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Health research capacity development in Low and Middle Income Countries: reality or rhetoric? A systematic meta-narrative review of the qualitative literature

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1 Title

2 Health research capacity development in Low and Middle Income Countries: reality or
3 rhetoric? A systematic meta-narrative review of the qualitative literature

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17 Health Research, Capacity Development, Low and Middle Income Countries, Research
18 Systems, Clinical Trials

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21

22 Abstract

23 **Objectives:** Locally-led health research in Low and Middle Income Countries (LMIC) is
24 critical for overcoming global health challenges. Yet, despite over 25 years of international
25 efforts, health research capacity in LMICs remains insufficient and development attempts
26 continue to be fragmented. The aim of this systematic review is to identify and critically
27 examine the main approaches and trends in health research capacity development and
28 consolidate key thinking to identify a more coherent approach.

29 **Methods:** This review includes academic and grey literature published between Jan 2000
30 and July 2013. Using a predetermined search strategy, we systematically searched
31 PubMed, hand-searched Google Scholar, and checked reference lists. This process
32 yielded 1668 papers. 240 papers were selected based on a priori criteria. A modified
33 version of meta-narrative synthesis was used to analyse the papers.

34 **Results:** Three key narratives were identified: the effect of power relations on capacity
35 development; demand for stronger links between research, policy, and practice; and the
36 importance of a systems approach. Capacity development was delivered through 4 main
37 modalities: vertical research projects, centres of excellence, North-South partnerships, and
38 networks; all were controversial and each had their strengths and weaknesses. A plurality
39 of development strategies were employed to address specific barriers to health research.
40 However, lack of empirical research and monitoring and evaluation meant that their
41 effectiveness was unclear and learning was weak.

42 **Conclusions:** There has been steady progress in LMIC health research capacity but
43 major barriers to research persist and more empirical evidence on development strategies
44 is required. Despite an evolution in development thinking, international actors continue to
45 use outdated development models that are recognised as ineffective. To realise newer
46 development thinking, research capacity outcomes need to be equally valued as research

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47 outputs. While some development actors are now adopting this dedicated capacity
48 development approach, they are in the minority.

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49 **Strengths and limitations of this study**

- 50 • This systematic review goes beyond previous attempts that lacked reflexivity, to
51 provide a nuanced, in-depth, and enquiring critique of health research capacity
52 development approaches.
- 53
- 54 • This review integrates diverse qualitative literature that largely lacked formal reporting
55 procedures or empirical base, allowing the inclusion of voices that are traditionally
56 excluded in other styles of systematic analyses.
- 57
- 58 • Some academic articles may have been missed because PubMed was the only formal
59 database used, and there was limited inclusion of evaluation and programme-level
60 data due to poor grey literature indexing in Google and Google Scholar.
- 61
- 62 • However, the meta-narrative method aims to develop overarching narratives through
63 saturation of themes, rather than include every eligible article, so inclusion of
64 additional papers would be unlikely change the findings of the study.

1 Introduction

Locally-led health research is critical for overcoming global health challenges in Low and Middle Income Countries (LMICs) [1]. This research is needed to “propose culturally apt and cost-effective individual and collective interventions, to investigate their implementation, and to explore the obstacles that prevent recommended strategies from being implemented” [2]. Such research is now the focus of key capacity development efforts, such as the regional educational centres supported by the Special Programme for Research and Training in Tropical Diseases (TDR) [3].

However, these arguments are not new; the importance of LMIC research capacity has been recognised for well over two decades. The 1990 Commission on Health Research for Development stated that strengthening research capacity in LMICs is “one of the most powerful, cost-effective, and sustainable means of advancing health and development” [4]. This marked the beginning of a “revolution” in health research [5] where there was a surge of investment and concerted effort to conduct health research aimed at solving health problems in LMICs [6].

Nevertheless, at the turn of the millennium LMICs accounted for 85% of the world’s population but 92% of the global disease burden, and only 10% of global funding for health research was devoted to addressing these persistent health challenges [6]. Recognition of this “10/90” gap led to renewed calls for health research capacity development in LMICs and further investment [5].

Yet nearly 15 years later, many LMICs still lack sufficient health research capacity to build a local evidence-base with which to inform policy and improve population health. This was recently and profoundly described in The 2013 World Health Report which argued that “all nations should be producers and users of research as well as consumers”, noting that this was not yet the case [1].

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3 90 Therefore, despite years of international collaborations and investment, development of
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5 91 LMIC nation's capacity to address their own health problems appears enduringly
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7 92 problematic. Where there has been progress, such gains often do not appear sustainable
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10 93 without continued strong foreign support [7, 8], which is itself questionable in light of recent
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12 94 austerity and bilateral aid agency restructuring [1, 9, 10].

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14 95 Although there is a large and diverse body of literature on health research capacity
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16 96 development, it remains confusing, controversial, and poorly defined, with various
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18 97 contradictory understandings [11] and conceptualisations [1]. Since capacity development
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20 98 is now something that most research actors are expected to participate in, or at least be
21
22 99 knowledgeable on [5, 12], this is problematic. To increase the likelihood of future capacity
23
24 100 development efforts being effective, there is a need to take stock of past experiences and
25
26 101 learn from successes and failures. Such an exercise would not only provide a unifying
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28 102 picture to appraise previous capacity development efforts, but also encourage discussion
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30 103 and reflection that could lead to fresh thinking.

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34 104 The aim of this systematic review is to identify and critically examine the main
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36 105 approaches, strategies, and trends in health research capacity development and
37
38 106 consolidate key thinking in order to identify a more coherent approach. This review should
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40 107 prove useful to all stakeholders interested in learning how to undertake the complex
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42 108 business of capacity development, and will be of particular interest to actors working to
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44 109 develop locally-led and sustainable health research capacity in LMICs.
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110 **2 Methods**

111 Our systematic review followed the 6 stages of the meta-narrative methodology
112 developed by Greenhalgh *et al* [13]. The meta-narrative method is a “systematic, theory-
113 driven interpretative technique, which [was] developed to help make sense of
114 heterogeneous evidence about complex interventions applied in diverse contexts in a way
115 that informs policy” [14]. It was therefore highly suited to the purposes of this study.

116 **2.1 Inclusion criteria**

117 This review considers the perspectives of all actors involved in health research
118 capacity development (HRCD) that publish within academic and grey literature from the
119 year 2000 onwards. We included any papers that broadly discussed HRCD or its more
120 specific components. Papers that mentioned HRCD but did not discuss the issue further
121 were not included. Non-English language publications were excluded due to lack of
122 resources for translation. Papers published before the year 2000 were initially included,
123 but after screening it became clear that paradigm shifts in global health at the turn of the
124 millennium [5, 6] meant that much of their content was not relevant to current day.
125 Furthermore, many papers published post 2000 effectively summarised historically
126 important issues. Therefore, all papers published pre-2000 were excluded.

127 **2.2 Search strategy and study selection**

128 The search and study selection process is presented in Figure 1. We searched
129 PubMed using the search terms presented in Box 1 for all papers published up to 20 June
130 2013. This search yielded 1668 potentially relevant papers. The titles and abstracts of
131 these papers were then screened for eligibility, resulting in 1376 papers being excluded
132 based on pre-screening, with an additional 75 papers excluded after it was decided that
133 papers published before 1 January 2000 should not be included.

134

Fig 1: Search and study selection process

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Box 1: Search terms used in PubMed search

(((((capacities building[MeSH Terms]) OR ((("developing"[Title/Abstract]) OR "develop"[Title/Abstract]) OR "capacity"[Title/Abstract]))) OR "strengthen"[Title/Abstract]) OR "strengthening"[Title/Abstract])) AND (((developing country[MeSH Terms]) OR Africa) OR Asia) OR Latin America))) AND (((("trial"[Title]) OR "trials"[Title]) OR "research"[Title]))) NOT clinical trial[Publication Type]) NOT informed consent[MeSH Terms]) NOT waste management[MeSH Terms]) NOT air pollution[MeSH Terms]) NOT agriculture[MeSH Terms]) NOT ("Na6(H2O)8(ZnAsO4)6" [Supplementary Concept] OR "K3Zn4O(AsO4)3" [Supplementary Concept])

138

139 The PubMed search was complemented by a search of Google and Google Scholar
 140 using the terms "Health AND research AND capacity AND strengthening OR Building OR
 141 Development". All literature added from Google were found in the first 10 pages (n=30).
 142 After the first 10 pages, no search results were relevant to the study. Literature collections
 143 of the authors and other experts were also hand searched and references snowballed
 144 (n=45). A total of 292 papers were read in full and considered for eligibility. Based on this
 145 screening, the final synthesis involved 240 papers. The full list of papers included in this
 146 review can be found in supplementary file S1.

147 Relevant papers published between June 20 2013 and December 14 2014 were
 148 scanned and read to determine if the synthesis findings were still valid post-search.
 149 Although there were some pertinent new articles, their content would not have changed
 150 the findings of this synthesis.

151 2.3 Quality assessment

152 No papers were excluded based on assessment of quality because the majority of papers
 153 lacked an empirical or explicit study design, and all stakeholders' views regardless of their
 154 perceived validity were considered important. Furthermore, capacity development

1
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3 155 discussion is inherently political and most contributions are based on personal opinion
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5 156 informed by theoretical, ethical, or experiential standpoint. Accordingly much of it is biased.
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7 157 Rather than attempt to remove the bias, assumptions and motivations were explicitly
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9 158 studied to uncover authors' implicit logic, so that readers can make their own informed
10
11 159 opinion.

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14 160 Instead of using quality criteria, similarity of arguments within the literature was used as an
15
16 161 indicator of current agreement on a topic or popularity of an idea. This allowed a
17
18 162 comprehensive analysis of all the HRCN narratives, while still highlighting and giving
19
20 163 emphasis to the most widely accepted opinions.

23 164 **2.4 Data extraction and synthesis**

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26 165 To synthesise the literature, papers need to be framed within a "storyline" that recognises
27
28 166 where the contribution came from [13]. *Greenhalgh et al.*'s method explicitly catalogues
29
30 167 these storylines as "meta-narratives" [13]. Developing meta-narratives provides context to
31
32 168 contributions whose underlying assumptions and interests would otherwise be opaque.
33
34 169 Although less prescribed than a quantitative systematic review, this approach
35
36 170 pragmatically allows a plurality of ideas, recognising there may be no single correct
37
38 171 answer.

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42 172 To ensure that source content was interpreted alongside its context, even when
43
44 173 broken into themes and narratives, a tagging system was used instead of a traditional
45
46 174 extraction form. All sources were organised in EndNote X7 (Thomson Reuters) and
47
48 175 associated citations, metadata and PDF copies of the documents were attached. These
49
50 176 data were then imported into Nvivo 9 qualitative analysis software (QSR International)
51
52 177 where the sources were given tags using deductive codes for key characteristics.

53
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55 178 Meta-narratives were then identified inductively by reading each paper and coding
56
57 179 for meta-narratives where several authors in the literature discussed and presented topics
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3 180 similarly. This is an interpretive approach similar to that used in thematic coding analysis,
4
5 181 where reoccurring themes that are conceptually related are grouped into concepts. Once
6
7 182 the meta-narratives had been finalised they were systematically applied to all relevant
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10 183 papers. No prior theory beyond the guidance presented by Greenhalgh *et al.* [13] was
11
12 184 explicitly used to help identify and categorise the meta-narratives. Instead, iterative rounds
13
14 185 of open data-driven inductive coding were used.

17 186 **2.5 Position of the authors**

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20 187 This systematic review was undertaken, in part, to inform the design of a larger body of
21
22 188 empirical research on health research capacity development in LMICs. The authors of this
23
24 189 paper do not include individuals from LMICs, but this paper was reviewed and commented
25
26 190 on by individuals from LMICs who collaborated on the aforementioned empirical research,
27
28 191 and discussed with other relevant experts at meetings and conferences. While some
29
30 192 context-specific differences in experiences were inevitably raised, all individuals
31
32 193 considered the findings of this study to be relevant and consistent with their broad view of
33
34 194 health research capacity development in LMICs. All authors have backgrounds in social
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36 195 science and global health.
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196 **3 Results**

197 **3.1 Definitions and actors**

198 The concept of capacity development can be confusing because there are multiple and
199 conflicting terminologies for development activities and actors. To assist the reader,
200 typologies of key definitions and development actors were produced. Supplementary file
201 S2 presents these definitions alongside reasons for adopting them, and supplementary file
202 S3 categorises and provides background to development actors' activities.

203 **3.2 Characteristics of included papers**

204 Table 1 summarises the main characteristics of the papers included in the review.
205 Based on first author characteristics, the greatest number of articles came from LMIC
206 academic and healthcare institutions (31.3%), closely followed by HIC academic and
207 healthcare institutions (29.6%). Contributions from funders were very low (0.8%), and
208 industry and civil society were absent, potentially reflecting the sampling from academic
209 databases. Europe was the greatest contributing region (32.9%) followed by Sub-Saharan
210 Africa at 23.8%. Contributions from Latin America (2.5%), Middle East (1.7%) and North
211 Africa (0.8%) were low. Although most articles were concerned with capacity development
212 across all LMICs (42.1%), Sub-Saharan Africa dominated the regional specific discussions
213 (34.6%). The main basis for viewpoints were opinion, debate or personal perspectives
214 (34.2%); sharing experiences represented 21.7%, and empirical work 20.8%.

Table 1: Characteristics of papers included in this review

Category* of development actor (for first author)	%	Location of first author's institution	%	Region of interest	%	Main topic of development interest	%	Main disease of interest	%	Basis for viewpoint	%
LMIC Academic and Healthcare Institutions	31.3	Europe	32.9	All LMIC countries	42.1	Multiple broad issues discussed	24.6	Not disease specific or address multiple	72.5	Opinion, debate, perspective	34.2
HIC Academic and Healthcare Institutions	29.6	Sub Saharan Africa	23.8	Sub Saharan Africa	34.6	Individual level development	15.8	HIV	6.3	Experience report	21.7
Multi-laterals	10.4	North America	13.8	South Asia	10	Partnerships networking, consortia	15.8	Malaria	5.8	Empirical research	20.8
Consortia & Networks, NGOs and Public-Private Partnerships	8.8	South Asia	10	East Asia	6.7	Operational challenges & opportunities	11.3	Other	4.6	Literature review, summary or synthesis	7.9
Academic Journals	5.4	East Asia	9.2	All Asia	2.9	System approaches and macro level development	9.2	Mental Health and Addiction	2.5	Proceedings or conference report	7.5
LMIC Governmental	4.6	Australia	2.9	Latin America	1.7	Agenda and priority setting	6.3	Maternal Child Health and Paediatrics	2.5	Organisation document	4.6
LMIC Funders, Research Councils and Institutes of Health	4.6	Latin America	2.5	Pacific	0.8	Institution level development	5.4	Tuberculosis	2.1	News report	3.3
Bi-lateral aid agencies	2.1	Not specific	2.1	Middle East	0.8	Monitoring and evaluation	2.9	Non-communicable diseases	2.1		
HIC Research Councils and Institutes of Health	2.1	Middle East	1.7	Central Asia	0.4	Research and development	2.1	Dental or oral health	1.7		
Private Foundations or Charity Funders	0.8	North Africa	0.8			Ethics and regulations	1.7				
Industry	0	Pacific	0.4			Knowledge cycle	0.8				
Civil Society and Media	0										

* Some categories have been merged because they could not be discretely separate

217 **3.3 Meta-narratives in health research capacity development**

218 Three key narratives ran through the literature: the effect of power relations on capacity
219 development; demand for stronger links between research, policy, and practice; and the
220 importance of a systems approach to HRCd. Each narrative is described below with
221 reference to the key papers that discussed these narratives in detail.

222 **3.3.1 Effect of power relations on capacity development**

223 The effect of power relations on capacity development was the most common narrative
224 running through the literature (present in 29% of papers). The main concerns of this topic
225 are that research agendas in LMICs are set more by international funders than by LMIC
226 institutions, and research conducted in LMICs is predominantly led by HIC researchers
227 with little involvement of LMIC individuals or institutions. This is argued to erode national
228 sovereignty [15], prevent capacity development [16, 17], and create research priorities that
229 more closely match funder agendas than countries' needs [18-20] leading to a situation of
230 "he who pays the piper calls the tune" [20, 21]. Examples include "spotlight issues", which
231 receive funding regardless of relative need [22], and "parachute" research where data is
232 collected in LMICs but all other work is conducted in HIC institutions.

233 "North-South" collaborations between HIC and LMIC research institutions are
234 considered to be better mechanisms for developing research capacity [8], but many
235 authors still thought that they comparatively disadvantage the LMIC partner [9, 12, 15].
236 The perceived situation of "treating Africa as a repository of raw materials for expatriate-
237 driven research" [9] led to the development of guidelines for research collaboration. To
238 reflect the change in approach, there was a rhetorical shift to using the term "partnership"
239 to describe collaborations that were equitable [17]. These partnerships should be built on
240 mutual trust and shared decision making, national ownership, early planning for translation
241 of research findings and development of national research capacity [17]. Importantly, it is

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3 242 now expected that all partnerships should have capacity development at their forefront
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5 243 [12]. However, despite discussion for well over a decade, a good proportion of the
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7 244 international community still feels that partnerships are not yet equal [12, 23, 24], and they
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9 245 cannot be until the power divide is addressed [15] because LMICs are unable to negotiate
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11 246 for a fairer deal [15, 25, 26].

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14 247 In an effort to adjust the power balance there have been conscious efforts towards
15
16 248 recognising local research capacity in LMICs [12, 20]. This change is again reflected in
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18 249 rhetoric through the evolution of the term “capacity development” which gradually places
19
20 250 stronger emphasis on extant capacity; changing from “capacity building” to “capacity
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22 251 strengthening” [20] to “capacity utilisation” [27], “unleashing” and “releasing” [20]. Many
23
24 252 authors now propose that research and capacity development in LMICs should be locally
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26 253 owned and led [17, 20, 28, 29]. This is because LMIC researchers have the best
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28 254 understanding of evidence gaps [17] and can present research to policy makers with an
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30 255 understanding of the political and cultural context which increases the chance of evidence
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32 256 uptake [30, 31]. Locally-led studies are also thought to be better aligned with national
33
34 257 agendas [32] and address more applied implementation topics than foreign-led research
35
36 258 [17].

