century 'sanitary revolution' in
287 Europe and North America.⁵⁵ A plausible explanation can be found in the analysis of context
288 and increasing returns to scale described in the section on neighbourhood interventions
289 (Panel A). Wolf and colleagues,⁵⁶ provide a classification of intervention water
290 comprehensiveness, a proxy for 'dose'. Water provision may be 'improved' (according to the
291 United Nations (UN) definition) by making it readily available from standpipes outside the
292 house, or it might be piped into the home or piped into the home and quality assured.
293 Likewise, sanitation may be 'improved' by providing pit latrines or it can be extended to
294 include sewer connections. The literature on slums specifically is insufficient to further
295 examine the role of 'dose' and we therefore turned to systematic reviews on water and
296 sanitation interventions generally (i.e. including but not limited to slums) ⁵⁶⁻⁵⁸. Results are
297 given in Web Appendix 2.1 and shown in Figure 2.2, where increasing returns to
298 comprehensiveness ('dose') of the intervention can be seen, conforming to the theoretical
299 representation in Panel A, Box A. It would appear from these findings that pit-latrines, for all
300 that the UN classifies them as 'improved' sanitation, are of minimal effectiveness generally
301 and there is further evidence that they do little to reduce environmental contamination in

302 congested slum neighbourhoods.⁵⁹ Where adequately quality assured piped water cannot be
303 provided, then point of use methods provide an alternative since the above systematic
304 reviews consistently demonstrate substantial effect sizes; 0·65 (0·48, 0·88) in Fewtrell's
305 review⁵⁸ and 0·55 (0·38, 0·81) for filtered and safely stored water in Wolf's review.⁵⁶

306 Effectiveness is likely to be influenced by contextual factors as well as dose. For example,
307 effectiveness will be attenuated if people do not make use of facilities; the likely explanation
308 for null results in two recent cluster RCTs of making pit latrines available in India^{60, 61} A
309 further reason for variable results from physical interventions lies in poor maintenance of
310 facilities and inadequate installations; piped water distribution systems are often
311 contaminated.⁵⁹ It might be expected that combining sanitation and water interventions
312 would be more effective than either alone but this remains unproven (Web Appendix 2.1).

313 **[Figure 2.2]**

314

315 *Home improvements*

316 The Cochrane review of slum interventions identified a natural experiment⁶² in which the
317 provision of cement floor reduced the incidence of diarrhoea in children under six years old
318 (RR 0·87 [0·76-1·00]) in Mexico. A subsequent experimental study evaluating home
319 improvements that included a raised floor across El Salvador, Mexico and Uruguay⁶³ also
320 showed a borderline significant reduction in diarrhoea incidence (2·7% absolute risk
321 reduction from 15·1%) in two of the countries excluding Uruguay.

322

323 *Lighting, repaving and garbage removal*

324 Improved street lighting and paving have been strongly recommended by UN-Habitat on the
325 basis of observational studies but the single RCT in the Cochrane Review⁴ did not confirm
326 improved security or health.⁶⁴ Removing solid waste is doubtless a good idea given its

327 effects on health and wellbeing (paper one) but little evidence was found on how best to
328 dispose of garbage or on the health benefits of doing so.

329 Taken in the round, the literature provides numerous case studies of interventions but
330 woefully insufficient large-scale studies where in depth observations complement
331 comparisons across sites, such as can be found, for example, in studies of home
332 improvements in high-income countries.⁶⁵

333

334 **Health and public services**

335 A number of *health improvement* studies have been carried out in general populations but
336 also replicated in slums specifically:

- 337 • A meta-analysis of 11 studies across urban and rural locations showed that
338 behavioural interventions to promote hand washing resulted in a lower prevalence of
339 diarrhoea⁵⁸ and this was mirrored in trials specifically in slums in Pakistan⁶⁶ and
340 Nepal.⁶⁷
- 341 • A systematic review examining paediatric burn prevention identified 30 studies from
342 high and low income countries (Table A2, Web Appendix 2.2). The benefits observed
343 from reducing hazards such as unsafe paraffin cook-stoves were replicated in a
344 single RCT in a slum environment (in South Africa).⁶⁸
- 345 • A systematic review of behaviour change interventions to reduce indoor pollution
346 across 20 countries reported that these could result in an 88% fall in indoor
347 particulate levels (13.2 to 1.6 parts per million), a 21% reduction in respiratory
348 disease (absolute risk not given) and savings on fuel costs.⁶⁹ Two of the interventions
349 were carried out in slums (Bangladesh and Uganda) but results are not broken down
350 by location.

351 A substantial number of individual RCTs of health promotion interventions have been
352 conducted specifically in slums (Web Appendix 2.2 Table A3) yielding positive results

353 concerning behavioural interventions to reduce obesity in women and children in Brazil ^{70, 71},
354 childhood malnutrition in Peru,⁷² breast feeding in Kenya,⁶⁷ and ‘delinquent’ behaviour in
355 Uganda.⁷³ Providing fortified snack bars resulted in improved nutritional status in India ⁷⁴ and
356 Bangladesh ⁷⁵ (arguably avoiding the harmful effects resulting from imbalance of competing
357 elements, e.g. zinc and copper, with chemical formulations of micro-nutrients).

358 These results, taken in the round, support the theory that slum populations benefit from
359 health promotion measures as long as they receive them. This conclusion, that access is the
360 rate limiting step to achieving benefit for people who live in slums appears to apply also to
361 *health protection*. Child immunisation is considered the single most cost effective
362 intervention for health in LMIC ⁷⁶ yet children in slums are less likely to be vaccinated than
363 other urban infants.⁷⁷ This is especially unjust given that, as stated in the search strategies,
364 slums are often used as a convenient sample in vaccine trials (Panel B). When it comes to
365 screening, we do not know of studies specific to slums but rates are very low across low
366 income countries; 4.1% and 2.2% in the relevant populations for cervical and breast cancer
367 respectively, for example. However, slum populations benefit when access to health
368 protection is provided. For instance five RCTs specifically in slums ⁷⁸⁻⁸² have shown that
369 parasite loads can be reduced by treatment targeted at high risk groups and some show
370 improved child growth (although the latter is a highly contested topic across all
371 populations).⁸³

372 The problem with *clinical services* is also one of access on the assumption that indications
373 for treatment do not change because a person lives in a slum. The unifying theme across all
374 health provision of all types in slums is the need to improve access. Services must be
375 available outside normal office hours and be pro-active for the reasons given under
376 ‘determinants of health’ in paper one. Such services include a judicious and comprehensive
377 mix of Community Health Workers, local clinics and use of mobile technology to ensure
378 coverage with respect to health protection, health improvement and clinical services. A
379 recent paper contributing to the Lancet Commission on Universal Healthcare, Markets, Profit

380 and the Public Good, showed that providing a network of accessible free clinics ‘crowded
 381 out’ low quality, under-qualified providers.⁸⁴ Further work to design services that meet local
 382 preferences ⁸⁵ is urgently required and we note that the high population densities allow many
 383 people to be reached per unit of staff time; another potential example of increased
 384 economies to scale when intervening at the neighbourhood level in slums.

385 We summarise what can be said given current information on the likely effectiveness of both
 386 enabling (meso-level) and specific (micro-level) interventions in Table 2.1.

387

388 **Table 2.1: Summary of intervention effectiveness across both meso-level and micro-**
 389 **level interventions**

	Policy	Aim	Effect
Meso-level (enabling policies)	Limit free movement	Discourage growth of slums.	Does not solve underlying problem, illiberal and is not a permanent solution.
	Benign neglect	Limit size of slums on the grounds that they are self-correcting.	Leaves vulnerable people in prolonged and severe need and generates poverty traps. Too late for many countries where urbanisation is already advanced.
	Relocation and resettlement	Clear slums and provide alternative, superior living environment.	Countries with large slums generally have insufficient resources / lack political will to do a proper job, and provide necessary infrastructure. Promises more than it delivers.
	Title and tenure	Encourage ‘in situ’ regeneration by giving people a stake in their community and homes.	Providing title is effective but may not be possible where title is disputed. Security of tenure without title may be sufficient.
	City governance	Recognising slums and conferring rights creates conditions conducive to health. Land zoning	Many examples of good and bad practice. Providing rights and

		protects vulnerable citizens.	services is an effective policy.
	Community engagement / empowerment	Uses 'assets' of the community; empowers citizens.	Many empirical examples of success – most effective where citizens are genuinely empowered.
Specific (micro-level) interventions	Physical methods of slum improvement	Uncontaminated water piped into homes / point of use decontamination. Reduce environmental contamination through sanitation.	'Dose' dependent effect .Pit latrines have very small benefit especially in slums. Point of use methods of decontamination effective where clean tap water not provided.
	Home and environment	Improve home insulation, street paving, lighting and drainage; garbage removal.	Sensible measures for reasons given in paper one but poorly studied in slum contexts.
	Health services	Improve access to health protection, health improvement, and clinical care.	Public health and clinical services effective in slums as elsewhere, barriers to access have been studied (paper one), but the most cost-effective mix of services is in need of urgent study.

391 **Recommendations for Policy and Research**

392 We have shown that very little research has been devoted to the subject of slum health
393 (paper one). Consequently, despite nearly a billion people already living in slum locations in
394 LMICs, we do not understand enough about their health vulnerabilities and what impact can
395 be achieved from slum-focused health interventions. In particular, we need to understand
396 how neighbourhood effects operate so that we can get the intensity of interventions right as
397 discussed in Panel A. We offer below a number of research and policy recommendations to
398 advance the field of slum health.

399

400 **Identifying and studying slums as spatial entities**

401 Although slums are easily identifiable physically in many LMIC cities, they remain invisible in
402 many data systems that drive research and policy. Slums are rarely identified in national
403 censuses, which form the sampling frames for national surveys. We recommend that all
404 censuses include identification for slum and non-slum clusters for all urban areas. This will
405 encourage all studies and national surveys to generate separate health indicators for slum
406 and non-slum areas both for research purposes and to identify local priorities for action: for
407 instance determining where diarrhoea and stunting are most prevalent (Figure 2.3). As we
408 have seen repeatedly in this series most research provides data for urban areas as a whole.
409 Such data are of limited value; for example, if slums have worse outcomes than non-slum
410 urban areas and the slum population (as a proportion of urban population), has been
411 changing, then urban trend indicators may represent nothing more than differences in the
412 respective growth rates of slum vs. non-slum urban populations. All measures of place of
413 residence should move from a binary urban-rural construct to one that splits urban into slum
414 and non-slum. We spell out how this could be achieved in Panel C. Pending implementation
415 of the recommended changes to include identification of slums in censuses, individual
416 researchers can estimate the locations of high risk areas using geo-located data. We
417 illustrate this idea by mapping the prevalence of diarrhoea and stunting in children to well-

418 known slums in three urban areas in Nairobi, Port-au-Prince, Haiti and Lagos, Nigeria using
419 data from the Demographic Health Survey (DHS) in Figure 2.3. There is clustering of cases
420 in the vicinity of well-known slums but precision would be much improved if slum areas were
421 clearly demarcated.

422

423 **Panel C. Suggested process to identify slums and include them in censuses so that**
424 **studies/surveys based on a census sampling frame can distinguish between slum and**
425 **non-slum locations.**

426 In order to achieve the above objective:1) enumeration areas should be designated (tagged)
427 to one of three categories (slum, non-slum, or rural) in such a way that no single urban
428 enumeration area straddles slum and non-slum areas; 2) while nations classify slums
429 according to their own context, their methods should be transparent, and consider the five
430 household level criteria in the UN-Habitat definition; and 3) quality assurance should check
431 that all clusters are enumerated and then that all dwellings are recorded within each cluster.