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39 259 Most stakeholders now agree that research and capacity development should, at a
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41 260 minimum, include the local research community in the design and conduct of research
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43 261 studies [33]. Development actors are also advised to be more sensitive to the power
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45 262 dynamics they create and ensure they strengthen, not weaken, the role of national
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47 263 governments by responding specifically to their priorities [20, 29, 34] and including the
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49 264 “recipients” in any agenda setting [35]. However, others argue that this situation will
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51 265 inevitably continue so long as foreign countries are the majority financers of research in
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53 266 LMICs [36]; only through greater national investment and commitment will LMICs have a
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55 267 stronger voice to make relations more equitable [7, 9, 37]. Nevertheless, the vast majority
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3 268 of development efforts reportedly still focus on international collaborative research
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5 269 meaning local investigator-led studies are largely ignored [38]. This is evidenced by only 3
6
7 270 papers in this review being focussed on supporting locally-led clinical trials, compared to
8
9 271 33 papers aimed at developing international clinical trials.

272 **3.3.2 Demand for stronger links between research, policy and practice**

273 Arguments for stronger links between research, policy and practice were present in
274 16% of sources. These emerged due to concerns that much research was failing to be
275 translated into policy [25, 39], and was too narrowly conceived and disease-specific to
276 have impact [40].

277 Accordingly, applied fields now deemed to be highly relevant to decision makers and
278 those that promote sustainable adoption and implementation of evidence based medicine
279 have been called for [30, 41, 42]. These include health policy and systems research [43],
280 health services research [44], implementation research, and operations research [45-47].
281 These arguments formed the backbone of the WHO strategy on “research for health”
282 which “gives priority to research and innovation that has the greatest potential to improve
283 global health security, accelerate health-related development, redress health inequities
284 and help to attain the Millennium Development Goals” [48] .

285 Despite these discussions, much research is still regarded as uncoordinated and
286 concentrating on a few high profile diseases [49] such as the “big 3”: HIV/AIDS, Malaria
287 and Tuberculosis. Furthermore, the majority of research is critiqued as largely technology
288 development focused, even though many argue that the impact of this research is low [44]
289 and more lives could be saved by improving service delivery of existing interventions [25,
290 43, 50].

291 3.3.3 The importance of a systems approach to capacity development

292 The importance of taking a systems approach to HRCD was discussed in 24% of
293 sources. Conceived in the 1990s and popularized after the Ministerial Summit on Health
294 Research in Mexico in 2004 [25], systems approaches to HRCD emerged in response to
295 perceived failings of capacity development targeted at only one level. Particular
296 weaknesses cited included: lack of provision for trained individuals to use their skills [6]
297 leading to “brain drain” of LMIC researchers to HICs [51, 52]; exclusively focusing on high
298 performing individuals [53] rather than strengthening local institutions to develop
299 researchers [54]; absence of national bodies to coordinate priorities, develop policy, and
300 translate evidence into action [55]; and the fragmentation of capacity development
301 activities [56, 57].

302 Proponents of systems approaches argue that for capacity development to be effective
303 and sustainable [8, 58], new approaches to addressing all three levels of the national
304 research system are needed; macro, institutional and individual [58] (for definitions of
305 these levels, please see supplementary file 2). Macro-level capacity development should
306 include: priority setting, planning and coordinating research, governance and regulation,
307 and knowledge translation and dissemination [48, 57, 59]. Individual development should
308 include a broader range of stakeholders than just research producers (e.g. policy makers,
309 administrators, medical personnel and ethics board members) and teach a wider variety of
310 skills and disciplines, particularly “soft skills” such as organisation, management and
311 leadership [55]. Institutional development should focus on the ability to generate, retain
312 and utilise individual capacity through improving curricula, training support, mentorship,
313 and research resources [60-62].

314 Although presented as a complex task with long time frames [63], taking a systems
315 approach is said to result in more dynamic capacity development that produces
316 endogenous change, greater local ownership, and removal of perennial system barriers

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2
3 317 [20] which helps countries to effectively target their own health needs [19]. This is in stark
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5 318 contrast to previous approaches that established parallel structures to deliberately bypass
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7 319 local systems because they were deemed to be chronically ineffective [24]. However,
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9 320 despite the accepted importance of research systems development, little is known about
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11 321 how health research systems can be formed [19], there are few successful examples of
12
13 322 research system strengthening, and little guidance is available [64].
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16 17 323 **3.4 A summary of modern health research capacity development** 18 19 324 **modalities**

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22 325 After attempts at aligning human, material and technical capacities failed in the 1980s,
23
24 326 research models that directed funds and technology through HIC institutions became the
25
26 327 preferred HRCD mechanism [5]. These mechanisms are now the most common approach
27
28 328 to HRCD. The justification for requiring LMICs to collaborate with HICs is that knowledge
29
30 329 transfer and HIC expertise are required to achieve capacity development [65, 66].
31
32 330 However, others argue that such development models propagate inequities in research
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34 331 and development [17, 36]. Discussions on development modalities are therefore
35
36 332 contentious. The following sections summarise the justifications, benefits, drawbacks and
37
38 333 controversies of the main development modalities.
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42 43 334 **3.4.1 Vertical research projects**

44
45 335 One of the earliest and most persistent research models arising from the HIC fund
46
47 336 channelling mechanism was vertical research projects [5]. This involves a HIC research
48
49 337 collaborator working in a LMIC to conduct applied, normally short-term research projects
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51 338 with narrow objectives [54]. The theoretical advantage of a vertical strategy is that it
52
53 339 maintains focus on a specific scientific mission [67]. This allows the necessary capacity to
54
55 340 be developed more rapidly and can quickly produce research outputs [5] even where
56
57 341 major expansion of R&D is required [35]. These approaches now account for the biggest
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3 342 share of health research funding [58]. Examples include product development partnerships
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5 343 such as The Global Alliance for TB Drug Development, and many commercial or non-
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7 344 commercial clinical trials [68].
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10 345 HRCD is often included in these programmes, but development of capacity is usually
11
12 346 not the primary objective [59]. Rather it is designed to develop capacities that will benefit
13
14 347 the successful completion of the project [60] and result in high quality research outputs
15
16 348 [54]. Vertical projects often have strong expatriate leadership and are frequently managed
17
18 349 by external institutions [54], which is argued to result in parallel structures that bypass local
19
20 350 research institutions [69]. Where individual-level development is provided, it is typically
21
22 351 short term and project specific [70].
23

24
25 352 Critics of vertical projects argue that local researchers often only have support roles
26
27 353 [16], samples may be shipped abroad for analysis [23] and there can be little investment
28
29 354 in local institutions because they are bypassed [15, 69]. Therefore when these short-term
30
31 355 projects finish, research sites and individuals are rarely left with the skills or resources to
32
33 356 run their own studies [41, 68]. Another criticism is that vertical approaches force the
34
35 357 research community to work separately on overlapping issues [71] leading to
36
37 358 fragmentation of national research systems [55].
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41 359 Proponents of vertical interventions are however mindful that there is a trade-off
42
43 360 between the speed and quality of research, and capacity development [72]. They argue
44
45 361 that in the case of health emergencies, investment should be made in excellent research,
46
47 362 not excellent capacity development.
48

49 363 **3.4.2 Centres of excellence**

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52 364 A common modality for developing long-term capacity to conduct advanced research in
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54 365 LMICs is “centres of excellence”. These have taken various forms, but the approach
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56 366 generally concentrates investment within a few institutions that show potential to excel and
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3 367 become high quality self-sustaining sites. These models are reportedly useful because
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5 368 they increase the likelihood of high quality research and renewed investment in an
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7 369 otherwise challenging environment [52, 55, 73].
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10 370 Early forms of this concept were criticised as being “annexed” research sites,
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12 371 effectively led and managed by expatriate staff [74]. Others argue that they create parallel
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14 372 research structures outside of the national system that further depletes the local resource
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16 373 pool by diverting investment and human resources towards these better funded sites [17,
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18 374 24, 44]. More recent forms of “centres of excellence”, such as those championed by the
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20 375 European and Developing Countries Clinical Trials Partnership, strive for greater Southern
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22 376 leadership and better integration with local research systems [75].
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25 377 **3.4.3 North-South partnership**

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28 378 Another common development model is North-South partnerships. They are distinct
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30 379 forms of collaboration between HIC and LMIC researchers because unlike “centres of
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32 380 excellence”, they are usually project specific rather than institution building, and they put
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34 381 more emphasis on sustainable research, shared leadership and mutual benefit than
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36 382 vertical research projects. However, depending on the nature of the partnership, these
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38 383 demarcations can become blurred.
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41 384 Since the millennium, North-South partnerships and have been heavily promoted by
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43 385 organisations such as The Global Forum for Health Research [6] and The European and
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45 386 Developing Countries Clinical Trial Partnership (EDCTP) [75]. Such partnerships are said
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47 387 to be responsible for increasing resource flows to LMICs [31] and have been advocated
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49 388 for: increasing scientific productivity [76], training of graduates, staff exchange and
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51 389 knowledge sharing, exposure to cutting edge technology [52], strengthening local
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53 390 education programmes and moderate levels of institutional strengthening [6, 77, 78]. This
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55 391 is argued to result in more sustainable development [54], greater cost-efficiency and a
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392 broader research scope than exclusively expatriate-led or locally-led research could
393 achieve alone [17, 20].

394 Despite their popularity, a greater proportion of the literature is dedicated to discussing
395 problems with North-South partnerships than their benefits. Many authors still feel that
396 despite much guidance for entering into partnerships [12, 17, 53, 80, 81], too few benefits
397 are accrued by the Southern partner [9, 12, 23, 24, 79] because they are forced to
398 collaborate with HIC institutions to meet funding requirements [82]. Accordingly, LMIC
399 partners are reported to sometimes receive little financial benefit, go unrecognised in
400 publications, and release intellectual property rights [9, 12]. Proposed amendments to this
401 model have involved adapting partnerships to be driven by LMIC demand [60], led by the
402 Southern partner [20] or supporting more South-South partnerships [28][83].

403 **3.4.4 Networks and consortia**

404 Networks and consortia development models emerged in the mid-1990s. By the mid-
405 2000s they were used to tackle whole programmes of research [60] and are now very
406 popular with funders [60]. Actors adopting network models are highly diverse and can
407 sometimes be hard to separate from partnership models or vertical programmes. However,
408 they all involve linking multiple research departments, groups or institutions.

409 Networks are considered advantageous because they encourage less-hierarchical
410 leadership and competitive and individualistic attitudes. They are therefore reportedly
411 useful for working cooperatively on shared problems at regional or global levels [84, 85].
412 Because networks facilitate information exchange and pooling of resources to achieve a
413 critical mass [86], they are seen as particularly important where groups may be isolated
414 [87] or when one group alone would have insufficient capacity to address an issue [88].
415 Networks are also thought to: help focus on common research priorities [60, 89]; increase
416 knowledge exchange and speed diffusion of innovations [57, 64]; and help forge long term

relationships [5, 87], and sustainability [37, 86, 90, 91]. However, some authors point out that most networks focus on highly thematic research projects [60] and only develop capacity of individual research groups, not research systems [87].

3.5 Specific development strategies

The reviewed literature contained a multitude of development strategies targeted at all levels of the health research system; macro, institutional and individual. These are presented in Table 3 and grouped according to the barrier they address. The popularity of the development strategies are indicated as a percentage of the reviewed sources that proposed them as a solution to a health research barrier.

Table 3: Summary of capacity development strategies designed to address specific barriers to health research

Barrier to research	Strategies designed to address barriers to research	Popularity (% of sources)
Fragmented research systems	<ul style="list-style-type: none"> Undertake a situational analysis & build on existing assets [28, 29, 57, 92] Collaboratively develop research agendas with LMIC stakeholders [55, 70, 75] Create a research coordinating body or scientific councils [29, 64, 93] 	Recently gaining popularity (12%)
Insufficient research funding	<ul style="list-style-type: none"> Establish a research finance system using innovative revenue generation [52, 94, 95] Provide long-term funding & flexible grants [8, 63, 96] Advocate for funding through shared causes & engaging with the media [68, 97] 	Very popular (21%)
Limited use of research evidence	<ul style="list-style-type: none"> Build capacities of policy makers to demand & scrutinise research [25, 84, 98] Develop evidence repositories & use Research-to-Action-Groups as knowledge brokers to package findings appropriately [39, 99] Create knowledge translation platforms to support evidence dissemination & dialogue between research producers and users [30, 39, 64, 100] 	Consistent popularity (11%)
Limited governance & regulatory capacity	<ul style="list-style-type: none"> Work research into a legislative framework [64, 101, 102] Clarify guidelines, map review capacity, & streamline procedures [74, 103] Strengthen regulatory & ethical review capacity [42, 64] 	Growing popularity (21%)
Insufficient networking	<ul style="list-style-type: none"> Develop and share a database of researchers and their expertise [31] Utilise or develop professional networks, especially web-based communities [42, 104] Organise conferences & working groups on locally important topics [2, 105] 	Very popular (26%)
Inefficient admin & research management	<ul style="list-style-type: none"> Train management & research support staff [29, 106] Set up a research support office to help with grant management, reporting & contracts, & develop information and finance systems [20, 28, 72] Develop transparent & accountable policies & procedures [69, 107] 	Unpopular but increasing (8%)

Inadequate material capacity	<ul style="list-style-type: none"> • Upgrade libraries & journal availability and invest in laboratories [28, 91, 108] • Improve Information Technology, particularly internet [6, 78] • Ensure stable power & water supplies [108] 	Widely recognised (20%)
Insufficient human capacity with research knowledge & skills	<ul style="list-style-type: none"> • Develop LMIC university research training capacity using “train the trainer” programmes, LMIC-HIC “sandwich” courses, or visiting research fellowships [20, 70, 92, 96, 109-111] • Make research principles & skills key components of undergraduate & continuing professional medical education [37, 70, 112] • Develop a variety of research roles: nurses, data managers, statisticians, laboratory personnel, managers, data collectors [9, 63, 70, 109, 113-115] • Increase distance learning via e-technologies or e-learning resources [26, 41, 70, 116, 117] • Training in major skills gaps: data collection, data management, data analysis & statistics, GCP, laboratory skills, computer literacy & ethics [46, 51, 54, 109, 118] • Training in core capabilities: protocol development, writing for grant applications & publication, grant management & budgeting, & policy dialogue [29, 45, 55, 63, 119] 	Extremely popular (41%). Training in core capabilities less popular (15%)
Insufficient practical research experience	<ul style="list-style-type: none"> • Supplement didactic training with research “learning by doing” opportunities [40, 47, 55] • Involve more LMIC institutional staff in research projects [54] • Exchange visits to advanced research sites to update skills [120] • Pilot or small grants for early stage researchers to gain experience [53, 121] 	Fairly accepted (11%)
Too few research leaders	<ul style="list-style-type: none"> • Develop leadership, project and human resource management skills [8, 72] • Opportunities for junior staff to take responsibility within a supportive environment [20] • In collaborative projects, local staff must be involved in the entire research process [122] 	Gaining popularity (13%)
Too few mentors & role models	<ul style="list-style-type: none"> • Support mentors with long term funded positions & recognition [73, 78] • Where mentoring is not available locally, institutional partnerships/exchanges or peer mentorship can be used [9, 11, 55] 	Popular (15%)
Lack of research culture	<ul style="list-style-type: none"> • Promote academic departmental leaders based on research experience [112] • Set up a departmental committee to promote research [123] • Journal clubs & seminars to develop interest in research & critical thinking [70, 120] 	Not popular (6%)
Low motivation to conduct research	<ul style="list-style-type: none"> • Protected research time & longer term contracts [54, 76] • Re-entry grants or guaranteed jobs to encourage “brain drain” diaspora to return home [109, 110] • Higher salaries or funded research time to off-set private-practice incentives [76, 124] 	Popular (18%)

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429 3.6 Reported success and effectiveness of development efforts

430 Broadly, authors consider capacity to conduct health research in Africa to have
 431 increased considerably since the millennium [12] with potential to leverage further gains
 432 from current efforts [59]. This is best exemplified by increases in the number of clinical
 433 trials conducted in LMICs [103, 125] with reports of enhanced trial capacity [68],

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3 434 particularly laboratories [126] and quality standards [38, 117, 127], and greater LMIC
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5 435 inclusion [106, 128]. Such institutional strengthening is also thought to have helped
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7 436 reduce brain drain in specific cases [109]. Although some countries still lag behind in
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9 437 regulatory and ethical review capacity, several publications indicate that LMICs have made
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11 438 good progress [108, 129].

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14 439 The increase in research capacity is thought to have been driven by recognition of
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16 440 the importance of health research over the last 20 years [5], a revised strategic focus [30],
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18 441 and the expansion of networks and partnerships for addressing research needs [60, 67,
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20 442 91]. However, it is not possible to attribute success to these development approaches due
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22 443 to lack of monitoring and evaluation data; in Africa, positive outcomes in the quality and
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24 444 quantity of published research have been recorded [60, 109, 130], but their connection to
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26 445 development inputs and outputs is not established [131]. Operational research and sharing
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28 446 of on-the-ground experiences is thought to be a useful learning resource, but with the
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30 447 exception of a few examples [42, 132], little published material on operations is thought to
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32 448 exist [133]. This is argued to make it hard to learn from previous efforts and experience
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34 449 [60] and determine why and how successes were achieved [28].

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38 450 The paucity of monitoring and evaluation data is a recognised problem [60][58][5],
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40 451 with authors attributing it to long time-lags to achieve objectives [11], outcomes such as
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42 452 organisational culture being difficult to measure [11], lack of commonly agreed and
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44 453 conceptually robust indicators [59, 60, 102], and most evaluation data not being published
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46 454 [131]. To remedy this situation, guidance on planning and implementing monitoring and
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48 455 evaluation for health research has been developed [29], and one research group provides
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50 456 online resources to help record and share operational guidance [41].