432 This will ensure all national surveys and data systems can effectively sample and report
433 indicators using three residential domains: rural, urban slum, and urban non-slum. Some
434 countries, notably Kenya and Bangladesh, already follow a process to identify slum
435 enumeration areas and include identification of slum and non-slum clusters in national
436 master sampling frames. This is why these countries were selected for the study in Table
437 1.2, paper one.

438 It would be impossible (or at least it would take a very long time) to negotiate a common
439 definition of a slum across all countries and, in any case, a common definition is not a
440 prerequisite for examination of the proposed spatial construct of slum health. The subject
441 can develop, notwithstanding differences in definitions, just as the topic of urban health has
442 developed despite different national definitions of an urban area.

443

444 **[Figure 2.3]**

445

446 **Child health**

447 While the evidence base in slum health is under-developed, some recommendations for
448 improvement can be made. In particular, the evidence in paper one highlighted the plight of
449 children who are exposed to high-risk of infection while their immune systems are immature.
450 Children are also a priority because conditions at the start of life will limit their subsequent
451 life chances. Interventions that should be considered, contingent on local circumstances,
452 include: improved uptake of vaccination; promotion of breastfeeding, nutrition, clean water,
453 and sanitation, indoor protection against burns, and inhalation of particles/noxious fumes. As
454 they grow into young adulthood, violent crime is a big challenge, although we need to better
455 understand how supportive and destructive neighbourhood cultures develop and hence how
456 interventions may help.

457

458 **Sanitation and water quality**

459 Improvements in water supply and sanitation have yielded modest health benefits in modern
460 slums by comparison with the massive effects credited to the major works carried out in
461 European and North American cities during the 'sanitary awakening' in the 19th century.⁵⁵
462 We speculate that there is a straightforward reason for this which turns on the issue of
463 increasing returns to scale described in the introduction; most interventions have simply not
464 been up to the job. Piped water installations have been prone to contamination and
465 sanitation has removed insufficient waste to reduce faecal contamination of the environment
466 to the 'tipping point' where rapidly increasing returns to scale might be achieved (Panel A).
467 The international community may even have exacerbated the problem by setting standards
468 for 'improved' sanitation (pit latrines) that are unsuitable for densely crowded slum
469 conditions.⁵⁰ We therefore recommend that this inadequate standard should be withdrawn

470 for slum contexts and that, working with local communities, comprehensive installations (e.g.
471 linked to a sewerage system) should be installed as a matter of urgency within the
472 framework of robust large scale comparative studies to work out which types of installation
473 are suitable for which types of slum environment.

474

475 **The art of the possible in slum improvement**

476 If some standards are set too low, others may be too high. It has become fashionable for
477 scholars to argue that the whole ‘slum nexus’ should be tackled in a co-ordinated way.⁸⁶⁻⁸⁸ At
478 the limit such an approach amounts to a programme to convert slum to non-slum. While this
479 is a laudable aim, we are concerned that the ideal should not become the enemy of the
480 good; as Buckley has argued, cost-effective interventions, such as vaccination and installing
481 sanitation systems, should not wait until the moment is propitious for a holistic strategy⁸⁹
482 and access to amenities should not be dependent on title or tenure.⁹⁰ We also caution that
483 reliance on ‘community assets’ should not be taken too far – work in rural areas shows that
484 the greatest potential health and wellbeing gains are among those most deeply trapped in
485 poverty and hence most in need of a helping hand.^{91, 92}

486

487 **A call for multicentre studies with contemporaneous controls**

488 The literature on policy interventions and on physical upgrading of slums is based largely on
489 case studies. We do not wish to disparage such studies, but we advocate balancing the
490 literature with a greater proportion of studies with contemporaneous controls.^{93, 94} While not
491 reifying experimental methods, Field and Kramer cite empirical evidence that supports
492 theoretical arguments for use of experimental methods in a slum context.⁹⁵⁻⁹⁷

493

494 **Consider multiple outcomes and populations**

495 The effects of policy and service are often broad – they ‘spill over’ to affect outcomes
496 different to the original target. For instance, improving water and sanitation has beneficial
497 effects on education, wellbeing and productivity in addition to those on health (Web
498 Appendix 2.1). A corollary is the importance of capturing both dimensions of health (for
499 example in Disability Adjusted Life Years) and of subjective wellbeing (happiness, life
500 satisfaction, and mental health). Special attention should be paid to groups who are
501 marginalised or especially vulnerable,⁹⁸ and cost-effectiveness analyses should seek to
502 examine dimensions of equity, particularly catastrophic out-of-pocket expenses and
503 proportions of people pushed below the poverty line (US\$2 per day at purchasing power
504 parity).⁹⁹

505

506 **Slum health as an academic discipline**

507 These papers have been predicated on the idea that there is merit in abstracting the idea of
508 slum health from that of poverty in general or urban health in particular. Given the salience of
509 space, and the massive scale of modern slums, we think there is a need for a subject
510 dedicated to improving conditions in slums. We identify four groups of people who can
511 promote this cause – those who control the purse strings, those who control the intervention,
512 those whose lives are at stake, and those who have experience and expertise in the design,
513 conduct and reporting of academic studies. Organisations that promulgate interventions
514 across jurisdictions, such as the World Bank, agencies of the UN, and major donors, are in a
515 good position to exert both the necessary leadership and provide practical support to kick-
516 start a community of practice across the above four groups. Multidisciplinary research
517 collaboration will be needed to make progress in improving slum health.

518

519 **Conclusion**

520 While it is no longer true to say that people who live in slums are invisible, they are
521 insufficiently visible and as a result continue to be marginalised. Many slums are not
522 identified in national surveys based on census sampling frames; research effort in slums is
523 incommensurate with the size of the issue (particularly with respect to multicentre controlled
524 studies); people who live in slums remain politically weak and subject to expropriation; and
525 conditions in slums are improving only slowly. The profile of slum health and welfare needs
526 to be raised and the time to do so is propitious given the forthcoming UN-Habitat III
527 conference, the third of its type in 40 years, and the first UN global summit after the
528 adoption of the 2030 Agenda for Sustainable Development and the Sustainable
529 Development Goals. The time is ripe to revisit the Urban Agenda with a strong emphasis
530 on slum health and slum upgrading and on strengthening the capacities of urban
531 governments to work with people who live in slums to act on these. This will help in
532 securing commitments to ensure that policies are backed up with adequate finance.
533 Above all, we advocate the academic development of slum health in the form of a
534 partnership between policymakers, academics, and representatives of those who live in
535 slums, so that knowledge can grow in tandem with efforts to improve health and
536 wellbeing.

537 The putative neighbourhood effect in slums is both a problem and an opportunity. It is a
538 problem because it is likely to amplify health hazards and it is an opportunity because a
539 single intervention can simultaneously improve so many lives in one densely packed
540 community. It is time for a concerted effort to generate political momentum and bear
541 down heavily on known threats to health and wellbeing in slums. Since young children
542 are especially vulnerable in slums, and since the effects of chronic illnesses are
543 indelible, we recommend a concerted and sustained international movement to provide
544 effective interventions to improve child health – vaccinations, water/sanitation,
545 breastfeeding and nutrition, and safe non-polluting cook stoves.

546

547 **Key messages**

- 548 1. The neighbourhood effects in slums are likely to offer economies of scale and increasing
549 returns to investments to create a healthy environment.
- 550 2. While relocation and resettlement can be necessary for reasons of safety, slum
551 upgrading in situ is usually preferable.
- 552 3. Sanitation, which started the public health revolution in Europe and America during the
553 19th century, remains a cardinal neighbourhood challenge in slums. Interventions must
554 be sufficiently comprehensive to impact the steep part of the returns to scale curve.
- 555 4. Health services should be designed specifically to overcome barriers to utilisation, such
556 as distance and cost, for people who live in slums.
- 557 5. Further to the above health services should be pro-active in health protection, e.g. by
558 immunisation and surveillance for childhood malnutrition.
- 559 6. People who live in slums and their organisations should have an active say in the
560 prioritisation, design, implementation, and evaluation of interventions in slums.
- 561 7. Slum enumeration areas should be identified in all census listings and sampling frames
562 to enable clearer understanding of the neighbourhood effects of slums.
- 563 8. Enabled by this spatial construct, much more research is needed on slum health and
564 how to improve it, and a greater proportion of this research should be based on
565 multicentre studies with contemporaneous controls.
- 566 9. In addition, we advocate the development of capacity for research into slum health and
567 the emergence of this as an academic discipline.

568

569

570 **Contributors**

571 This series on slum health has been an international collaboration led by the University of
572 Warwick, African Population and Health Research Centre, United Nations Human
573 Settlements Programme (UN-Habitat), International Institute for Environment and
574 Development, United Nations University, Federal University of Minas Gerais, and Oxford
575 Policy Management Institute. RJL and AE jointly conceptualised the intellectual framework
576 and initial draft of this paper. GJMT, JS, SW and YFC conducted the systematic reviews and
577 OO led on the health aspects. All authors provided references and material and contributed
578 actively to the drafting and reviewing of the manuscript.

579

580 **Declaration of interests**

581 The authors declare no competing interests

582

583 **Acknowledgements**

584 The authors would like to acknowledge Aileen Clarke, Christine MacArthur, Trevor Hancock
585 and Trudy Harpham for their useful review comments during the writing process. We would
586 also like to acknowledge Peter Chilton for his help with references, and preparing the figures
587 and manuscript for publication.

588 Prof Richard Lilford and Dr Oyinlola Oyebode are supported by the National Institute for
589 Health Research (NIHR) Collaborations for Leadership in Applied Health Research and Care
590 (CLAHRC) West Midlands initiative. Prof Waleska T. Caiaffa is supported by the Brazilian
591 National Council for Scientific and Technological Development (CNPq). The African
592 Population and Health Research Centre (APHRC) team are supported in part from core
593 support grants from the Hewlett Foundation, the Swedish International Development
594 Cooperation Agency (Sida) and an anonymous funder. This paper presents independent
595 research and the views expressed are those of the author(s) and not necessarily those of
596 the funding sources, the National Health Service (NHS), or the UK Department of Health.

597

598

599

600

601

602

603

604

605

606 **Figure Legends**

607

608 **Figure Panel A. (Left) Relationship between exposure to a risk factor for a disease of**
609 **interest and prevalence of the disease in three different neighbourhoods. (Right)**
610 **Observed effectiveness of an intervention aimed at reducing a specific exposure, with**
611 **success measured by examination of prevalence of the disease of interest.**

612 Δ = intervention effect

613 (Left) A, B and C represent three different slum neighbourhoods. In A and C, prevalence is
614 relatively inelastic over varying levels of exposure, perhaps because another powerful risk
615 factor is present (A) or because there is a ceiling effect as prevalence is already low (C)
616 perhaps because the population has been vaccinated against the risk factor. In B, the dose
617 response is non-linear so that an intervention may show increasing (and then decreasing)
618 returns to scale.

619 (Right) When an intervention is implemented which aims to reduce exposure to the risk
620 factor, the effects are minimal in neighbourhoods A and C where this risk factor is not the
621 main determinant of disease. In B, the pre-intervention exposure and the intervention dose
622 have a crucial effect on the intervention effectiveness because of the non-linear dose
623 response, so an intervention that reduces the exposure from x3 to x2 has much less
624 effectiveness than an intervention that reduces the exposure from x2 to x1.

625

626 **Figure 2.1. Representation of causal pathways impacting on the lives of people who**
627 **live in slums**

628 *Topics under this heading adapted from the framework in the Cochrane Review ⁴
629 augmented from the literature review.

630 **Topics under this heading based on the Social Determinants of Health – Office of Disease
631 Prevention and Promotion.¹⁰

632 We do not discuss microfinance in this paper as none of the three systematic reviews
633 evaluated this topic for slums specifically. We do not cover education as this substantial
634 topic is worthy of its own review.