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54 457 It was also clear from the literature that significant capacity gaps remain in many
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56 458 LMICs. Following the example of clinical trials, authors point out that early phase studies
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58 459 are still lacking [134] and there are too few quality research sites to meet demand [103].
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3 460 Despite increases in some capacities, translation of findings into policy is considered an
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5 461 enduringly difficult outcome [60, 135] and LMIC leadership and authorship in studies is still
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7 462 thought to be too low [43]. Reportedly insufficient political buy-in for strengthening
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9 463 investment in health research has also raised concerns over the sustainability of capacity
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11 464 development achievements [7, 8]. Some authors argue that longer term projects and
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13 465 planning for sustainability of research staff and services is needed [103], but little literature
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15 466 explores this [63].
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467 **4 Discussion**

468 **4.1 An evolution in health research capacity development thinking**

469 This literature synthesis has objectively presented the main HRCD modalities and
470 strategies, and shows that some development actors continue to operate research models
471 that are contrary to widely accepted views of best practice. Nevertheless, the literature
472 reveals that there has been steady progress in health research capacity in LMICs.
473 Development actors have continuously reassessed their approaches and have become
474 much more reflexive of their actions. National stakeholders have taken on a stronger voice
475 and greater ownership, and are generally in a more self-sufficient position.

476 Overall, development actors now agree that there is no panacea or one-size-fits-all
477 model to HRCD. Instead a plurality of solutions exists, the choice of which should be
478 determined by the specific capacities constraints and research goals of LMIC institutions.
479 However, despite progress, major barriers to health research persist, there is little
480 evidence to support decision-making, and the sustainability of HRCD achievements is
481 questionable.

482 **4.2 Health research capacity development, reality or just rhetoric?**

483 The evolution in HRCD thinking appears promising, but the literature demonstrates that
484 good HRCD practices are not always enacted. While the requirement for short term
485 projects is recognised [5], the vertical model has been the dominant model for almost 20
486 years [58]. This would indicate that vertical approaches have be used in situations that
487 would be better served by longer term systems strengthening strategies [5]. However,
488 there are far fewer programmes dedicated to implementing systems approaches to
489 capacity development. Other examples include: focusing on a few high profile diseases,
490 donor-led research agendas, compulsory requirements for collaboration with HICs, setting

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3 491 up parallel structures, and fragmentary competitive research. To make the HRCD rhetoric
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5 492 a reality, there is a need to understand why research models that do not enhance or
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7 493 potentially inhibit locally-led research remain the *modus operandi*, even though there is
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9 494 clear agreement that they are bad practice.

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11 495 The literature findings clearly and frequently show that the persistence of flawed
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13 496 development strategies is driven by approaching capacity development within the context
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15 497 of a dedicated research model. This creates a trade-off between doing good research and
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17 498 doing good capacity development. Projects prioritising good research place research
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19 499 outputs as the primary goal and assume capacity will be developed through limited LMIC
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21 500 involvement in research activities. This means that specific development strategies
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23 501 designed to improve capacity are not used. This “implicit” capacity development is known
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25 502 to be largely ineffective [63, 72], yet is it regularly used. As a result, local research
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27 503 systems may fail to develop or deteriorate [22], and development efforts are likely to
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29 504 become multiplicative and fragmented [60, 92], despite overlapping interests and generic
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31 505 requirements [104]

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33 506 The other main alternative is “explicit” capacity development. This refers to research
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35 507 projects that place more priority on capacity development and use specific strategies
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37 508 designed to address capacity gaps. There is wide recognition that this is a superior
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39 509 approach and is more likely to improve capacity sustainably [11, 63]. However, because
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41 510 the research component is usually more valued by the research community, capacity
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43 511 development receives less attention and often focusses on developing project-specific
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45 512 capacities, not addressing systemic deficiencies. Accordingly, the capacity development
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47 513 component often becomes “bolted-on” and *ad hoc* [11, 28]; thus making it “implicit” in
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49 514 disguise.

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51 515 Instead, the review findings suggest that conducting research to improve health in
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53 516 LMICs, and developing health research capacity in LMICs, must be considered two,

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3 517 sometimes diverging objectives. Recognising this leads to a third way; “dedicated”
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5 518 capacity development. This implies that developing local capacity is as equally valued as
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7 519 the research outputs and should be considered as carefully as the research designs. Due
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9 520 to the additional resources this requires, previous efforts have been limited to individual
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11 521 capacity development or centres of excellence [91]. However, some capacity development
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13 522 actors are now attempting to do this at a more systemic level. Examples include: The
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15 523 Special Programme for Research and Training in Tropical Disease’s (TDR) operational
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17 524 research programmes [3], WHO’s Strategic Initiative for Developing Capacity in Ethical
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19 525 Review [136], ESSENCE on Health Research [137], and The Global Health Network [138].
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23 526 **4.3 Implications for policy and practice**

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26 527 This systematic literature review provides an important synthesis of HRCD that should
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28 528 prove useful for policy makers and practitioners alike. It identifies the strengths, limitations
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30 529 and, controversies of the main development approaches and summarises strategies that
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32 530 can be used to overcome specific research system barriers.
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35 531 Dedicated capacity development appears to offer the best approach for achieving the
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37 532 WHO’s vision of all nations becoming producers and users of research [1]. However, a
38
39 533 key barrier to designing development strategies based on this thinking is the lack of
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41 534 empirical evidence. Without operational and implementation research and quality
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43 535 evaluation data, it is not possible to know the relative effectiveness of different
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45 536 development strategies and difficult to predict if they will be appropriate for a given context.
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47 537 The current experience sharing data is a good start, but more systematic empirical
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49 538 research is required. This should be done with the same rigorous attention to
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51 539 methodological design, analysis, and reporting standards as any other research
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53 540 endeavour.
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541 **4.4 Study strengths and limitations**

542 Previous reviews of capacity development have lacked sufficient reflexivity and
543 questioning of assumptions implicit in many strategies [40]. This systematic review
544 produced a nuanced and enquiring critique of HRCD approaches in LMICs and has
545 identified dedicated capacity development as a promising strategy for future HRCD efforts.
546 It also integrated diverse qualitative literature that largely lacked formal reporting
547 procedures or empirical base, allowing the inclusion of voices that are traditionally
548 excluded in other styles of systematic analyses.

549 Some academic articles may have been missed because PubMed was the only formal
550 database used. However, the meta-narrative method aims to develop overarching
551 narratives through saturation of themes, rather than include every eligible article, so using
552 additional databases would add little to the study. More problematic was the limited
553 availability and inclusion of programme evaluations and evidence supporting operational
554 learning. While expert opinion and the popularity of development strategies was
555 presented, it was apparent that this is not a reliable indicator of good development
556 practice. Searching Google and Google Scholar, hand searching literature collections, and
557 snowballing references did identify the most seminal papers, but some useful
558 organisational documents will have been missed due to poor grey literature indexing.
559 Furthermore, most articles had a general focus or related only to sub-Saharan Africa,
560 meaning that context and research specific differences could not be examined in detail.

561 **4.5 Conclusion**

562 Despite gains in health research capacity and progress in development thinking, further
563 work is needed to develop sustainable health research systems in LMICs. One promising
564 option is dedicated capacity development in which capacity outcomes are as equally
565 valued as research outputs. However, more empirical research is needed to identify the

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3 566 most effective strategies. If these issues are successfully addressed, health research in all
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5 567 nations could become a reality, rather than just rhetoric.
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31
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33
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45 583 **Competing interests**

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51 585 **Data sharing statement**

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54 586 No additional data are available.
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Supplementary file captions

S1: Full list of papers included in the systematic review

S2: Key terminology and definitions used in this synthesis

S3: Typology of capacity development actors

For peer review only

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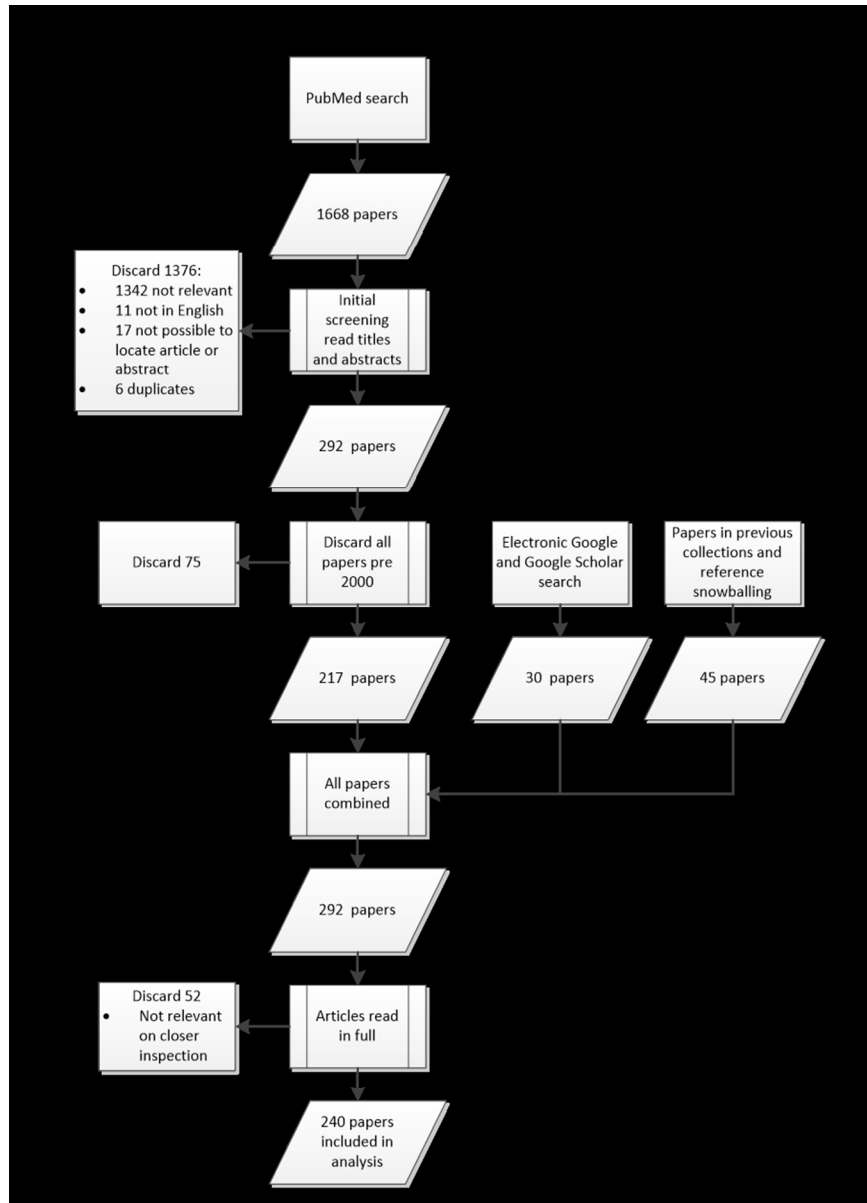


Figure 1: Search and study selection process

Figure 1

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Supplementary file S1: All papers included in the systematic review

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Supplementary file S2: Key terminology and definitions used in this synthesis

Term	Definition adopted	Examples	Comments and caveats
Health research capacity development (HRCD)	“Capacity development is defined as the ability of individuals, organisations or systems to perform appropriate functions effectively, efficiently and in a sustainable manner. When applied to health research, this translates to enabling both individuals and institutions to define health problems, set objectives and priorities, build sustainable institutions and organisations and identify solutions to key national health problems”. [1]	Conducted by a large numbers of actors including: private foundations, multi and bi-lateral funders, international organisations, consortia, research councils, universities, NGOs and Industry. Examples include Rockefeller Foundation, The Swedish International Development Agency and WHO TDR. Usually involves knowledge or resource transfer at individual, institutional or macro levels.	This definition by Magwaza et al. [1] was found to be the most straightforward and encompassing definition of health research capacity development. Although the term “capacity development” has some pejorative connotations (assumption that there is little extant capacity), in its broadest sense capacity development could involve both building new capacity and strengthening existing capacity. It also semantically links capacity development to the international development agenda.
Research system	Concept representing a system designed to coordinate and manage health research at all stages of the knowledge cycle with the goal of improving health and health equity. The research system can be conceptualised as the environment or ecosystem that research takes place in [2].	Research systems encompass health research structures, regulations, governance, ethics, infrastructure, priority setting, financial and resource planning, acquisition and allocation at national, regional or global levels [3]. They include and connect all other levels, including the supra-national level.	Research system is not to be confused with “System Level”. “System Level” is sometimes used to describe the “Macro Level”.
Development modality	Modality refers to the methods or organisational setup used to deliver development interventions	May include basket funding to institutions, vertical support to projects, or horizontal capacity development, collaboration or partnerships [4].	Similar to research model. Modality is distinct from “strategy” which more specifically describes the development intervention.
Development strategy	Strategy refers to the selection and deployment of interventions aimed at resolving specific development barriers	Strategies can focussed at the individual, institutional, or macro level. Examples include training fellowships, building laboratories, or creating knowledge development platforms.	Modality is distinct from “strategy” which more specifically describes the development intervention.
Macro level capacity	The highest level of the national research system. Capacities at this level may be agenda setting, policies, national budgetary allocations, demand creation and strategic planning [5].	Government ministries such as Ministry of Health, Research or Education. Also includes regulatory and ethics bodies, funding bodies, top level administrative structures, professional associations and national registries.	Often used interchangeably with “System Level” [5]. However, this is confusing because the system encompasses individual, institutional, macro and supra-national levels.
Institutional	Refers to the ability of institutions to	Elements of institutions include: human	Based on the working definitions used by The

level capacity	fund, manage and sustain themselves to perform all tasks required to deliver their services or goals. Common institutions include: universities, hospitals, and ministerial departments.	resources, material resources (computers and machinery), infrastructure (libraries and laboratories), service connections (internet, water, and power), service delivery and finance and management systems.	Global Forum for Health Research and the World Health Organisation as they encompass the most common conceptualisations of the term [2, 5-7].
Organisational level capacity	The capacities of individual units within and governed by “institutions”.	Usually include departments or research units within universities or research divisions within ministries of health	The term “institution” is often used interchangeably with “organisation”. However, differentiating between these terms is useful because it distinguishes between the wider governing institution and organisational units within institutions [8].
Individual level capacity	Individual capacity development attempts to increase the capacities of individuals to perform their work effectively	Traditionally focused on producers of research. More recently extended to other stakeholders and includes “soft” skills training such as leadership.	Based on commonly accepted definitions used by The Global Forum for Health Research and the World Health Organisation [2, 5-7].

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Supplementary file S3: Typology of capacity development actors

Actor	Examples	History	Roles	Development strategies	Research focus
Private foundations or charities	Wellcome Trust, Gates Foundation, Rockefeller Foundation	Most are relatively new to HRCD but some well-established	Funding	Mostly individual-level development to undertake specific projects. Little investment in local institutions.	Mostly support research generation but recent moves to translation
Multi-lateral agencies	World Health Organisation, World Bank, African Development Bank, Global Fund	WHO TDR & HRP are some of the oldest actors in HRCD. Most relatively new to HRCD.	Governance, stewardship, agenda setting, advocacy & funding	Usually channel funds through independent or subsidiary organisations. WHO offers individual-level development. Traditionally did not support institutions & had little system interest. However, now taking the lead in system approaches & may channel funds through local institutions.	Typically support research generation but increasing emphasis on translation, & dissemination
Bilateral agencies	Swedish International Development Agency, Department for International Development	Generally the longest running financial supporters of HRCD, but some are newer.	Varied	Usually support individual & institutional development. Little system development until very recently.	Historical focus on knowledge generation but progressively more emphasis on knowledge utilisation & dissemination
Global organisations	Global Forum for Health Research, European & Developing Countries Clinical Trial Partnership	Mostly since mid-1990s but some older. Often formed by, or as, a subsidiary of multi-laterals.	Stewardship roles set & promote global agendas. Also have multi-lateral funding brokerage roles.	Act as a catalyst to support & direct diverse actors to common goals. Usually fund & work with networks & consortia. Organise forums. Historically supported individual & institutional development but now support HRCD at most levels & modes. Provide advice & strong advocacy roles.	Originally interested in knowledge generation & translation but now tackle all stages of knowledge cycle
Consortia & networks	Alliance for Health Policy & Systems Research, International Network for Clinical Epidemiology, Central African Network on TB HIV/AIDS & Malaria	Largely a recent phenomenon forming mid-late 1990s onwards	Development, advocacy or funding brokerage roles Global, regional or local reach.	Individual & institutional support for specific projects or organisations that are thematically focussed. Not traditionally institution-wide or system development but recently more attention to those areas. Mixture of horizontal & vertical initiatives.	Collectively they cover the entire knowledge cycle but most have specific focus.
Public private partnerships & product development partnerships	Medicines for Malaria Venture, International AIDS Vaccine Initiative, Global Alliance for TB Drug Development	Largely a recent phenomenon forming mid-late 1990s onwards. Over 70 formed between 1995 & 2003.	Thematically based on disease or intervention of interest. Product development "upstream" R&D research.	Development approaches usually concentrated on building capacity to run specific studies through vertical interventions. Recently a little more attention to individual level & infrastructure development.	Knowledge generation & strong emphasis on translation

LMIC research councils & institutes of health	South African Medical Research Council, The National Research Council of Sri Lanka	Much less common than in HICs but increasing & some well-established.	Varies widely but usually in accordance with national priorities & focus on specific conditions or projects.	Funding is often limited but appears to be increasing. Formation of research sites, particularly centres of excellence. Individual & institutional development. Often in collaboration with international networks. Early moves towards system development. May also carry out own research.	Mostly knowledge generation
LMIC Governments	South Africa, Brazil, Zambia	Highly variable often according to GDP but also economic policies. Some investing a lot, others not at all. Typically only recent investments in HRCD.	Variable but usually in accordance with national priorities. May be linked to infrastructure development.	Some ministries have their own research centres & develop capacity "in house". Others provide project grants or individual development. Governments may upgrade or create research institutions. Investment value typically small due to resource constraints or low priority of research. However, some countries investing heavily. More recent attention to macro level capacities.	Varied. Knowledge generation common but recently agenda setting, stewardship, demand creation & knowledge utilisation
LMIC academic & healthcare institutions	University of KwaZulu-Natal, Makerere University, Fundação Oswaldo Cruz	Varied history. Some very well established in research but most new to HRCD. May be public or private.	Variable. Research may be in accordance with national or global priorities, or investigator interest.	Mainly undergraduate & some graduate training. Provide institutional resources for research. Development of institutions usually reliant on governmental funds, unless private. Normally training & education takes precedence over research.	Knowledge generation
HIC research councils & institutes of health	Medical Research Council (UK), NIH (USA), Canadian Institutes for Health Research, Royal Society	Institutions with a long history but only recently (around 2000) expanding their role in HRCD	Varied. But no specific remit to conduct capacity development.	Provide various funding & scholarships for individuals to undertake post graduate training. Also fund specific research projects which may include institutional development. Normally work in collaboration with institutions from donor country. Usually not system level. Some encourage scientific excellence by forming links with other LMIC societies, but do not conduct HRCD directly.	May conduct research themselves. Mostly support knowledge generation but may have smaller investments in knowledge utilisation.
HIC academic & healthcare institutions	University of Oxford, Institut Pasteur, Johns Hopkins University	A long history of research in LMICs. Some project specific HRCD but only recently taking on more explicit capacity development.	Project focused around research goals. Mostly investigator-led but may follow national priorities.	Development is usually to facilitate a specific project. May involve developing research sites & staff. Often focus on centres of excellence. Individual development either in-country or at HIC universities. System development not common. Normally in partnership with local groups which increases knowledge transfer.	Mostly knowledge generation. Specific projects may target knowledge utilisation & sometimes dissemination but much rarer.