635

636 **Figure 2.2 Representation of Magnitude of Effect by Comprehensiveness of**
637 **Intervention Across Studies in Slum and Non-Slum Systematic Reviews and the DHS**
638 **Survey**

639 * Relative risk ratio for episodes of diarrhoea (waterborne disease) in Cochrane [Turley]
640 review of interventions in slums.

641 † **Water:** *Level 1* = 'improved supply of piped water into vicinity of homes; *Level 2* = piped
642 into home; *Level 3* = piped into home and quality assured.

643 **Sanitation:** *Level 1* = 'improved' (pit latrine); *Level 3* = pit latrine connected to sewage
644 system.

645 This classification is based on Wolf, et al. 2014.⁵⁶

646 i. Wolf's review⁵⁶

647 ii. DHS study⁵⁴

648 iii. Butala et al. 2010⁵²

649

650

651 **Figure 2.3. Maps showing risk of diarrhoea in children aged under five and childhood**
652 **stunting across Nairobi, Port-au-Prince, and Lagos with major slum areas indicated**
653 **by circled letters**

654 Red indicates higher risk and turquoise lower risk. Blue lines outline areas with a greater
655 than 80% probability of increased risk of the disease relative to other areas in the city.

656 Disease risk is estimated by applying a spatial filter across a regular lattice grid over each
657 urban area using data from the Demographic and Health Surveys (DHS) and then estimating
658 a binomial model to predict disease risk at each grid point. Contact the authors for further
659 information.

660 **References**

- 661 1. Lilford RJ, Chilton PJ, Hemming K, Girling AJ, Taylor CA, Barach P. Evaluating
662 policy and service interventions: framework to guide selection and interpretation
663 of study end points. *BMJ* 2010; **341**: c4413.
- 664 2. Donabedian A. Explorations in Quality Assessment and Monitoring, Volume I:
665 The Definition of Quality and Approaches to Its Assessment. Ann Arbor, MI:
666 Health Administration Press, 1980.
- 667 3. Hardoy JE, Cairncross S, Satterthwaite D. The Poor Die Young: Housing and
668 Health in Third World Cities. London: Earthscan Publications, 1990.
- 669 4. Turley R, Saith R, Bhan N, Rehfuess E, Carter B. Slum upgrading strategies
670 involving physical environment and infrastructure interventions and their effects
671 on health and socio-economic outcomes. *Cochrane Database Syst Rev* 2013; **1**:
672 CD010067.
- 673 5. Baker J. Urban Poverty: A Global View. Washington, D.C.:The World Bank, 2008.
- 674 6. Abuya B, Kassahun A, Ngware M, Onsomu E, Oketch M. Free Primary Education
675 and Implementation in Kenya: The Role of Primary School Teachers in
676 Addressing the Policy Gap. *SAGE Open* 2015: 1-10.
- 677 7. World Health Organization. World Health Statistics Geneva: World Health
678 Organization, 2015.
- 679 8. Kyu HH, Shannon HS, Georgiades K, Boyle MH. Association of Urban Slum
680 Residency with Infant Mortality and Child Stunting in Low and Middle Income
681 Countries. *BioMed Res Int* 2013: 1-12.
- 682 9. Mitchell S. Victorian Britain Encyclopedia New York: Garland Publishing, 1988.
- 683 10. Office of Disease Prevention and Health Promotion. Social Determinants of
684 Health. 2016. URL: [https://www.healthypeople.gov/2020/topics-](https://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-of-health)
685 [objectives/topic/social-determinants-of-health](https://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-of-health) (accessed 17 Feb 2016).
- 686 11. UN-Habitat. Slums of the World: The Face of Urban Poverty in the New
687 Millennium. Nairobi, Kenya: UN-Habitat, 2003.
- 688 12. Harris JR, Todaro MP. Migration, Unemployment and Development: A Two-
689 Sector Analysis. *Am Econ Rev* 1970; **60**(1): 126-42.
- 690 13. UN-Habitat. World Cities Report 2016: Urbanization and Development Emerging
691 Futures. Nairobi, Kenya: UN-Habitat, 2016.
- 692 14. Xavier HN, Magalhães F. Urban slums report: The case of Rio de Janeiro.
693 London: University College London, 2003.
- 694 15. Bradlow B, Bolnick J, Shearing C. Housing, institutions, money: the failures and
695 promise of human settlements policy and practice in South Africa. *Environ Urban*
696 *2011*; **3**(1): 267-75.
- 697 16. Kapse V, Pofale A, Mathur M. Paradigm of Relocation of Urban Poor Habitats
698 (Slums): Case Study of Nagpur City. *Int J Soc Behav Educ Econ Bus Ind Eng*
699 *2012*; **6**(11): 2916-23.
- 700 17. Collins W, Shester KL. Slum Clearance and Urban Renewal in the United States.
701 *Am Econ J: Appl Econ* 2013; **5**(1): 239-73.
- 702 18. Chetty R, Hendren N, Katz L. The Effects of Exposure to Better Neighbourhoods
703 on Children: New Evidence from the Moving to Opportunity Experiment. *Am Econ*
704 *Rev* 2016; **106**(4): 855-902.
- 705 19. Barnhardt S, Field E, Pande R. Moving to Opportunity or Isolation? Network
706 Effects of a Randomised Housing Lottery in Urban India. NBER Working Paper
707 21419. Massachusetts: National Bureau of Economics, 2015.
- 708 20. Patel SB. Dharavi: Makeover or takeover?. *Econ Polit Weekly* 2010; **45**(24): 47-
709 54.
- 710 21. Banerjee A, Gertler P, Ghatak M. Empowerment and Efficiency: Tenancy Reform
711 in West Bengal. *J Polit Econ* 2002; **110**(2): 239-80.
- 712 22. Field E. Property Rights and Investment in Urban Slums. *J Eur Econ Assoc* 2005;
713 **3**(2-3): 279-90.