Industry	GlaxoSmithKline, IBM, local industries	Pharmaceutical companies important but IT companies increasingly involved. International & national industry involved.	Product development & innovation technologies. Mostly in Asia. Currently less reach to Africa.	Develop capacity through technology or "know how" transfer. Infrastructure strengthening, particularly IT. May fund individual training or institutional development. May also provide services at favourable rate or free. Usually work in partnership with other actors.	Knowledge generation & translation but also knowledge management. May work in other areas depending on company.
Non-governmental organisations (NGO)	Medicine Sans Frontiers, Drugs for Neglected Diseases Initiative, One World Health, local NGOS	Recent involvement in research & HRCD (post 2005)	Either highly applied research or product development R&D. Some work in partnerships with other actors.	Strengthen research within networks or embedded in health delivery. Usually individual or specialised institutional support. As part of civil society, have strong advocacy & moderation roles. Can mobilise resources towards non-profit activities	All stages of knowledge cycle.
Academic journals	International Committee of Medical Journal Editors, Lancet, PLOS, Tanzanian Journal of Health Research	Long history of discussion on HRCD but becoming increasingly prominent in last 5 years.	Advocacy & opinion leaders. Role as moderators & amplifiers. Provide access to information & publishing.	Improve access to information & enable individuals to publish by changing publication & subscription policies. Promoting best practice & improving quality & reliability of publications. Encourage debate & advocate.	Knowledge dissemination



PRISMA 2009 Checklist

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Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	Page 1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	Pages 2-3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	Pages 5-6
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	Page 6 (end)
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	No formal protocol exists
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Section 2.1, page 7
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	Section 2.2., pages 7
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Box 1, page 8
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	Sections 2.2 & 2.3, pages 7. Also figure 1.
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	Section 2.4, pages 9
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	Section 2.4, pages 9.
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	Section 2.3. Page 8
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means)	Section 2.4,

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			pages 9
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	Section 2.4, pages 9

Page 1 of 2

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	Section 4.4., pages 27, and section 3.6, pages 22
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	NA
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Section 2.2., Pages 7. Figure 1.
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Section 3.2, pages 11. Table 2.
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	NA – See section 2.3, page 8.
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	NA
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	Sections 3.3. and 3.4, pages

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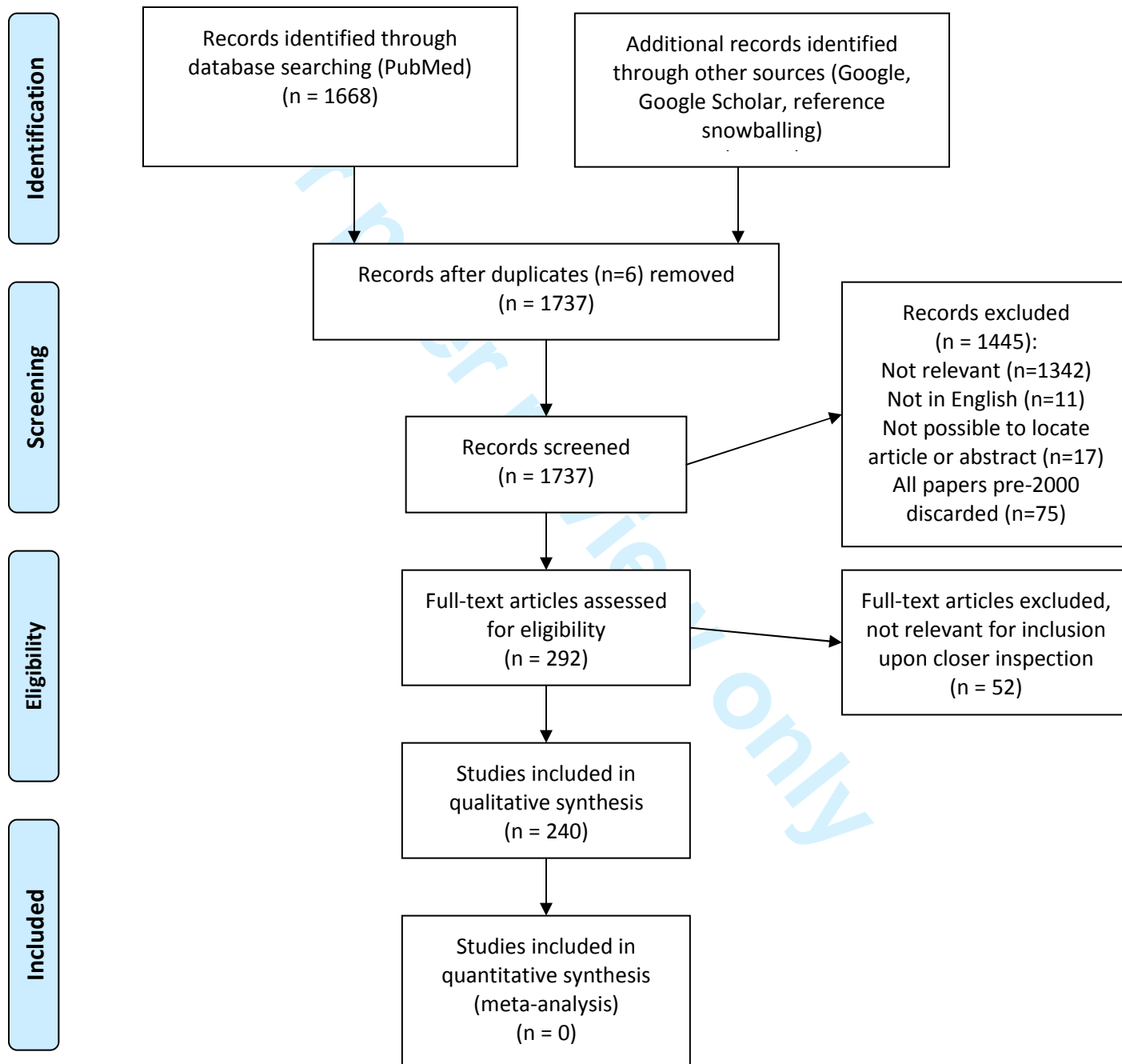
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Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	NA – See section 2.3, page 8.
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	NA
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	Section 4.1, page 25, and 4.3 pages 27
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	Section 4.4, pages 28-29
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	Sections 4.2 pages 27 & 4.5 page 28
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	Funding statement, page 29

36 From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097.
37 doi:10.1371/journal.pmed1000097

38 For more information, visit: www.prisma-statement.org.



PRISMA 2009 Flow Diagram: Health research capacity development in Low and Middle Income Countries: reality or rhetoric? A systematic meta-narrative review of the qualitative literature



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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BMJ Open

Health research capacity development in Low and Middle Income Countries: reality or rhetoric? A systematic meta-narrative review of the qualitative literature

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2016-012332.R1
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Date Submitted by the Author:	25-Aug-2016
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Primary Subject Heading:	Global health
Secondary Subject Heading:	Evidence based practice, Qualitative research, Research methods
Keywords:	QUALITATIVE RESEARCH, TROPICAL MEDICINE, EDUCATION & TRAINING (see Medical Education & Training)

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1 Title

2 Health research capacity development in Low and Middle Income Countries: reality or
3 rhetoric? A systematic meta-narrative review of the qualitative literature

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15 Tropical Medicine, London W, UK.

16 Key words

17 Health Research, Capacity Development, Low and Middle Income Countries, Research
18 Systems, Clinical Trials

19 Word count

20 5653

21

22 Abstract

23 **Objectives:** Locally-led health research in Low and Middle Income Countries (LMIC) is
24 critical for overcoming global health challenges. Yet, despite over 25 years of international
25 efforts, health research capacity in LMICs remains insufficient and development attempts
26 continue to be fragmented. The aim of this systematic review is to identify and critically
27 examine the main approaches and trends in health research capacity development and
28 consolidate key thinking to identify a more coherent approach.

29 **Methods:** This review includes academic and grey literature published between Jan 2000
30 and July 2013. Using a predetermined search strategy, we systematically searched
31 PubMed, hand-searched Google Scholar, and checked reference lists. This process
32 yielded 1668 papers. 240 papers were selected based on a priori criteria. A modified
33 version of meta-narrative synthesis was used to analyse the papers.

34 **Results:** Three key narratives were identified: the effect of power relations on capacity
35 development; demand for stronger links between research, policy, and practice; and the
36 importance of a systems approach. Capacity development was delivered through 4 main
37 modalities: vertical research projects, centres of excellence, North-South partnerships, and
38 networks; all were controversial and each had their strengths and weaknesses. A plurality
39 of development strategies was employed to address specific barriers to health research.
40 However, lack of empirical research and monitoring and evaluation meant that their
41 effectiveness was unclear and learning was weak.

42 **Conclusions:** There has been steady progress in LMIC health research capacity but
43 major barriers to research persist and more empirical evidence on development strategies
44 is required. Despite an evolution in development thinking, international actors continue to
45 use outdated development models that are recognised as ineffective. To realise newer
46 development thinking, research capacity outcomes need to be equally valued as research

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49 **Strengths and limitations of this study**

- 50 • This systematic review goes beyond previous attempts that lacked reflexivity, to
51 provide a nuanced, in-depth, and enquiring critique of health research capacity
52 development approaches.
- 53
- 54 • This review integrates diverse qualitative literature that largely lacked formal reporting
55 procedures or empirical base, allowing the inclusion of voices that are traditionally
56 excluded in other styles of systematic analyses.
- 57
- 58 • Some academic articles may have been missed because PubMed was the only formal
59 database used, and there was limited inclusion of evaluation and programme-level
60 data due to poor grey literature indexing in Google and Google Scholar.
- 61
- 62 • However, the meta-narrative method aims to develop overarching narratives through
63 saturation of themes, rather than include every eligible article, so inclusion of
64 additional papers would be unlikely to change the findings of the study.

1 Introduction

Locally-led health research is critical for overcoming global health challenges in Low and Middle Income Countries (LMICs) [1]. This research is needed to “propose culturally apt and cost-effective individual and collective interventions, to investigate their implementation, and to explore the obstacles that prevent recommended strategies from being implemented” [2]. Such research is now the focus of key capacity development efforts, such as the regional educational centres supported by the Special Programme for Research and Training in Tropical Diseases (TDR) [3].

However, these arguments are not new; the importance of LMIC research capacity has been recognised for well over two decades. The 1990 Commission on Health Research for Development stated that strengthening research capacity in LMICs is “one of the most powerful, cost-effective, and sustainable means of advancing health and development” [4]. This marked the beginning of a “revolution” in health research [5] where there was a surge of investment and concerted effort to conduct health research aimed at solving health problems in LMICs [6].

Nevertheless, at the turn of the millennium LMICs accounted for 85% of the world’s population, 92% of the global disease burden, but only 10% of global funding for health research was devoted to addressing these persistent health challenges [6]. Recognition of this “10/90” gap led to renewed calls for health research capacity development in LMICs and further investment [5].

Yet nearly 15 years later, many LMICs still lack sufficient health research capacity to build a local evidence-base with which to inform policy and improve population health. This was recently and profoundly described in The 2013 World Health Report which argued that “all nations should be producers and users of research as well as consumers”, noting that this was not yet the case [1].

1
2
3 90 Therefore, despite years of international collaborations and investment, development of
4
5 91 LMIC nation's capacity to address their own health problems appears enduringly
6
7 92 problematic. Where there has been progress, such gains often do not appear sustainable
8
9
10 93 without continued strong foreign support [7, 8], which is itself questionable in light of recent
11
12 94 austerity and bilateral aid agency restructuring [1, 9, 10].

13
14 95 Although there is a large and diverse body of literature on health research capacity
15
16 96 development, it remains confusing, controversial, and poorly defined, with various
17
18 97 contradictory understandings [11] and conceptualisations [1]. Since capacity development
19
20 98 is now something that most research actors are expected to participate in, or at least be
21
22 99 knowledgeable on [5, 12], this is problematic. To increase the likelihood of future capacity
23
24 100 development efforts being effective, there is a need to take stock of past experiences and
25
26 101 learn from successes and failures. Such an exercise would not only provide a unifying
27
28 102 picture to appraise previous capacity development efforts, but also encourage discussion
29
30 103 and reflection that could lead to fresh thinking.

31
32
33
34 104 The aim of this systematic review is to identify and critically examine the main
35
36 105 approaches, strategies, and trends in health research capacity development and
37
38 106 consolidate key thinking in order to identify a more coherent approach. This review should
39
40 107 prove useful to all stakeholders interested in learning how to undertake the complex
41
42 108 business of capacity development, and will be of particular interest to actors working to
43
44 109 make locally-led and sustainable health research capacity in LMICs a reality.
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110 2 Methods

111 Our systematic review followed the 6 stages of the meta-narrative methodology
112 developed by Greenhalgh *et al* [13]. The meta-narrative method is a “systematic, theory-
113 driven interpretative technique, which [was] developed to help make sense of
114 heterogeneous evidence about complex interventions applied in diverse contexts in a way
115 that informs policy” [14]. Since the Health Research Capacity Development (HRCD)
116 literature shares these characteristics, the meta-narrative method was highly suited to the
117 purposes of this study.

118 2.1 Inclusion criteria

119 This review considers the perspectives of all actors involved in HRCD that have
120 published within academic and grey literature from the year 2000 onwards. We included
121 any papers that broadly discussed HRCD or its more specific components. Papers that
122 mentioned HRCD but did not discuss the issue further were not included. Non-English
123 language publications were excluded due to lack of resources for translation. Papers
124 published before the year 2000 were initially included, but after screening it became clear
125 that paradigm shifts in global health at the turn of the millennium [5, 6] meant that much of
126 their content was not relevant to current day. Furthermore, many papers published post
127 2000 effectively summarised historically important issues. Therefore, all papers published
128 pre-2000 were excluded.

129 2.2 Search strategy and study selection

130 The search and study selection process is presented in Figure 1. We searched
131 PubMed using the search terms presented in Box 1 for all papers published up to 20 June
132 2013. This search yielded 1668 potentially relevant papers. The titles and abstracts of
133 these papers were then screened for eligibility, resulting in 1376 papers being excluded

134 based on pre-screening, with an additional 75 papers excluded after it was decided that
135 papers published before 1 January 2000 should not be included.

136

137 **Fig 1: Search and study selection process**

138

139 **Box 1: Search terms used in PubMed search**

```
((((((((((((((((capacity building[MeSH Terms]) OR (("developing"[Title/Abstract]) OR
"develop"[Title/Abstract]) OR "capacity"[Title/Abstract]))) OR "strengthen"[Title/Abstract])
OR "strengthening"[Title/Abstract])) AND (((developing country[MeSH Terms]) OR Africa)
OR Asia) OR Latin America))) AND (((("trial"[Title]) OR "trials"[Title]) OR "research"[Title])))
NOT clinical trial[Publication Type]) NOT informed consent[MeSH Terms]) NOT waste
management[MeSH Terms]) NOT air pollution[MeSH Terms]) NOT agriculture[MeSH
Terms]) NOT ("Na6(H2O)8(ZnAsO4)6" [Supplementary Concept] OR "K3Zn4O(AsO4)3"
[Supplementary Concept])
```

140

141 The PubMed search was complemented by a search of Google and Google Scholar
142 using the terms “Health AND research AND capacity AND strengthening OR Building OR
143 Development”. All literature added from Google were found in the first 10 pages (n=30).
144 After the first 10 pages, no search results were relevant to the study. Literature collections
145 of the authors and other experts were also hand searched and references snowballed
146 (n=45). A total of 292 papers were read in full and considered for eligibility. Based on this
147 screening, the final synthesis involved 240 papers. The full list of papers included in this
148 review can be found in supplementary file S1.

149 Relevant papers published between June 20 2013 and December 14 2014 were
150 scanned and read to determine if the synthesis findings were still valid post-search.
151 Although there were some pertinent new articles, their content would not have changed
152 the findings of this synthesis.

153 **2.3 Quality assessment**

154 No papers were excluded based on assessment of quality because the majority of papers
155 lacked an empirical or explicit study design, and all stakeholders' views regardless of their
156 perceived validity were considered important. Furthermore, capacity development
157 discussion is inherently political and most contributions are based on personal opinion
158 informed by theoretical, ethical, or experiential standpoint. Accordingly much of it is biased.
159 Rather than attempt to remove the bias, assumptions and motivations were explicitly
160 studied to uncover authors' implicit logic, so that readers can make their own informed
161 opinion.

162 Instead of using quality criteria, similarity of arguments within the literature was used as an
163 indicator of current agreement on a topic or popularity of an idea. This allowed a
164 comprehensive analysis of all the HRCN narratives, while still highlighting and giving
165 emphasis to the most widely accepted opinions.