- 714 23. Gandelman N. Property rights and chronic diseases: evidence from a natural
715 experiment in Montevideo, Uruguay 1990-2006. *Econ Hum Biol* 2010; **8**(2): 159-
716 67.
- 717 24. Buckley RM, Kalarickal J. Housing Policy in Developing Countries: Conjectures
718 and Refutations. Oxford: Oxford University Press, 2005.
- 719 25. Handzic K. Is legalized land tenure necessary in slum upgrading? Learning from
720 Rio's land tenure policies in the Favela Bairro Program. *Habitat Int* 2010; (34): 11-
721 7.
- 722 26. Rydin Y, Bleahu A, Davies M, et al. Shaping cities for health: complexity and the
723 planning of urban environments in the 21st century. *Lancet* 2012; **379**(9831):
724 2079-108.
- 725 27. Muller A, Mitlin D. Securing inclusion: strategies for community empowerment
726 and state redistribution *Environ Urban* 2007; **19**(2): 425-39.
- 727 28. Njoku J. Why Festac, Shagari housing schemes failed 29th April 2014 2014.
728 URL: [http://www.vanguardngr.com/2014/04/festac-shagari-housing-schemes-](http://www.vanguardngr.com/2014/04/festac-shagari-housing-schemes-failed-expert/)
729 [failed-expert/](http://www.vanguardngr.com/2014/04/festac-shagari-housing-schemes-failed-expert/) (accessed 4 March 2016).
- 730 29. Etim EE, Atser J, Akpabio F. The new social housing scheme in Nigeria: How
731 beneficial for the less privileged? *Glob J Soc Sci* 2007; **6**(1): 1-6.
- 732 30. Vlahov D, Caiaffa WT. Healthy urban governance and population health.
733 Participatory budgeting in Belo Horizonte, Brazil. In: Sclar ED, Volavka-Close N,
734 Brown P, eds. The urban transformation: health, shelter and climate change.
735 London: Taylor & Francis, 2013: pp. 63-81.
- 736 31. Viero OM, Cordeiro AP. New Rules, New Roles: Does PSP Benefit the Poor?
737 The Case for Public Provisioning in Pôrto Alegre. Pôrto Alegre: Wateraid, 2003.
- 738 32. Goldsmith WW, Vainer CB. Participatory Budgeting and Power Politics in Porto
739 Alegre. *Land Lines* 2001; **3**(1).
- 740 33. Wang F, Xuejin Z. Inside China's Cities: Institutional Barriers and Opportunities
741 for Urban Migrants. *Am Econ Rev* 1999; **89**(2): 276-80.
- 742 34. Subbaraman R, O'Brien J, Shitole T, et al. Off the map: the health and social
743 implications of being a non-notified slum in India. *Environ Urban* 2012; **24**(2):
744 643-63.
- 745 35. Qiu P, Yang Y, Zhang J, Ma X. Rural-to-urban migration and its implication for
746 new cooperative medical scheme coverage and utilization in China. *BMC Public*
747 *Health* 2011; **11**: 520.
- 748 36. Mudege NN, Zulu EM. Discourses of illegality and exclusion: when water access
749 matters. *Glob Public Health* 2011; **6**(3): 221-33.
- 750 37. Brunton G, Caird J, Stokes G, et al. Review 1: Community engagement for health
751 via coalitions, collaborations and partnerships - a systematic review. London:
752 EPPI Centre UCL, 2015.
- 753 38. Cyril S, Smith BJ, Possamai-Inesedy A, Renzaho AM. Exploring the role of
754 community engagement in improving the health of disadvantaged populations: a
755 systematic review. *Glob Health Act* 2015; **8**: 29842.
- 756 39. Rosato M. A framework and methodology for differentiating community
757 intervention forms in global health. *Community Dev J* 2015; **50**(2): 244-63.
- 758 40. Prost A, Colbourn T, Seward N, et al. Women's groups practising participatory
759 learning and action to improve maternal and newborn health in low-resource
760 settings: a systematic review and meta-analysis. *Lancet* 2013; **381**(9879): 1736-
761 46.
- 762 41. More NS, Bapat U, Das S, et al. Community mobilization in Mumbai slums to
763 improve perinatal care and outcomes: a cluster randomized controlled trial. *PLoS*
764 *Medicine* 2012; **9**(7): e1001257.
- 765 42. Dias S. Overview of Legal Framework for Social Inclusion in Solid Waste
766 Management in Brazil. Cambridge, USA: WIEGO, 2010.