166 **2.4 Data extraction and synthesis**

167 To synthesise the literature, papers need to be framed within a "storyline" that recognises
168 where the contribution came from [13]. *Greenhalgh et al.*'s method explicitly catalogues
169 these storylines as "meta-narratives" [13]. Developing meta-narratives provides context to
170 contributions whose underlying assumptions and interests would otherwise be opaque.
171 Although less prescribed than a quantitative systematic review, this approach
172 pragmatically allows a plurality of ideas, recognising there may be no single correct
173 answer.

174 To ensure that source content was interpreted alongside its context, even when
175 broken into themes and narratives, a tagging system was used instead of a traditional
176 extraction form. All sources were organised in EndNote X7 (Thomson Reuters) and
177 associated citations, metadata and PDF copies of the documents were attached. These

1
2
3 178 data were then imported into Nvivo 9 qualitative analysis software (QSR International)
4
5 179 where the sources were given tags using deductive codes for key characteristics.
6

7 180 Meta-narratives were then identified inductively by reading each paper and coding
8
9 181 for meta-narratives where several authors in the literature discussed and presented topics
10
11 182 similarly. This is an interpretive approach similar to that used in thematic coding analysis,
12
13 183 where reoccurring themes that are conceptually related are grouped into concepts. Once
14
15 184 the meta-narratives had been finalised they were systematically applied to all relevant
16
17 185 papers. No prior theory beyond the guidance presented by Greenhalgh *et al.* [13] was
18
19 186 explicitly used to help identify and categorise the meta-narratives. Instead, iterative rounds
20
21 187 of open data-driven inductive coding were used.
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28 189 **2.5 Role and position of the authors**

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30
31 190 This systematic review was undertaken, in part, to inform the design of a larger body of
32
33 191 empirical research on health research capacity development in LMICs. All authors have
34
35 192 backgrounds in social science and global health. Initial coding was conducted by Samuel
36
37 193 Franzen, and then refined based on face-to-face discussions with other authors around the
38
39 194 coding framework and preliminary findings. The authors of this paper do not include
40
41 195 individuals from LMICs, but this paper was reviewed and commented on by individuals
42
43 196 from LMICs who collaborated on and participated in the parallel empirical research, and
44
45 197 discussed with other relevant experts at meetings and conferences. These team
46
47 198 processes represent a deviation from the meta-narrative method presented by Greenhalgh
48
49 199 *et al.* [13] because the authors did not constitute a multi-disciplinary team and input from
50
51 200 external peers was largely ad hoc, rather than through regular planned inputs. These
52
53 201 methodological deviations were required to enable the systematic review to feed into the
54
55 202 evolving parallel empirical research.
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203 **3 Results**

204 **3.1 Definitions and actors**

205 The concept of capacity development can be confusing because there are multiple and
206 conflicting terminologies for development activities and actors. To assist the reader,
207 typologies of key definitions and development actors were produced. Supplementary file
208 S2 presents these definitions alongside reasons for adopting them, and supplementary file
209 S3 categorises and provides background to development actors' activities.

210 **3.2 Characteristics of included papers**

211 Table 1 summarises the main characteristics of the papers included in the review.
212 Based on first author characteristics, the greatest number of articles came from LMIC
213 academic and healthcare institutions (31.3%), closely followed by HIC academic and
214 healthcare institutions (29.6%). Contributions from funders were very low (0.8%), and
215 industry and civil society were absent, potentially reflecting the sampling from academic
216 databases. Europe was the greatest contributing region (32.9%) followed by Sub-Saharan
217 Africa at 23.8% and North America at 13.8%. Contributions from Latin America (2.5%),
218 Middle East (1.7%) and North Africa (0.8%) were low. Although most articles were
219 concerned with capacity development across all LMICs (42.1%), Sub-Saharan Africa
220 dominated the regional specific discussions (34.6%). The main basis for viewpoints were
221 opinion, debate or personal perspectives (34.2%); sharing experiences represented
222 21.7%, and empirical work 20.8%.

Table 1: Characteristics of papers included in this review

Category* of development actor (for first author)	%	Location of first author's institution	%	Region of interest	%	Main topic of development interest	%	Main disease of interest	%	Basis for viewpoint	%
LMIC Academic and Healthcare Institutions	31.3	Europe	32.9	All LMIC countries	42.1	Multiple broad issues discussed	24.6	Not disease specific or address multiple	72.5	Opinion, debate, perspective	34.2
HIC Academic and Healthcare Institutions	29.6	Sub Saharan Africa	23.8	Sub Saharan Africa	34.6	Individual level development	15.8	HIV	6.3	Experience report	21.7
Multi-laterals	10.4	North America	13.8	South Asia	10	Partnerships networking, consortia	15.8	Malaria	5.8	Empirical research	20.8
Consortia & Networks, NGOs and Public-Private Partnerships	8.8	South Asia	10	East Asia	6.7	Operational challenges & opportunities	11.3	Other	4.6	Literature review, summary or synthesis	7.9
Academic Journals	5.4	East Asia	9.2	All Asia	2.9	System approaches and macro level development	9.2	Mental Health and Addiction	2.5	Proceedings or conference report	7.5
LMIC Governmental	4.6	Australia	2.9	Latin America	1.7	Agenda and priority setting	6.3	Maternal Child Health and Paediatrics	2.5	Organisation document	4.6
LMIC Funders, Research Councils and Institutes of Health	4.6	Latin America	2.5	Pacific	0.8	Institution level development	5.4	Tuberculosis	2.1	News report	3.3
Bi-lateral aid agencies	2.1	Not specific	2.1	Middle East	0.8	Monitoring and evaluation	2.9	Non-communicable diseases	2.1		
HIC Research Councils and Institutes of Health	2.1	Middle East	1.7	Central Asia	0.4	Research and development	2.1	Dental or oral health	1.7		
Private Foundations or Charity Funders	0.8	North Africa	0.8			Ethics and regulations	1.7				
Industry	0	Pacific	0.4			Knowledge cycle	0.8				
Civil Society and Media	0										

* Some categories have been merged because they could not be separated

225 **3.3 Meta-narratives in health research capacity development**

226 Three key narratives ran through the literature: the effect of power relations on capacity
227 development; demand for stronger links between research, policy, and practice; and the
228 importance of a systems approach to HRCd. Each narrative is described below with
229 reference to the key papers that discussed these narratives in detail.

230 **3.3.1 Effect of power relations on capacity development**

231 The effect of power relations on capacity development was the most common narrative
232 running through the literature (present in 29% of papers). The main concerns of this topic
233 are that research agendas in LMICs are set more by international funders than by LMIC
234 institutions, and research conducted in LMICs is predominantly led by HIC researchers
235 with little involvement of LMIC individuals or institutions. This is argued to erode national
236 sovereignty [15], prevent capacity development [16, 17], and create research priorities that
237 more closely match funder agendas than countries' needs [18-20] leading to a situation of
238 "he who pays the piper calls the tune" [20, 21]. Examples include "spotlight issues", which
239 receive funding regardless of relative need [22], and "parachute" research where data is
240 collected in LMICs but all other work is conducted in HIC institutions.

241 "North-South" collaborations between HIC and LMIC research institutions are
242 considered to be better mechanisms for developing research capacity [8], but many
243 authors still thought that they comparatively disadvantage the LMIC partner [9, 12, 15].
244 The perceived situation of "treating Africa as a repository of raw materials for expatriate-
245 driven research" [9] led to the development of guidelines for research collaboration. To
246 reflect the change in approach, there was a rhetorical shift to using the term "partnership"
247 to describe collaborations that were equitable [17]. These partnerships should be built on
248 mutual trust and shared decision making, national ownership, early planning for translation
249 of research findings and development of national research capacity [17]. Importantly, it is

1
2
3 250 now expected that all partnerships should have capacity development at their forefront
4
5 251 [12]. However, despite discussion for well over a decade, a good proportion of the
6
7 252 international community still feels that partnerships are not yet equal [12, 23, 24], and they
8
9 253 cannot be until the power divide is addressed [15] because LMICs are unable to negotiate
10
11 254 for a fairer deal [15, 25, 26].

12
13
14 255 In an effort to adjust the power balance there have been conscious efforts towards
15
16 256 recognising local research capacity in LMICs [12, 20]. This change is again reflected in
17
18 257 rhetoric through the evolution of the term “capacity development” which gradually places
19
20 258 stronger emphasis on extant capacity; changing from “capacity building” to “capacity
21
22 259 strengthening” [20] to “capacity utilisation” [27], “unleashing” and “releasing” [20]. Many
23
24 260 authors now propose that research and capacity development in LMICs should be locally
25
26 261 owned and led [17, 20, 28, 29]. This is because LMIC researchers have the best
27
28 262 understanding of evidence gaps [17] and can present research to policy makers with an
29
30 263 understanding of the political and cultural context which increases the chance of evidence
31
32 264 uptake [30, 31]. Locally-led studies are also thought to be better aligned with national
33
34 265 agendas [32] and address more applied implementation topics than foreign-led research
35
36 266 [17].

37
38
39 267 Most stakeholders now agree that research and capacity development should, at a
40
41 268 minimum, include the local research community in the design and conduct of research
42
43 269 studies [33]. Development actors are also advised to be more sensitive to the power
44
45 270 dynamics they create and ensure they strengthen, not weaken, the role of national
46
47 271 governments by responding specifically to their priorities [20, 29, 34] and including the
48
49 272 “recipients” in any agenda setting [35]. However, others argue that this situation will
50
51 273 inevitably continue so long as foreign countries are the majority financers of research in
52
53 274 LMICs [36]; only through greater national investment and commitment will LMICs have a
54
55 275 stronger voice to make relations more equitable [7, 9, 37]. Nevertheless, the vast majority
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1
2
3 276 of development efforts reportedly still focus on international collaborative research
4
5 277 meaning local investigator-led studies are largely ignored [38]. This is evidenced by only 3
6
7 278 papers in this review being focussed on supporting locally-led clinical trials, compared to
8
9 279 33 papers aimed at developing international clinical trials.
10

11 280 **3.3.2 Demand for stronger links between research, policy and practice**

12
13
14
15 281 Arguments for stronger links between research, policy and practice were present in
16
17 282 16% of sources. These emerged due to concerns that much research was failing to be
18
19 283 translated into policy [25, 39], and was too narrowly conceived and disease-specific to
20
21 284 have impact [40].
22

23
24 285 Accordingly, applied fields now deemed to be highly relevant to decision makers and
25
26 286 those that promote sustainable adoption and implementation of evidence based medicine
27
28 287 have been called for [30, 41, 42]. These include health policy and systems research [43],
29
30 288 health services research [44], implementation research, and operations research [45-47].
31
32 289 These arguments formed the backbone of the WHO strategy on “research for health”
33
34 290 which “gives priority to research and innovation that has the greatest potential to improve
35
36 291 global health security, accelerate health-related development, redress health inequities
37
38 292 and help to attain the Millennium Development Goals” [48] .
39

40
41 293 Despite these discussions, much research is still regarded as uncoordinated and
42
43 294 concentrating on a few high profile diseases [49] such as the “big 3”: HIV/AIDS, Malaria
44
45 295 and Tuberculosis. Furthermore, the majority of research is critiqued as largely technology
46
47 296 development focused, even though many argue that the impact of this research is low [44]
48
49 297 and more lives could be saved by improving service delivery of existing interventions [25,
50
51 298 43, 50].
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299 3.3.3 The importance of a systems approach to capacity development

300 The importance of taking a systems approach to HRCD was discussed in 24% of
301 sources. Conceived in the 1990s and popularized after the Ministerial Summit on Health
302 Research in Mexico in 2004 [25], systems approaches to HRCD emerged in response to
303 perceived failings of capacity development targeted at only one level. Particular
304 weaknesses cited included: lack of provision for trained individuals to use their skills [6]
305 leading to “brain drain” of LMIC researchers to HICs [51, 52]; exclusively focusing on high
306 performing individuals [53] rather than strengthening local institutions to develop
307 researchers [54]; absence of national bodies to coordinate priorities, develop policy, and
308 translate evidence into action [55]; and the fragmentation of capacity development
309 activities [56, 57].

310 Proponents of systems approaches argue that for capacity development to be effective
311 and sustainable [8, 58], new approaches to addressing all three levels of the national
312 research system are needed; macro, institutional and individual [58] (for definitions of
313 these levels, please see supplementary file 2). Macro-level capacity development should
314 include: priority setting, planning and coordinating research, governance and regulation,
315 and knowledge translation and dissemination [48, 57, 59]. Individual development should
316 include a broader range of stakeholders than just research producers (e.g. policy makers,
317 administrators, medical personnel and ethics board members) and teach a wider variety of
318 skills and disciplines, particularly “soft skills” such as organisation, management and
319 leadership [55]. Institutional development should focus on the ability to generate, retain
320 and utilise individual capacity through improving curricula, training support, mentorship,
321 and research resources [60-62].

322 Although presented as a complex task with long time frames [63], taking a systems
323 approach is said to result in more dynamic capacity development that produces
324 endogenous change, greater local ownership, and removal of perennial system barriers

1
2
3 325 [20] which helps countries to effectively target their own health needs [19]. This is in stark
4
5 326 contrast to previous approaches that established parallel structures to deliberately bypass
6
7 327 local systems because they were deemed to be chronically ineffective [24]. However,
8
9 328 despite the accepted importance of research systems development, little is known about
10
11 329 how health research systems can be formed [19], there are few successful examples of
12
13
14 330 research system strengthening, and little guidance is available [64].
15

16 17 331 **3.4 A summary of modern health research capacity development** 18 19 332 **modalities** 20

21
22 333 After attempts at aligning human, material and technical capacities failed in the 1980s,
23
24 334 research models that directed funds and technology through HIC institutions became the
25
26 335 preferred HRCD mechanism [5]. These mechanisms are now the most common approach
27
28 336 to HRCD. The justification for requiring LMICs to collaborate with HICs is that knowledge
29
30 337 transfer and HIC expertise are required to achieve capacity development [65, 66].
31
32 338 However, others argue that such development models propagate inequities in research
33
34 339 and development [17, 36]. Discussions on development modalities are therefore
35
36 340 contentious. The following sections summarise the justifications, benefits, drawbacks and
37
38 341 controversies of the main development modalities.
39

40 41 42 342 **3.4.1 Vertical research projects** 43

44
45 343 One of the earliest and most persistent research models arising from the HIC fund
46
47 344 channelling mechanism was vertical research projects [5]. This involves a HIC research
48
49 345 collaborator working in a LMIC to conduct applied, normally short-term research projects
50
51 346 with narrow objectives [54]. The theoretical advantage of a vertical strategy is that it
52
53 347 maintains focus on a specific scientific mission [67]. This allows the necessary capacity to
54
55 348 be developed more rapidly and can quickly produce research outputs [5] even where
56
57 349 major expansion of R&D is required [35]. These approaches now account for the biggest
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1
2
3 350 share of health research funding [58]. Examples include product development partnerships
4
5 351 such as The Global Alliance for TB Drug Development, and many commercial or non-
6
7 352 commercial clinical trials [68].
8

9
10 353 HRCD is often included in these programmes, but development of capacity is usually
11
12 354 not the primary objective [59]. Rather it is designed to develop capacities that will benefit
13
14 355 the successful completion of the project [60] and result in high quality research outputs
15
16 356 [54]. Vertical projects often have strong expatriate leadership and are frequently managed
17
18 357 by external institutions [54], which is argued to result in parallel structures that bypass local
19
20 358 research institutions [69]. Where individual-level development is provided, it is typically
21
22 359 short term and project specific [70].
23

24
25 360 Critics of vertical projects argue that local researchers often only have support roles
26
27 361 [16], samples may be shipped abroad for analysis [23] and there can be little investment
28
29 362 in local institutions because they are bypassed [15, 69]. Therefore when these short-term
30
31 363 projects finish, research sites and individuals are rarely left with the skills or resources to
32
33 364 run their own studies [41, 68]. Another criticism is that vertical approaches force the
34
35 365 research community to work separately on overlapping issues [71] leading to
36
37 366 fragmentation of national research systems [55].
38
39

40
41 367 Proponents of vertical interventions are however mindful that there is a trade-off
42
43 368 between the speed and quality of research, and capacity development [72]. They argue
44
45 369 that in the case of health emergencies, investment should be made in excellent research,
46
47 370 not excellent capacity development.
48

49 50 371 **3.4.2 Centres of excellence**

51
52 372 A common modality for developing long-term capacity to conduct advanced research in
53
54 373 LMICs is “centres of excellence”. These have taken various forms, but the approach
55
56 374 generally concentrates investment within a few institutions that show potential to excel and
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1
2
3 375 become high quality self-sustaining sites. These models are reportedly useful because
4
5 376 they increase the likelihood of high quality research and renewed investment in an
6
7 377 otherwise challenging environment [52, 55, 73].
8

9
10 378 Early forms of this concept were criticised as being “annexed” research sites,
11
12 379 effectively led and managed by expatriate staff [74]. Others argue that they create parallel
13
14 380 research structures outside of the national system that further depletes the local resource
15
16 381 pool by diverting investment and human resources towards these better funded sites [17,
17
18 382 24, 44]. More recent forms of “centres of excellence”, such as those championed by the
19
20 383 European and Developing Countries Clinical Trials Partnership, strive for greater Southern
21
22 384 leadership and better integration with local research systems [75].
23
24

25 385 **3.4.3 North-South partnership**

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27

28 386 Another common development model is North-South partnerships. They are distinct
29
30 387 forms of collaboration between HIC and LMIC researchers because unlike “centres of
31
32 388 excellence”, they are usually project specific rather than institution building, and they put
33
34 389 more emphasis on sustainable research, shared leadership and mutual benefit than
35
36 390 vertical research projects. However, depending on the nature of the partnership, these
37
38 391 demarcations can become blurred.
39
40

41 392 Since the millennium, North-South partnerships and have been heavily promoted by
42
43 393 organisations such as The Global Forum for Health Research [6] and The European and
44
45 394 Developing Countries Clinical Trial Partnership (EDCTP) [75]. Such partnerships are said
46
47 395 to be responsible for increasing resource flows to LMICs [31] and have been advocated
48
49 396 for: increasing scientific productivity [76], training of graduates, staff exchange and
50
51 397 knowledge sharing, exposure to cutting edge technology [52], strengthening local
52
53 398 education programmes and moderate levels of institutional strengthening [6, 77, 78]. This
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55 399 is argued to result in more sustainable development [54], greater cost-efficiency and a
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3 400 broader research scope than exclusively expatriate-led or locally-led research could
4
5 401 achieve alone [17, 20].
6

7 402 Despite their popularity, a greater proportion of the literature is dedicated to discussing
8
9 403 problems with North-South partnerships than their benefits. Many authors still feel that
10
11 404 despite much guidance for entering into partnerships [12, 17, 53, 79, 80], too few benefits
12
13 405 are accrued by the Southern partner [9, 12, 23, 24, 81] because they are forced to
14
15 406 collaborate with HIC institutions to meet funding requirements [82]. Accordingly, LMIC
16
17 407 partners are reported to sometimes receive little financial benefit, go unrecognised in
18
19 408 publications, and release intellectual property rights [9, 12]. Proposed amendments to this
20
21 409 model have involved adapting partnerships to be driven by LMIC demand [60], led by the
22
23 410 Southern partner [20] or supporting more South-South partnerships [28, 83].
24
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28 411 **3.4.4 Networks and consortia**

29
30 412 Networks and consortia development models emerged in the mid-1990s. By the mid-
31
32 413 2000s they were used to tackle whole programmes of research [60] and are now very
33
34 414 popular with funders [60]. Actors adopting network models are highly diverse and can
35
36 415 sometimes be hard to separate from partnership models or vertical programmes. However,
37
38 416 they all involve linking multiple research departments, groups or institutions.
39

40
41 417 Networks are considered advantageous because they encourage less-hierarchical
42
43 418 leadership and competitive and individualistic attitudes. They are therefore reportedly
44
45 419 useful for working cooperatively on shared problems at regional or global levels [84, 85].
46
47 420 Because networks facilitate information exchange and pooling of resources to achieve a
48
49 421 critical mass [86], they are seen as particularly important where groups may be isolated
50
51 422 [87] or when one group alone would have insufficient capacity to address an issue [88].
52
53 423 Networks are also thought to: help focus on common research priorities [60, 89]; increase
54
55 424 knowledge exchange and speed diffusion of innovations [57, 64]; and help forge long term
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relationships [5, 87], and sustainability [37, 86, 90, 91]. However, some authors point out that most networks focus on highly thematic research projects [60] and only develop capacity of individual research groups, not research systems [87].