- 767 43. Chen M, Vanek J, Lund F, Heintz J, Jhabvala R, Bonner C. Progress of the
768 World's Women 2005: Women, Work and Poverty: United Nations Development
769 Fund for Women (UNIFEM). New York: United Nations, 2005.
- 770 44. Chen M, Jhabvala R, Kanbur R, Richards C. Membership based organisations of
771 the poor. London: Routledge, 2007.
- 772 45. Chen M, Snodgrass D. Managing resources, activities, and risk in urban India:
773 The impact of SEWA Bank. Washington D.C.: AIMS, 2001.
- 774 46. Cabannes Y. The impact of participatory budgeting on basic services; municipal
775 practices and evidence from the field. *Environ Urban* 2015; **27**(1): 257-84.
- 776 47. Bakibinga P, Ettarh R, Ziraba AK, et al. The effect of enhanced public-private
777 partnerships on Maternal, Newborn and child Health Services and outcomes in
778 Nairobi-Kenya: the PAMANECH quasi-experimental research protocol. *BMJ*
779 *Open* 2014; **4**(10): e006608.
- 780 48. Kerrigan D, Kennedy CE, Morgan-Thomas R, et al. A community empowerment
781 approach to the HIV response among sex workers: effectiveness, challenges,
782 and considerations for implementation and scale-up. *Lancet* 2015; **385**(9963):
783 172-85.
- 784 49. Fergutz O, Dias S, Mitlin D. Developing urban waste management in Brazil with
785 waste picker organizations. *Environ Urban* 2011; **23**(2): 597-608.
- 786 50. Patel S, Baptist C. Documenting by the undocumented. *Environ Urban* 2012;
787 **24**(1): 3-12.
- 788 51. Galiani S, Gonzalez-Rozada M, Schargrotsky E. Water expansions in
789 Shantytowns: Health and Savings. Washington D.C.: Inter-American
790 Development Bank, 2007.
- 791 52. Butala NM, VanRooyen MJ, Patel RB. Improved health outcomes in urban slums
792 through infrastructure upgrading. *Soc Sci Med* 2010; **71**(5): 935-40.
- 793 53. Soares F, Soares Y. The socio-economic impact of Favela-Bairro. What do the
794 data say? Washington, D.C.: Inter-American Development Bank, 2005.
- 795 54. Gunther I, Gunther F. Water, sanitation and children's health : evidence from 172
796 DHS surveys. Policy Research working paper WPS 5275. Washington D.C.: The
797 World Bank, 2010.
- 798 55. Chaplin SE. Cities, sewers and poverty: India's politics of sanitation. *Environ*
799 *Urban* 1999; **11**(1): 145-58.
- 800 56. Wolf J, Prüss-Ustün A, Cumming O, et al. Assessing the impact of drinking water
801 and sanitation on diarrhoeal disease in low- and middle-income settings:
802 systematic review and meta-regression. *Trop Med Int Health* 2014; **19**(8): 928-42.
- 803 57. Clasen TF, Bostoen K, Schmidt WP, et al. Interventions to improve disposal of
804 human excreta for preventing diarrhoea. *Cochrane Database Syst Rev* 2010; **6**:
805 CD007180.
- 806 58. Fewtrell L, Kaufmann RB, Kay D, Enanoria W, Haller L, Colford JM, Jr. Water,
807 sanitation, and hygiene interventions to reduce diarrhoea in less developed
808 countries: a systematic review and meta-analysis. *Lancet Infect Dis* 2005; **5**(1):
809 42-52.
- 810 59. Nakagiri A, Niwagaba CB, Nyenje PM, Kulabako RN, Tumuhairwe JB, Kansime
811 F. Are pit latrines in urban areas of Sub-Saharan Africa performing? A review of
812 usage, filling, insects and odour nuisances. *BMC Public Health* 2016; **16**(1): 120.
- 813 60. Clasen T, Boisson S, Routray P, et al. Effectiveness of a rural sanitation
814 programme on diarrhoea, soil-transmitted helminth infection, and child
815 malnutrition in Odisha, India: a cluster-randomised trial. *Lancet Glob Health* 2014;
816 **2**(11): e645-53.
- 817 61. Patil SR, Arnold BF, Salvatore AL, et al. The effect of India's total sanitation
818 campaign on defecation behaviors and child health in rural Madhya Pradesh: a
819 cluster randomized controlled trial. *PLoS Med* 2014; **11**(8): e1001709.
- 820 62. Cattaneo M, Galiani S, Gertler P, Martinez S, Titiunik R. Housing, Health and
821 Happiness. *Am Econ J: Econ Policy* 2009; **1**(1): 75-105.

- 822 63. Galiani S, Gertler P, Cooper R, Martinez S, Ross A, Undurraga R. Shelter from
823 the storm: upgrading housing infrastructure in Latin American slums. Working
824 Paper 19322. Cambridge, MA: National Bureau of Economics, 2013.
- 825 64. Gonzalez-Navarro M, Quintana-Domeque C. Urban Infrastructure and Economic
826 Development: Experimental Evidence from Street Pavement. IZA Discussion
827 Paper No. 5346. Germany, 2010.
- 828 65. Thomson H, Thomas S, Sellstrom E, Petticrew M. Housing improvements for
829 health and associated socio-economic outcomes. *Cochrane Database Syst Rev*
830 2013; **2**: CD008657.
- 831 66. Bowen A, Agboatwalla M, Luby S, Tobery T, Ayers T, Hoekstra RM. Association
832 between intensive handwashing promotion and child development in Karachi,
833 Pakistan: a cluster randomized controlled trial. *Arch Pediatr Adolesc Med* 2012;
834 **166**(11): 1037-44.
- 835 67. Ernst KC, Phillips BS, Duncan BD. Slums are not places for children to live:
836 Vulnerabilities, health outcomes, and possible interventions. *Adv in Pediatr* 2013;
837 **60**: 53-87.
- 838 68. Parbhoo A, Louw QA, Grimmer-Somers K. Burn prevention programs for children
839 in developing countries require urgent attention: A targeted literature review.
840 *Burns* 2010; **36**(2): 164-75.
- 841 69. Goodwin NJ, O'Farrell SE, Jagoe K, et al. Use of behavior change techniques in
842 clean cooking interventions: a review of the evidence and scorecard of
843 effectiveness. *J Health Commu* 2015; **20**(s1): 43-54.
- 844 70. Alves JG, Gale CR, Souza E, Batty GD. Effect of physical exercise on
845 bodyweight in overweight children: a randomized controlled trial in a Brazilian
846 slum. *Cad Saude Publica* 2008; **24**(s2): S353-9.
- 847 71. Alves JG, Gale CR, Mutrie N, Correia JB, Batty GD. A 6-month exercise
848 intervention among inactive and overweight favela-residing women in Brazil: the
849 Caranguejo Exercise Trial. *Am J Public Health* 2009; **99**(1): 76-80.
- 850 72. Penny ME, Creed-Kanashiro HM, Robert RC, Narro MR, Caulfield LE, Black RE.
851 Effectiveness of an educational intervention delivered through the health services
852 to improve nutrition in young children: a cluster-randomised controlled trial.
853 *Lancet* 2005; **365**(9474): 1863-72.
- 854 73. Rotheram-Borus MJ, Lightfoot M, Kasirye R, Desmond K. Vocational training with
855 HIV prevention for Ugandan youth. *AIDS Behav* 2012; **16**(5): 1133-7.
- 856 74. Kehoe SH, Chopra H, Sahariah SA, et al. Effects of a food-based intervention on
857 markers of micronutrient status among Indian women of low socio-economic
858 status. *Br J Nutr* 2015; **113**(5): 813-21.
- 859 75. Ahmed T, Choudhury N, Hossain MI, et al. Development and acceptability testing
860 of ready-to-use supplementary food made from locally available food ingredients
861 in Bangladesh. *BMC Pediatr* 2014; **14**: 164.
- 862 76. Shillcutt SD, Walker DG, Goodman CA, Mills AJ. Cost effectiveness in low- and
863 middle-income countries: a review of the debates surrounding decision rules.
864 *Pharmacoeconomics* 2009; **27**(11): 903-17.
- 865 77. Mathew JL. Inequity in childhood immunization in India: A systematic review.
866 *Indian Pediatr* 2012; **49**(3): 203-23.
- 867 78. Pilger D, Heukelbach J, Khakban A, Oliveira FA, Fengler G, Feldmeier H.
868 Household-wide ivermectin treatment for head lice in an impoverished
869 community: randomized observer-blinded controlled trial. *Bull World Health*
870 *Organ* 2010; **88**(2): 90-6.
- 871 79. Awasthi S, Peto R, Pande VK, Fletcher RH, Read S, Bundy DA. Effects of
872 deworming on malnourished preschool children in India: an open-labelled,
873 cluster-randomized trial. *PLoS Negl Trop Dis* 2008; **2**(4): e223.
- 874 80. Sur D, Saha DR, Manna B, Rajendran K, Bhattacharya SK. Periodic deworming
875 with albendazole and its impact on growth status and diarrhoeal incidence among