3.5 Specific development strategies

The reviewed literature contained a multitude of development strategies targeted at all levels of the health research system; macro, institutional and individual. These are presented in Table 2 and grouped according to the barrier that they address. The research barrier groupings were identified by the authors through thematic coding of the literature content. The popularity of the development strategies are indicated as a percentage of the reviewed sources that proposed them as a solution to a health research barrier.

Table 2: Summary of capacity development strategies designed to address specific barriers to health research

Barrier to research	Strategies designed to address barriers to research	Popularity (% of sources)
Fragmented research systems	<ul style="list-style-type: none"> Undertake a situational analysis & build on existing assets [28, 29, 57, 92] Collaboratively develop research agendas with LMIC stakeholders [55, 70, 75] Create a research coordinating body or scientific councils [29, 64, 93] 	Recently gaining popularity (12%)
Insufficient research funding	<ul style="list-style-type: none"> Establish a research finance system using innovative revenue generation [52, 94, 95] Provide long-term funding & flexible grants [8, 63, 96] Advocate for funding through shared causes & engaging with the media [68, 97] 	Growing popularity (21%)
Limited use of research evidence	<ul style="list-style-type: none"> Build capacities of policy makers to demand & scrutinise research [25, 84, 98] Develop evidence repositories & use Research-to-Action-Groups as knowledge brokers to package findings appropriately [39, 99] Create knowledge translation platforms to support evidence dissemination & dialogue between research producers and users [30, 39, 64, 100] 	Consistent popularity (11%)
Limited governance & regulatory capacity	<ul style="list-style-type: none"> Work research into a legislative framework [64, 101, 102] Clarify guidelines, map review capacity, & streamline procedures [74, 103] Strengthen regulatory & ethical review capacity [42, 64] 	Growing popularity (21%)
Insufficient networking	<ul style="list-style-type: none"> Develop and share a database of researchers and their expertise [31] Utilise or develop professional networks, especially web-based communities [42, 104] Organise conferences & working groups on locally important topics [2, 105] 	Very popular (26%)
Inefficient admin & research management	<ul style="list-style-type: none"> Train management & research support staff [29, 106] Set up a research support office to help with grant management, reporting & contracts, & develop information and finance systems [20, 28, 72] Develop transparent & accountable policies & procedures [69, 107] 	Unpopular but increasing (8%)

Inadequate material capacity	<ul style="list-style-type: none"> • Upgrade libraries & journal availability and invest in laboratories [28, 91, 108] • Improve Information Technology, particularly internet [6, 78] • Ensure stable power & water supplies [108] 	Widely recognised (20%)
Insufficient human capacity with research knowledge & skills	<ul style="list-style-type: none"> • Develop LMIC university research training capacity using “train the trainer” programmes, LMIC-HIC “sandwich” courses, or visiting research fellowships [20, 70, 92, 96, 109-111] • Make research principles & skills key components of undergraduate & continuing professional medical education [37, 70, 112] • Develop a variety of research roles: nurses, data managers, statisticians, laboratory personnel, managers, data collectors [9, 63, 70, 109, 113-115] • Increase distance learning via e-technologies or e-learning resources [26, 41, 70, 116, 117] • Training in major skills gaps: data collection, data management, data analysis & statistics, GCP, laboratory skills, computer literacy & ethics [46, 51, 54, 109, 118] • Training in core capabilities: protocol development, writing for grant applications & publication, grant management & budgeting, & policy dialogue [29, 45, 55, 63, 119] 	Extremely popular (41%). Training in core capabilities less popular (15%)
Insufficient practical research experience	<ul style="list-style-type: none"> • Supplement didactic training with research “learning by doing” opportunities [40, 47, 55] • Involve more LMIC institutional staff in research projects [54] • Exchange visits to advanced research sites to update skills [120] • Pilot or small grants for early stage researchers to gain experience [53, 121] 	Fairly accepted (11%)
Too few research leaders	<ul style="list-style-type: none"> • Develop leadership, project and human resource management skills [8, 72] • Opportunities for junior staff to take responsibility within a supportive environment [20] • In collaborative projects, local staff must be involved in the entire research process [122] 	Gaining popularity (13%)
Too few mentors & role models	<ul style="list-style-type: none"> • Support mentors with long term funded positions & recognition [73, 78] • Where mentoring is not available locally, institutional partnerships/exchanges or peer mentorship can be used [9, 11, 55] 	Popular (15%)
Lack of research culture	<ul style="list-style-type: none"> • Promote academic departmental leaders based on research experience [112] • Set up a departmental committee to promote research [123] • Journal clubs & seminars to develop interest in research & critical thinking [70, 120] 	Not popular (6%)
Low motivation to conduct research	<ul style="list-style-type: none"> • Protected research time & longer term contracts [54, 76] • Re-entry grants or guaranteed jobs to encourage “brain drain” diaspora to return home [109, 110] • Higher salaries or funded research time to off-set private-practice incentives [76, 124] 	Popular (18%)

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438 3.6 Reported success and effectiveness of development efforts

439 Broadly, authors consider capacity to conduct health research in Africa to have
 440 increased considerably since the millennium [12] with potential to leverage further gains
 441 from current efforts [59]. This is best exemplified by increases in the number of clinical
 442 trials conducted in LMICs [103, 125] with reports of enhanced trial capacity [68],

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3 443 particularly laboratories [126] and quality standards [38, 117, 127], and greater LMIC
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5 444 inclusion [106, 128]. Such institutional strengthening is also thought to have helped
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7 445 reduce brain drain in specific cases [109]. Although some countries still lag behind in
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9 446 regulatory and ethical review capacity, several publications indicate that LMICs have made
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11 447 good progress [108, 129].

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14 448 The increase in research capacity is thought to have been driven by recognition of
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16 449 the importance of health research over the last 20 years [5], a revised strategic focus [30],
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18 450 and the expansion of networks and partnerships for addressing research needs [60, 67,
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20 451 91]. However, it is not possible to attribute success to these development approaches due
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22 452 to lack of monitoring and evaluation data; in Africa, positive outcomes in the quality and
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24 453 quantity of published research have been recorded [60, 109, 130], but their connection to
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26 454 development inputs and outputs is not established [131]. Operational research and sharing
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28 455 of on-the-ground experiences is thought to be a useful learning resource, but with the
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30 456 exception of a few examples [42, 132], little published material on operations is thought to
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32 457 exist [133]. This is argued to make it hard to learn from previous efforts and experience
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34 458 [60] and determine why and how successes were achieved [28].

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38 459 The paucity of monitoring and evaluation data is a recognised problem [5, 58, 60],
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40 460 with authors attributing it to long time-lags to achieve objectives [11], outcomes such as
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42 461 organisational culture being difficult to measure [11], lack of commonly agreed and
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44 462 conceptually robust indicators [59, 60, 102], and most evaluation data not being published
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46 463 [131]. To remedy this situation, guidance on planning and implementing monitoring and
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48 464 evaluation for health research has been developed [29], and one research group provides
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50 465 online resources to help record and share operational guidance [41].

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54 466 It was also clear from the literature that significant capacity gaps remain in many
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56 467 LMICs. Following the example of clinical trials, authors point out that early phase studies
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58 468 are still lacking [134] and there are too few quality research sites to meet demand [103].
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3 469 Despite increases in some capacities, translation of findings into policy is considered an
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5 470 enduringly difficult outcome [60, 135] and LMIC leadership and authorship in studies is still
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7 471 thought to be too low [43]. Reportedly insufficient political buy-in for strengthening
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9 472 investment in health research has also raised concerns over the sustainability of capacity
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11 473 development achievements [7, 8]. Some authors argue that longer term projects and
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13 474 planning for sustainability of research staff and services is needed [103], but little literature
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15 475 explores this [63].
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476 **4 Discussion**

477 **4.1 An evolution in health research capacity development thinking**

478 This literature synthesis has objectively presented the main HRCD modalities and
479 strategies, and shows that some development actors continue to operate research models
480 that are contrary to widely accepted views of best practice e.g. ex-patriate led parallel
481 research units. Nevertheless, the literature reveals that there has been steady progress in
482 health research capacity in LMICs. Development actors have continuously reassessed
483 their approaches and have become much more reflexive of their actions. National
484 stakeholders have taken on a stronger voice and greater ownership, and are generally in a
485 more self-sufficient position.

486 Overall, development actors now agree that there is no panacea or one-size-fits-all
487 model to HRCD. Instead a plurality of solutions exists, the choice of which should be
488 determined by the specific capacities constraints and research goals of LMIC institutions.
489 However, despite progress, major barriers to health research persist, there is little
490 evidence to support decision-making, and the sustainability of HRCD achievements is
491 questionable.

492 **4.2 Health research capacity development, reality or just rhetoric?**

493 The evolution in HRCD thinking appears promising, but the literature demonstrates that
494 good HRCD practices are not always enacted. While the requirement for short term
495 projects is recognised [5], the vertical model has been the dominant model for almost 20
496 years [58]. This would indicate that vertical approaches have been used in situations that
497 would be better served by longer term systems strengthening strategies [5]. However,
498 there are far fewer programmes dedicated to implementing systems approaches to
499 capacity development. Other examples include: focusing on a few high profile diseases,

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3 500 donor-led research agendas, compulsory requirements for collaboration with HICs, setting
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5 501 up parallel structures, and fragmentary competitive research. To make the HRCd rhetoric
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7 502 a reality, there is a need to understand why research models that do not enhance or
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9 503 potentially inhibit locally-led research remain the *modus operandi*, even though there is
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11 504 clear agreement that they are bad practice.

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14 505 The literature findings clearly and frequently show that the persistence of flawed
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16 506 development strategies is driven by approaching capacity development within the context
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18 507 of a dedicated research model. This creates a trade-off between doing good research and
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20 508 doing good capacity development. Projects prioritising good research place research
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22 509 outputs as the primary goal and assume capacity will be developed through limited LMIC
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24 510 involvement in research activities. This means that specific development strategies
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26 511 designed to improve capacity are not used. This “implicit” capacity development is known
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28 512 to be largely ineffective [63, 72], yet is it regularly used. As a result, local research
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30 513 systems may fail to develop or deteriorate [22], and development efforts are likely to
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32 514 become multiplicative and fragmented [60, 92], despite overlapping interests and generic
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34 515 requirements [104].

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38 516 The other main alternative is “explicit” capacity development. This refers to research
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40 517 projects that place more priority on capacity development and use specific strategies
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42 518 designed to address capacity gaps. There is wide recognition that this is a superior
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44 519 approach and is more likely to improve capacity sustainably [11, 63]. However, because
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46 520 the research component is usually more valued by the research community, capacity
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48 521 development receives less attention and often focusses on developing project-specific
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50 522 capacities, not addressing systemic deficiencies. Accordingly, the capacity development
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52 523 component often becomes “bolted-on” and *ad hoc* [11, 28]; thus making it “implicit” in
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54 524 disguise.

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3 525 Instead, the review findings suggest that conducting research to improve health in
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5 526 LMICs, and developing health research capacity in LMICs, must be considered two,
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7 527 sometimes diverging objectives. Recognising this leads to a third way; “dedicated”
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9 528 capacity development. This implies that developing local capacity is as equally valued as
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11 529 the research outputs and should be considered as carefully as the research designs. Due
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14 530 to the additional resources this requires, previous efforts have been limited to individual
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16 531 capacity development or centres of excellence [91]. However, some capacity development
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18 532 actors are now attempting to do this at a more systemic level. Examples include: The
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21 533 Special Programme for Research and Training in Tropical Disease’s (TDR)
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23 534 implementation research programmes [3], ESSENCE on Health Research [136], and The
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25 535 Global Health Network [137].
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28 536 **4.3 Implications for policy and practice**

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31 537 This systematic literature review provides an important synthesis of HRCD that should
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33 538 prove useful for policy makers and practitioners alike. It identifies the strengths, limitations
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35 539 and, controversies of the main development approaches and summarises strategies that
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37 540 can be used to overcome specific research system barriers.
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40 541 Dedicated capacity development appears to offer the best approach for achieving the
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42 542 WHO’s vision of all nations becoming producers and users of research [1]. However, a
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44 543 key barrier to designing development strategies based on this thinking is the lack of
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46 544 empirical evidence. Without operational and implementation research and quality
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48 545 evaluation data, it is not possible to know the relative effectiveness of different
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50 546 development strategies and difficult to predict if they will be appropriate for a given context.
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52 547 The current experience of sharing data is a good start, but more systematic empirical
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55 548 research is required. This should be done with the same rigorous attention to
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3 549 methodological design, analysis, and reporting standards as any other research
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8 551 **4.4 Study strengths and limitations**

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10 552 Previous reviews of capacity development have lacked sufficient reflexivity and
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12 553 questioning of assumptions implicit in many strategies [40]. This systematic review
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14 554 produced a nuanced and enquiring critique of HRCD approaches in LMICs and has
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16 555 identified dedicated capacity development as a promising strategy for future HRCD efforts.
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18 556 It also integrated diverse qualitative literature that largely lacked formal reporting
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20 557 procedures or empirical base, allowing the inclusion of voices that are traditionally
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22 558 excluded in other styles of systematic analyses.
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26 559 Some academic articles may have been missed because PubMed was the only formal
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28 560 database used and non-English language articles were excluded. However, the meta-
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30 561 narrative method aims to develop overarching narratives through saturation of themes,
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32 562 rather than include every eligible article, so using additional databases would add little to
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34 563 the study. More problematic was the limited availability and inclusion of programme
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36 564 evaluations and evidence supporting operational learning. While expert opinion and the
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38 565 popularity of development strategies was presented, it was apparent that this is not a
39
40 566 reliable indicator of good development practice. Searching Google and Google Scholar,
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42 567 hand searching literature collections, and snowballing references did identify the most
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44 568 seminal papers, but some useful organisational documents will have been missed due to
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46 569 poor grey literature indexing. Furthermore, most articles had a general focus or related
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48 570 only to sub-Saharan Africa, meaning that context and research specific differences could
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50 571 not be examined in detail. The focus of the literature on sub-Saharan Africa is likely due to
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52 572 the high publishing rates of African authors and many papers' disease specific-focus on
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54 573 high burden diseases of sub-Saharan Africa (HIV and Malaria). However, it may also be
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574 possible that the English-language search restriction excluded papers from authors
575 publishing about their region in non-English languages. Regardless, the HRCD evidence
576 gap in other developing regions is notable.

577 The limited number of authors working on this review reduced the breadth of
578 perspectives involved during analysis which could have biased interpretation towards the
579 authors' particular knowledge paradigms and world views. However, this was mitigated to
580 some extent by drawing on perspectives and experiences from concurrent research
581 collaborators and participants, and seeking feedback from relevant experts at meetings
582 and conferences. While some context-specific differences in experiences were inevitably
583 raised, all individuals who were consulted considered the findings of this study to be
584 relevant and consistent with their broad view of health research capacity development in
585 LMICs. Although it may have been desirable to have a second coder, this would not have
586 necessarily improved the validity of findings through inter-coder reliability comparisons
587 because regardless of the number of coders, the emerging coding scheme and findings
588 would always be subjective. Ensuring quality of interpretation relies, rather, on being
589 transparent in offering explanations of meanings rather than presenting definitive
590 causations, and explicitly acknowledging the subjective nature of the analysis and the bias
591 this creates. These principles were adhered to in the research process and the publication.

592

593 **4.5 Conclusion**

594 Despite gains in health research capacity and progress in development thinking, further
595 work is needed to develop sustainable health research systems in LMICs. One promising
596 option is dedicated capacity development in which capacity outcomes are as equally
597 valued as research outputs. However, more empirical research is needed to identify the

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3 598 most effective strategies. If these issues are successfully addressed, health research in all
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5 599 nations could become a reality, rather than just rhetoric.
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615 The authors declare that they have no competing interests.

616 **Data sharing statement**

617 No additional data are available.

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Supplementary file captions

S1: Full list of papers included in the systematic review

S2: Key terminology and definitions used in this synthesis

S3: Typology of capacity development actors

For peer review only

Figure 1: Search and study selection process

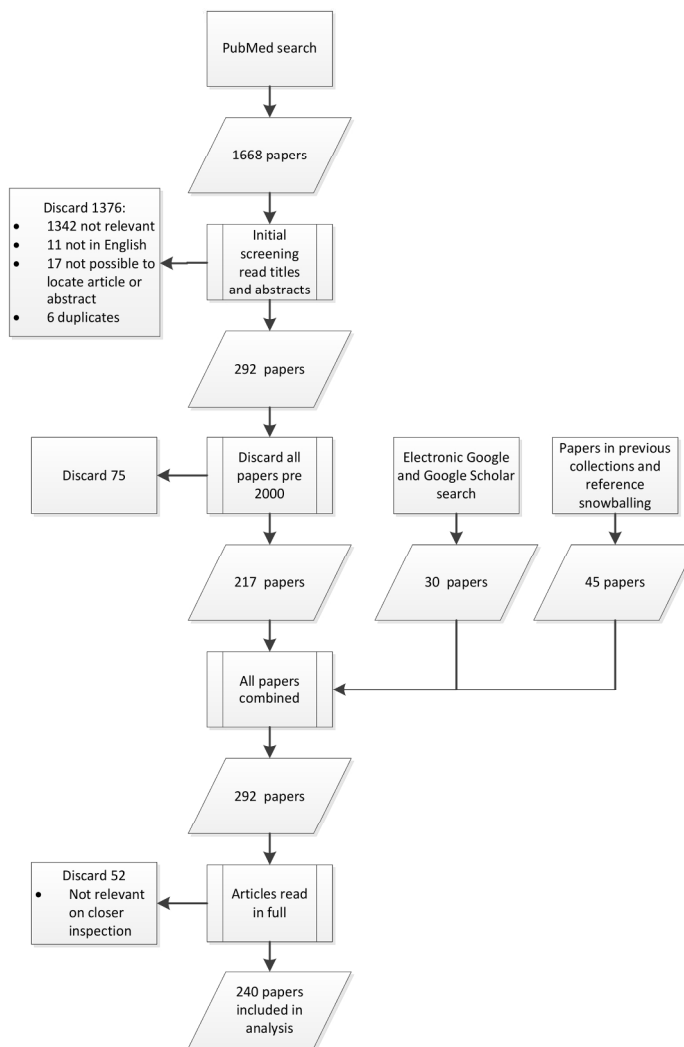


Figure 1: Search and study selection process

Figure 1

149x230mm (300 x 300 DPI)

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Supplementary file S2: Key terminology and definitions used in this synthesis

Term	Definition adopted	Examples	Comments and caveats
Health research capacity development (HRCD)	“Capacity development is defined as the ability of individuals, organisations or systems to perform appropriate functions effectively, efficiently and in a sustainable manner. When applied to health research, this translates to enabling both individuals and institutions to define health problems, set objectives and priorities, build sustainable institutions and organisations and identify solutions to key national health problems”. [1]	Conducted by a large numbers of actors including: private foundations, multi and bi-lateral funders, international organisations, consortia, research councils, universities, NGOs and Industry. Examples include Rockefeller Foundation, The Swedish International Development Agency and WHO TDR. Usually involves knowledge or resource transfer at individual, institutional or macro levels.	This definition by Magwaza et al. [1] was found to be the most straightforward and encompassing definition of health research capacity development. Although the term “capacity development” has some pejorative connotations (assumption that there is little extant capacity), in its broadest sense capacity development could involve both building new capacity and strengthening existing capacity. It also semantically links capacity development to the international development agenda.
Research system	Concept representing a system designed to coordinate and manage health research at all stages of the knowledge cycle with the goal of improving health and health equity. The research system can be conceptualised as the environment or ecosystem that research takes place in [2].	Research systems encompass health research structures, regulations, governance, ethics, infrastructure, priority setting, financial and resource planning, acquisition and allocation at national, regional or global levels [3]. They include and connect all other levels, including the supra-national level.	Research system is not to be confused with “System Level”. “System Level” is sometimes used to describe the Macro Level”.
Development modality	Modality refers to the methods or organisational setup used to deliver development interventions	May include basket funding to institutions, vertical support to projects, or horizontal capacity development, collaboration or partnerships [4].	Similar to research model. Modality is distinct from “strategy” which more specifically describes the development intervention.
Development strategy	Strategy refers to the selection and deployment of interventions aimed at resolving specific development barriers	Strategies can focussed at the individual, institutional, or macro level. Examples include training fellowships, building laboratories, or creating knowledge development platforms.	Modality is distinct from “strategy” which more specifically describes the development intervention.
Macro level capacity	The highest level of the national research system. Capacities at this level may be agenda setting, policies, national budgetary allocations, demand creation and strategic planning [5].	Government ministries such as Ministry of Health, Research or Education. Also includes regulatory and ethics bodies, funding bodies, top level administrative structures, professional associations and national registries.	Often used interchangeably with “System Level” [5]. However, this is confusing because the system encompasses individual, institutional, macro and supra-national levels.

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Institutional level capacity	Refers to the ability of institutions to fund, manage and sustain themselves to perform all tasks required to deliver their services or goals. Common institutions include: universities, hospitals, and ministerial departments.	Elements of institutions include: human resources, material resources (computers and machinery), infrastructure (libraries and laboratories), service connections (internet, water, and power), service delivery and finance and management systems.	Based on the working definitions used by The Global Forum for Health Research and the World Health Organisation as they encompass the most common conceptualisations of the term [2, 5-7].
Organisational level capacity	The capacities of individual units within and governed by "institutions".	Usually include departments or research units within universities or research divisions within ministries of health	The term "institution" is often used interchangeably with "organisation". However, differentiating between these terms is useful because it distinguishes between the wider governing institution and organisational units within institutions [8].
Individual level capacity	Individual capacity development attempts to increase the capacities of individuals to perform their work effectively	Traditionally focused on producers of research. More recently extended to other stakeholders and includes "soft" skills training such as leadership.	Based on commonly accepted definitions used by The Global Forum for Health Research and the World Health Organisation [2, 5-7].

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Supplementary file S3: Typology of capacity development actors

Actor	Examples	History	Roles	Development strategies	Research focus
Private foundations or charities	Wellcome Trust, Gates Foundation, Rockefeller Foundation	Most are relatively new to HRCD but some well-established	Funding	Mostly individual-level development to undertake specific projects. Little investment in local institutions.	Mostly support research generation but recent moves to translation
Multi-lateral agencies	World Health Organisation, World Bank, African Development Bank, Global Fund	WHO TDR & HRP are some of the oldest actors in HRCD. Most relatively new to HRCD.	Governance, stewardship, agenda setting, advocacy & funding	Usually channel funds through independent or subsidiary organisations. WHO offers individual-level development. Traditionally did not support institutions & had little system interest. However, now taking the lead in system approaches & may channel funds through local institutions.	Typically support research generation but increasing emphasis on translation, & dissemination
Bilateral agencies	Swedish International Development Agency, Department for International Development	Generally the longest running financial supporters of HRCD, but some are newer.	Varied	Usually support individual & institutional development. Little system development until very recently.	Historical focus on knowledge generation but progressively more emphasis on knowledge utilisation & dissemination
Global organisations	Global Forum for Health Research, European & Developing Countries Clinical Trial Partnership	Mostly since mid-1990s but some older. Often formed by, or as, a subsidiary of multi-laterals.	Stewardship roles set & promote global agendas. Also have multi-lateral funding brokerage roles.	Act as a catalyst to support & direct diverse actors to common goals. Usually fund & work with networks & consortia. Organise forums. Historically supported individual & institutional development but now support HRCD at most levels & modes. Provide advice & strong advocacy roles.	Originally interested in knowledge generation & translation but now tackle all stages of knowledge cycle
Consortia & networks	Alliance for Health Policy & Systems Research, International Network for Clinical Epidemiology, Central African Network on TB HIV/AIDS & Malaria	Largely a recent phenomenon forming mid-late 1990s onwards	Development, advocacy or funding brokerage roles Global, regional or local reach.	Individual & institutional support for specific projects or organisations that are thematically focussed. Not traditionally institution-wide or system development but recently more attention to those areas. Mixture of horizontal & vertical initiatives.	Collectively they cover the entire knowledge cycle but most have specific focus.
Public private partnerships & product development partnerships	Medicines for Malaria Venture, International AIDS Vaccine Initiative, Global Alliance for TB Drug Development	Largely a recent phenomenon forming mid-late 1990s onwards. Over 70 formed between 1995 & 2003.	Thematically based on disease or intervention of interest. Product development "upstream" R&D research.	Development approaches usually concentrated on building capacity to run specific studies through vertical interventions. Recently a little more attention to individual level & infrastructure development.	Knowledge generation & strong emphasis on translation

LMIC research councils & institutes of health	South African Medical Research Council, The National Research Council of Sri Lanka	Much less common than in HICs but increasing & some well-established.	Varies widely but usually in accordance with national priorities & focus on specific conditions or projects.	Funding is often limited but appears to be increasing. Formation of research sites, particularly centres of excellence. Individual & institutional development. Often in collaboration with international networks. Early moves towards system development. May also carry out own research.	Mostly knowledge generation
LMIC Governments	South Africa, Brazil, Zambia	Highly variable often according to GDP but also economic policies. Some investing a lot, others not at all. Typically only recent investments in HRCD.	Variable but usually in accordance with national priorities. May be linked to infrastructure development.	Some ministries have their own research centres & develop capacity "in house". Others provide project grants or individual development. Governments may upgrade or create research institutions. Investment value typically small due to resource constraints or low priority of research. However, some countries investing heavily. More recent attention to macro level capacities.	Varied. Knowledge generation common but recently agenda setting, stewardship, demand creation & knowledge utilisation
LMIC academic & healthcare institutions	University of KwaZulu-Natal, Makerere University, Fundação Oswaldo Cruz	Varied history. Some very well established in research but most new to HRCD. May be public or private.	Variable. Research may be in accordance with national or global priorities, or investigator interest.	Mainly undergraduate & some graduate training. Provide institutional resources for research. Development of institutions usually reliant on governmental funds, unless private. Normally training & education takes precedence over research.	Knowledge generation
HIC research councils & institutes of health	Medical Research Council (UK), NIH (USA), Canadian Institutes for Health Research, Royal Society	Institutions with a long history but only recently (around 2000) expanding their role in HRCD	Varied. But no specific remit to conduct capacity development.	Provide various funding & scholarships for individuals to undertake post graduate training. Also fund specific research projects which may include institutional development. Normally work in collaboration with institutions from donor country. Usually not system level. Some encourage scientific excellence by forming links with other LMIC societies, but do not conduct HRCD directly.	May conduct research themselves. Mostly support knowledge generation but may have smaller investments in knowledge utilisation.
HIC academic & healthcare institutions	University of Oxford, Institut Pasteur, Johns Hopkins University	A long history of research in LMICs. Some project specific HRCD but only recently taking on more explicit capacity development.	Project focused around research goals. Mostly investigator-led but may follow national priorities.	Development is usually to facilitate a specific project. May involve developing research sites & staff. Often focus on centres of excellence. Individual development either in-country or at HIC universities. System development not common. Normally partnership with local groups which increases knowledge transfer.	Mostly knowledge generation. Specific projects may target knowledge utilisation & sometimes dissemination but much rarer.

1 2 3 4 5 6	Industry	GlaxoSmithKline, IBM, local industries	Pharmaceutical companies important but IT companies increasingly involved. International & national industry involved.	Product development & innovation technologies. Mostly in Asia. Currently less reach to Africa.	Develop capacity through technology or "know how" transfer. Infrastructure strengthening, particularly IT. May fund individual training or institutional development. May also provide services at favourable rate or free. Usually work in partnership with other actors.	Knowledge generation & translation but also knowledge management. May work in other areas depending on company.
7 8 9 10 11 12 13	Non-governmental organisations (NGO)	Medicine Sans Frontiers, Drugs for Neglected Diseases Initiative, One World Health, local NGOS	Recent involvement in research & HRCD (post 2005)	Either highly applied research or product development R&D. Some work in partnerships with other actors.	Strengthen research within networks or embedded in health delivery. Usually individual or specialised institutional support. As part of civil society, have strong advocacy & moderation roles. Can mobilise resources towards non-profit activities.	All stages of knowledge cycle.
14 15 16 17 18 19 20 21 22	Academic journals	International Committee of Medical Journal Editors, Lancet, PLOS, Tanzanian Journal of Health Research	Long history of discussion on HRCD but becoming increasingly prominent in last 5 years.	Advocacy & opinion leaders. Role as moderators & amplifiers. Provide access to information & publishing.	Improve access to information & enable individuals to publish by changing publication & subscription policies. Promoting best practice & improving quality & reliability of publications. Encourage debate & advocate.	Knowledge dissemination



PRISMA 2009 Checklist

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Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	Page 1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	Pages 2-3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	Pages 5-6
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	Page 6 (end)
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	No formal protocol exists
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Section 2.1, page 7
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	Section 2.2., pages 7
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Box 1, page 8
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	Sections 2.2 & 2.3, pages 7. Also figure 1.
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	Section 2.4, pages 9
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	Section 2.4, pages 9.
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	Section 2.3. Page 8
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means)	Section 2.4,

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PRISMA 2009 Checklist

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			pages 9
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	Section 2.4, pages 9

Page 1 of 2

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	Section 4.4., pages 27, and section 3.6, pages 22
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	NA

RESULTS

Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Section 2.2., Pages 7. Figure 1.
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Section 3.2, pages 11. Table 2.
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	NA – See section 2.3, page 8.
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	NA
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	Sections 3.3. and 3.4, pages

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PRISMA 2009 Checklist

			12-22
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	NA – See section 2.3, page 8.
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	NA
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	Section 4.1, page 25, and 4.3 pages 27
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	Section 4.4, pages 28-29
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	Sections 4.2 pages 27 & 4.5 page 28
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	Funding statement, page 29

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

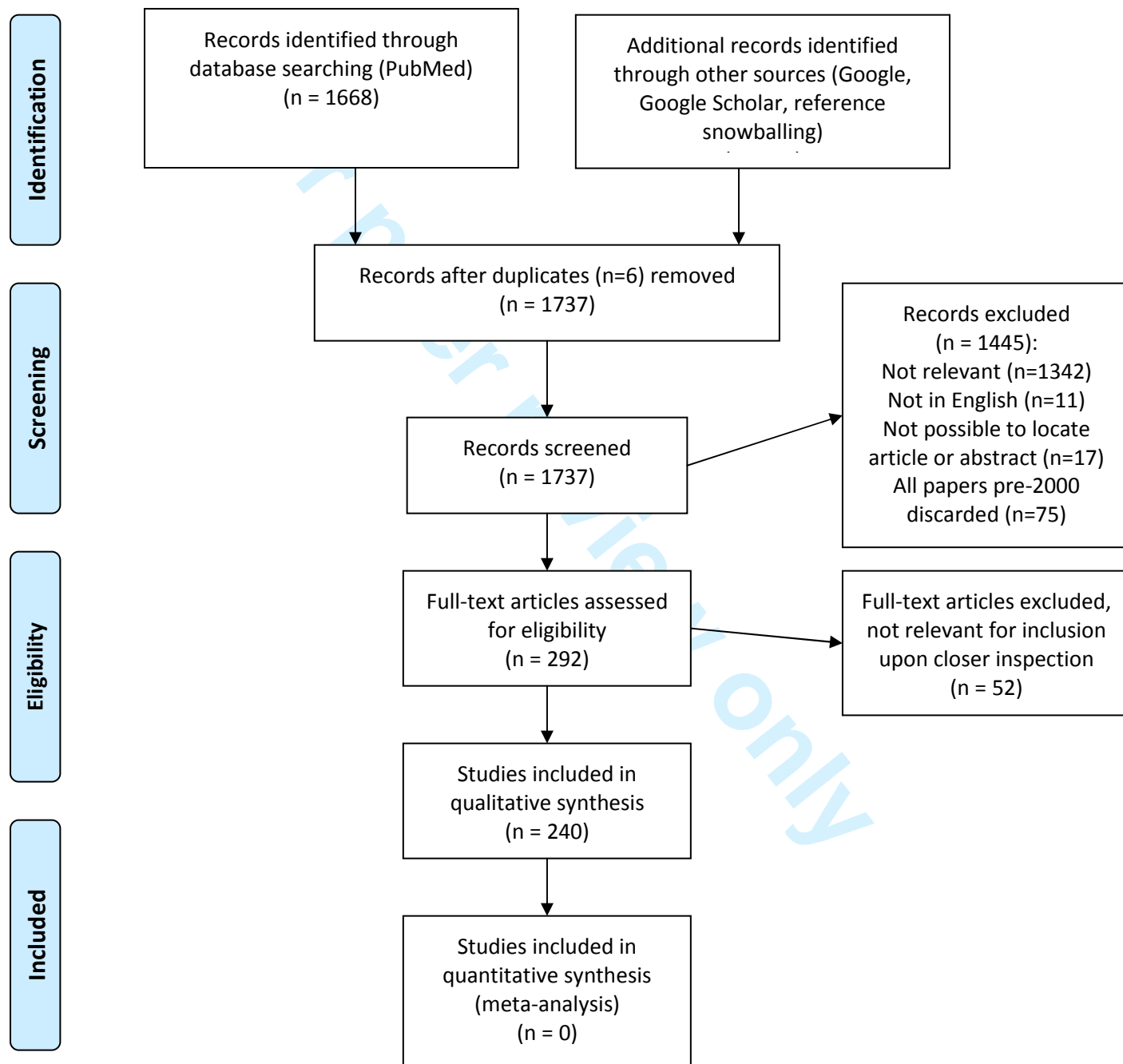
For more information, visit: www.prisma-statement.org.