- 876 children in an urban slum of India. *Trans R Soc Trop Med Hyg* 2005; **99**(4): 261-
877 7.
- 878 81. Sarkar NR, Anwar KS, Biswas KB, Mannan MA. Effect of deworming on
879 nutritional status of ascaris infested slum children of Dhaka, Bangladesh. *Indian*
880 *Pediatr* 2002; **39**(11): 1021-6.
- 881 82. Awasthi S, Pande VK. Six-monthly de-worming in infants to study effects on
882 growth. *Indian J Pediatr* 2001; **68**(9): 823-7.
- 883 83. Taylor-Robinson DC, Maayan N, Soares-Weiser K, Donegan S, Garner P.
884 Deworming drugs for soil-transmitted intestinal worms in children: effects on
885 nutritional indicators, haemoglobin, and school performance. *Cochrane Database*
886 *Syst Rev* 2015; (7): CD000371.
- 887 84. McPake B, Hanson K. Managing the public-private mix to achieve universal
888 health coverage. *Lancet* 2016 [ePub].
- 889 85. Samb B, Evans T, Dybul M, et al. An assessment of interactions between global
890 health initiatives and country health systems. *Lancet* 2009; **373**(9681): 2137-69.
- 891 86. Keare D, Parris S, Urb. Evaluation of shelter programs for the urban poor:
892 principal findings. Washington, D.C.: The World Bank, 1982.
- 893 87. Thieme T, Kovacs E. Services and Slums: Rethinking Infrastructures and
894 Provisioning across the Nexus. The Nexus Network Think Piece Series, Paper
895 004. Brighton: The Nexus Network, 2015.
- 896 88. Lobo J. The science and practice of urban planning in slums. 2016. URL:
897 [https://ugecviewpoints.wordpress.com/2016/05/31/the-science-and-practice-of-](https://ugecviewpoints.wordpress.com/2016/05/31/the-science-and-practice-of-urban-planning-in-slums/)
898 [urban-planning-in-slums/](https://ugecviewpoints.wordpress.com/2016/05/31/the-science-and-practice-of-urban-planning-in-slums/) (accessed 29 June 2016).
- 899 89. Buckley R. Social inclusion in Mumbai: economics matters too. *Environ Urban*
900 2011; **23**(1): 277-84.
- 901 90. Murthy SL. Land security and the challenges of realizing the human right to water
902 and sanitation in the slums of Mumbai, India. *Health Hum Rights* 2012; **14**(2): 61-
903 73.
- 904 91. Banerjee A, Duflo E, Chattopadhyay R, Shapiro J. Targeting the Hard-Core Poor:
905 An Impact Assessment. New York: PublicAffairs, 2011.
- 906 92. Banerjee AV, Duflo E. Mandated empowerment: Handing antipoverty policy back
907 to the poor? Reducing the Impact of Poverty on Health and Human Development:
908 Scientific Approaches. *Ann N Y Acad Sci* 2008; **1136**: 333-41.
- 909 93. Brown C, Hofer T, Johal A, et al. An epistemology of patient safety research: a
910 framework for study design and interpretation. Part 2. Study design. *Qual Saf*
911 *Health Care* 2008; **17**(3): 163-9.
- 912 94. Chen YF, Hemming K, Stevens AJ, Lilford RJ. Secular trends and evaluation of
913 complex interventions: the rising tide phenomenon. *BMJ Qual Saf* 2016; **25**(5):
914 303-10.
- 915 95. Kremer M, Field E. Impact Evaluation for Slum Upgrading Interventions.
916 Washington D.C.: The World Bank, 2006.
- 917 96. Hemming K, Haines TP, Chilton PJ, Girling AJ, Lilford RJ. The stepped wedge
918 cluster randomised trial: rationale, design, analysis, and reporting. *BMJ* 2015;
919 **350**: h391.
- 920 97. Girling AJ, Hemming K. Statistical efficiency and optimal design for stepped
921 cluster studies under linear mixed effects models. *Stat Med* 2016. 15; **35**(13):
922 2149-66
- 923 98. Sweeney S, Vassall A, Foster N, et al. Methodological Issues to Consider When
924 Collecting Data to Estimate Poverty Impact in Economic Evaluations in Low-
925 income and Middle-income Countries. *Health Econ* 2016; **25** (s1): 42-52.
- 926 99. Greco G, Lorgelly P, Yamabhai I. Outcomes in Economic Evaluations of Public
927 Health Interventions in Low- and Middle-Income Countries: Health, Capabilities
928 and Subjective Wellbeing. *Health Econ* 2016; **25** (s1): 83-94.