Page 2 of 2

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PRISMA 2009 Flow Diagram: Health research capacity development in Low and Middle Income Countries: reality or rhetoric? A systematic meta-narrative review of the qualitative literature



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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BMJ Open

Health research capacity development in Low and Middle Income Countries: reality or rhetoric? A systematic meta-narrative review of the qualitative literature

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Keywords:	QUALITATIVE RESEARCH, TROPICAL MEDICINE, EDUCATION & TRAINING (see Medical Education & Training)

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1 Title

2 Health research capacity development in Low and Middle Income Countries: reality or
3 rhetoric? A systematic meta-narrative review of the qualitative literature

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16 Key words

17 Health Research, Capacity Development, Low and Middle Income Countries, Research
18 Systems, Clinical Trials

19 Word count

20 5653

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22 Abstract

23 **Objectives:** Locally-led health research in Low and Middle Income Countries (LMIC) is
24 critical for overcoming global health challenges. Yet, despite over 25 years of international
25 efforts, health research capacity in LMICs remains insufficient and development attempts
26 continue to be fragmented. The aim of this systematic review is to identify and critically
27 examine the main approaches and trends in health research capacity development and
28 consolidate key thinking to identify a more coherent approach.

29 **Methods:** This review includes academic and grey literature published between Jan 2000
30 and July 2013. Using a predetermined search strategy, we systematically searched
31 PubMed, hand-searched Google Scholar, and checked reference lists. This process
32 yielded 1668 papers. 240 papers were selected based on a priori criteria. A modified
33 version of meta-narrative synthesis was used to analyse the papers.

34 **Results:** Three key narratives were identified: the effect of power relations on capacity
35 development; demand for stronger links between research, policy, and practice; and the
36 importance of a systems approach. Capacity development was delivered through 4 main
37 modalities: vertical research projects, centres of excellence, North-South partnerships, and
38 networks; all were controversial and each had their strengths and weaknesses. A plurality
39 of development strategies was employed to address specific barriers to health research.
40 However, lack of empirical research and monitoring and evaluation meant that their
41 effectiveness was unclear and learning was weak.

42 **Conclusions:** There has been steady progress in LMIC health research capacity but
43 major barriers to research persist and more empirical evidence on development strategies
44 is required. Despite an evolution in development thinking, international actors continue to
45 use outdated development models that are recognised as ineffective. To realise newer
46 development thinking, research capacity outcomes need to be equally valued as research

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47 outputs. While some development actors are now adopting this dedicated capacity
48 development approach, they are in the minority.

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49 **Strengths and limitations of this study**

- 50 • This systematic review goes beyond previous attempts that lacked reflexivity, to
51 provide a nuanced, in-depth, and enquiring critique of health research capacity
52 development approaches.
- 53
- 54 • This review integrates diverse qualitative literature that largely lacked formal reporting
55 procedures or empirical base, allowing the inclusion of voices that are traditionally
56 excluded in other styles of systematic analyses.
- 57
- 58 • Some academic articles may have been missed because PubMed was the only formal
59 database used, and there was limited inclusion of evaluation and programme-level
60 data due to poor grey literature indexing in Google and Google Scholar.
- 61
- 62 • However, the meta-narrative method aims to develop overarching narratives through
63 saturation of themes, rather than include every eligible article, so inclusion of
64 additional papers would be unlikely to change the findings of the study.

1 Introduction

Locally-led health research is critical for overcoming global health challenges in Low and Middle Income Countries (LMICs) [1]. This research is needed to “propose culturally apt and cost-effective individual and collective interventions, to investigate their implementation, and to explore the obstacles that prevent recommended strategies from being implemented” [2]. Such research is now the focus of key capacity development efforts, such as the regional educational centres supported by the Special Programme for Research and Training in Tropical Diseases (TDR) [3].

However, these arguments are not new; the importance of LMIC research capacity has been recognised for well over two decades. The 1990 Commission on Health Research for Development stated that strengthening research capacity in LMICs is “one of the most powerful, cost-effective, and sustainable means of advancing health and development” [4]. This marked the beginning of a “revolution” in health research [5] where there was a surge of investment and concerted effort to conduct health research aimed at solving health problems in LMICs [6].

Nevertheless, at the turn of the millennium LMICs accounted for 85% of the world’s population, 92% of the global disease burden, but only 10% of global funding for health research was devoted to addressing these persistent health challenges [6]. Recognition of this “10/90” gap led to renewed calls for health research capacity development in LMICs and further investment [5].

Yet nearly 15 years later, many LMICs still lack sufficient health research capacity to build a local evidence-base with which to inform policy and improve population health. This was recently and profoundly described in The 2013 World Health Report which argued that “all nations should be producers and users of research as well as consumers”, noting that this was not yet the case [1].

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3 90 Therefore, despite years of international collaborations and investment, development of
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5 91 LMIC nation's capacity to address their own health problems appears enduringly
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7 92 problematic. Where there has been progress, such gains often do not appear sustainable
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9 93 without continued strong foreign support [7, 8], which is itself questionable in light of recent
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11 94 austerity and bilateral aid agency restructuring [1, 9, 10].
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14 95 Although there is a large and diverse body of literature on health research capacity
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16 96 development, it remains confusing, controversial, and poorly defined, with various
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18 97 contradictory understandings [11] and conceptualisations [1]. Since capacity development
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20 98 is now something that most research actors are expected to participate in, or at least be
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22 99 knowledgeable on [5, 12], this is problematic. To increase the likelihood of future capacity
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24 100 development efforts being effective, there is a need to take stock of past experiences and
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26 101 learn from successes and failures. Such an exercise would not only provide a unifying
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28 102 picture to appraise previous capacity development efforts, but also encourage discussion
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30 103 and reflection that could lead to fresh thinking.
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34 104 The aim of this systematic review is to identify and critically examine the main
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36 105 approaches, strategies, and trends in health research capacity development and
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38 106 consolidate key thinking in order to identify a more coherent approach. This review should
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40 107 prove useful to all stakeholders interested in learning how to undertake the complex
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42 108 business of capacity development, and will be of particular interest to actors working to
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44 109 make locally-led and sustainable health research capacity in LMICs a reality.
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110 2 Methods

111 Our systematic review followed the 6 stages of the meta-narrative methodology
112 developed by Greenhalgh *et al* [13]. The meta-narrative method is a “systematic, theory-
113 driven interpretative technique, which [was] developed to help make sense of
114 heterogeneous evidence about complex interventions applied in diverse contexts in a way
115 that informs policy” [14]. Since the Health Research Capacity Development (HRCD)
116 literature shares these characteristics, the meta-narrative method was highly suited to the
117 purposes of this study.

118 2.1 Inclusion criteria

119 This review considers the perspectives of all actors involved in HRCD that have
120 published within academic and grey literature from the year 2000 onwards. We included
121 any papers that broadly discussed HRCD or its more specific components. Papers that
122 mentioned HRCD but did not discuss the issue further were not included. Non-English
123 language publications were excluded due to lack of resources for translation. Papers
124 published before the year 2000 were initially included, but after screening it became clear
125 that paradigm shifts in global health at the turn of the millennium [5, 6] meant that much of
126 their content was not relevant to current day. Furthermore, many papers published post
127 2000 effectively summarised historically important issues. Therefore, all papers published
128 pre-2000 were excluded.

129 2.2 Search strategy and study selection

130 The search and study selection process is presented in Figure 1. We searched
131 PubMed using the search terms presented in Box 1 for all papers published up to 20 June
132 2013. This search yielded 1668 potentially relevant papers. The titles and abstracts of
133 these papers were then screened for eligibility, resulting in 1376 papers being excluded

134 based on pre-screening, with an additional 75 papers excluded after it was decided that
135 papers published before 1 January 2000 should not be included.

136

137 **Fig 1: Search and study selection process**

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139 **Box 1: Search terms used in PubMed search**

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((((((((((((((((capacity building[MeSH Terms]) OR (("developing"[Title/Abstract]) OR
"develop"[Title/Abstract]) OR "capacity"[Title/Abstract]))) OR "strengthen"[Title/Abstract])
OR "strengthening"[Title/Abstract])) AND (((developing country[MeSH Terms]) OR Africa)
OR Asia) OR Latin America))) AND (((("trial"[Title]) OR "trials"[Title]) OR "research"[Title])))
NOT clinical trial[Publication Type]) NOT informed consent[MeSH Terms]) NOT waste
management[MeSH Terms]) NOT air pollution[MeSH Terms]) NOT agriculture[MeSH
Terms]) NOT ("Na6(H2O)8(ZnAsO4)6" [Supplementary Concept] OR "K3Zn4O(AsO4)3"
[Supplementary Concept])
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141 The PubMed search was complemented by a search of Google and Google Scholar
142 using the terms “Health AND research AND capacity AND strengthening OR Building OR
143 Development”. All literature added from Google were found in the first 10 pages (n=30).
144 After the first 10 pages, no search results were relevant to the study. Literature collections
145 of the authors and other experts were also hand searched and references snowballed
146 (n=45). A total of 292 papers were read in full and considered for eligibility. Based on this
147 screening, the final synthesis involved 240 papers. The full list of papers included in this
148 review can be found in supplementary file S1.

149 Relevant papers published between June 20 2013 and December 14 2014 were
150 scanned and read to determine if the synthesis findings were still valid post-search.
151 Although there were some pertinent new articles, their content would not have changed
152 the findings of this synthesis.

153 **2.3 Quality assessment**

154 No papers were excluded based on assessment of quality because the majority of papers
155 lacked an empirical or explicit study design, and all stakeholders' views regardless of their
156 perceived validity were considered important. Furthermore, capacity development
157 discussion is inherently political and most contributions are based on personal opinion
158 informed by theoretical, ethical, or experiential standpoint. Accordingly much of it is biased.
159 Rather than attempt to remove the bias, assumptions and motivations were explicitly
160 studied to uncover authors' implicit logic, so that readers can make their own informed
161 opinion.

162 Instead of using quality criteria, similarity of arguments within the literature was used as an
163 indicator of current agreement on a topic or popularity of an idea. This allowed a
164 comprehensive analysis of all the HRCN narratives, while still highlighting and giving
165 emphasis to the most widely accepted opinions.

166 **2.4 Data extraction and synthesis**

167 To synthesise the literature, papers need to be framed within a "storyline" that recognises
168 where the contribution came from [13]. *Greenhalgh et al.*'s method explicitly catalogues
169 these storylines as "meta-narratives" [13]. Developing meta-narratives provides context to
170 contributions whose underlying assumptions and interests would otherwise be opaque.
171 Although less prescribed than a quantitative systematic review, this approach
172 pragmatically allows a plurality of ideas, recognising there may be no single correct
173 answer.

174 To ensure that source content was interpreted alongside its context, even when
175 broken into themes and narratives, a tagging system was used instead of a traditional
176 extraction form. All sources were organised in EndNote X7 (Thomson Reuters) and
177 associated citations, metadata and PDF copies of the documents were attached. These

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3 178 data were then imported into Nvivo 9 qualitative analysis software (QSR International)
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5 179 where the sources were given tags using deductive codes for key characteristics.
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7 180 Meta-narratives were then identified inductively by reading each paper and coding
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9 181 for meta-narratives where several authors in the literature discussed and presented topics
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11 182 similarly. This is an interpretive approach similar to that used in thematic coding analysis,
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13 183 where reoccurring themes that are conceptually related are grouped into concepts. Once
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15 184 the meta-narratives had been finalised they were systematically applied to all relevant
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17 185 papers. No prior theory beyond the guidance presented by Greenhalgh *et al.* [13] was
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19 186 explicitly used to help identify and categorise the meta-narratives. Instead, iterative rounds
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21 187 of open data-driven inductive coding were used.
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28 189 **2.5 Role and position of the authors**

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31 190 This systematic review was undertaken, in part, to inform the design of a larger body of
32
33 191 empirical research on health research capacity development in LMICs. All authors have
34
35 192 backgrounds in social science and global health. Initial coding was conducted by Samuel
36
37 193 Franzen, and then refined based on face-to-face discussions with other authors around the
38
39 194 coding framework and preliminary findings. The authors of this paper do not include
40
41 195 individuals from LMICs, but this paper was reviewed and commented on by individuals
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43 196 from LMICs who collaborated on and participated in the parallel empirical research, and
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45 197 discussed with other relevant experts at meetings and conferences. These team
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47 198 processes represent a deviation from the meta-narrative method presented by Greenhalgh
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49 199 *et al.* [13] because the authors did not constitute a multi-disciplinary team and input from
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51 200 external peers was largely ad hoc, rather than through regular planned inputs. These
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53 201 methodological deviations were required to enable the systematic review to feed into the
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55 202 evolving parallel empirical research.
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203 **3 Results**

204 **3.1 Definitions and actors**

205 The concept of capacity development can be confusing because there are multiple and
206 conflicting terminologies for development activities and actors. To assist the reader,
207 typologies of key definitions and development actors were produced. Supplementary file
208 S2 presents these definitions alongside reasons for adopting them, and supplementary file
209 S3 categorises and provides background to development actors' activities.

210 **3.2 Characteristics of included papers**

211 Table 1 summarises the main characteristics of the papers included in the review.
212 Based on first author characteristics, the greatest number of articles came from LMIC
213 academic and healthcare institutions (31.3%), closely followed by HIC academic and
214 healthcare institutions (29.6%). Contributions from funders were very low (0.8%), and
215 industry and civil society were absent, potentially reflecting the sampling from academic
216 databases. Europe was the greatest contributing region (32.9%) followed by Sub-Saharan
217 Africa at 23.8% and North America at 13.8%. Contributions from Latin America (2.5%),
218 Middle East (1.7%) and North Africa (0.8%) were low. Although most articles were
219 concerned with capacity development across all LMICs (42.1%), Sub-Saharan Africa
220 dominated the regional specific discussions (34.6%). The main basis for viewpoints were
221 opinion, debate or personal perspectives (34.2%); sharing experiences represented
222 21.7%, and empirical work 20.8%.

Table 1: Characteristics of papers included in this review

Category* of development actor (for first author)	%	Location of first author's institution	%	Region of interest	%	Main topic of development interest	%	Main disease of interest	%	Basis for viewpoint	%
LMIC Academic and Healthcare Institutions	31.3	Europe	32.9	All LMIC countries	42.1	Multiple broad issues discussed	24.6	Not disease specific or address multiple	72.5	Opinion, debate, perspective	34.2
HIC Academic and Healthcare Institutions	29.6	Sub Saharan Africa	23.8	Sub Saharan Africa	34.6	Individual level development	15.8	HIV	6.3	Experience report	21.7
Multi-laterals	10.4	North America	13.8	South Asia	10	Partnerships networking, consortia	15.8	Malaria	5.8	Empirical research	20.8
Consortia & Networks, NGOs and Public-Private Partnerships	8.8	South Asia	10	East Asia	6.7	Operational challenges & opportunities	11.3	Other	4.6	Literature review, summary or synthesis	7.9
Academic Journals	5.4	East Asia	9.2	All Asia	2.9	System approaches and macro level development	9.2	Mental Health and Addiction	2.5	Proceedings or conference report	7.5
LMIC Governmental	4.6	Australia	2.9	Latin America	1.7	Agenda and priority setting	6.3	Maternal Child Health and Paediatrics	2.5	Organisation document	4.6
LMIC Funders, Research Councils and Institutes of Health	4.6	Latin America	2.5	Pacific	0.8	Institution level development	5.4	Tuberculosis	2.1	News report	3.3
Bi-lateral aid agencies	2.1	Not specific	2.1	Middle East	0.8	Monitoring and evaluation	2.9	Non-communicable diseases	2.1		
HIC Research Councils and Institutes of Health	2.1	Middle East	1.7	Central Asia	0.4	Research and development	2.1	Dental or oral health	1.7		
Private Foundations or Charity Funders	0.8	North Africa	0.8			Ethics and regulations	1.7				
Industry	0	Pacific	0.4			Knowledge cycle	0.8				
Civil Society and Media	0										

* Some categories have been merged because they could not be separated

225 **3.3 Meta-narratives in health research capacity development**

226 Three key narratives ran through the literature: the effect of power relations on capacity
227 development; demand for stronger links between research, policy, and practice; and the
228 importance of a systems approach to HRCd. Each narrative is described below with
229 reference to the key papers that discussed these narratives in detail.

230 **3.3.1 Effect of power relations on capacity development**

231 The effect of power relations on capacity development was the most common narrative
232 running through the literature (present in 29% of papers). The main concerns of this topic
233 are that research agendas in LMICs are set more by international funders than by LMIC
234 institutions, and research conducted in LMICs is predominantly led by HIC researchers
235 with little involvement of LMIC individuals or institutions. This is argued to erode national
236 sovereignty [15], prevent capacity development [16, 17], and create research priorities that
237 more closely match funder agendas than countries' needs [18-20] leading to a situation of
238 "he who pays the piper calls the tune" [20, 21]. Examples include "spotlight issues", which
239 receive funding regardless of relative need [22], and "parachute" research where data is
240 collected in LMICs but all other work is conducted in HIC institutions.

241 "North-South" collaborations between HIC and LMIC research institutions are
242 considered to be better mechanisms for developing research capacity [8], but many
243 authors still thought that they comparatively disadvantage the LMIC partner [9, 12, 15].
244 The perceived situation of "treating Africa as a repository of raw materials for expatriate-
245 driven research" [9] led to the development of guidelines for research collaboration. To
246 reflect the change in approach, there was a rhetorical shift to using the term "partnership"
247 to describe collaborations that were equitable [17]. These partnerships should be built on
248 mutual trust and shared decision making, national ownership, early planning for translation
249 of research findings and development of national research capacity [17]. Importantly, it is

1
2
3 250 now expected that all partnerships should have capacity development at their forefront
4
5 251 [12]. However, despite discussion for well over a decade, a good proportion of the
6
7 252 international community still feels that partnerships are not yet equal [12, 23, 24], and they
8
9 253 cannot be until the power divide is addressed [15] because LMICs are unable to negotiate
10
11 254 for a fairer deal [15, 25, 26].

12
13
14 255 In an effort to adjust the power balance there have been conscious efforts towards
15
16 256 recognising local research capacity in LMICs [12, 20]. This change is again reflected in
17
18 257 rhetoric through the evolution of the term “capacity development” which gradually places
19
20 258 stronger emphasis on extant capacity; changing from “capacity building” to “capacity
21
22 259 strengthening” [20] to “capacity utilisation” [27], “unleashing” and “releasing” [20]. Many
23
24 260 authors now propose that research and capacity development in LMICs should be locally
25
26 261 owned and led [17, 20, 28, 29]. This is because LMIC researchers have the best
27
28 262 understanding of evidence gaps [17] and can present research to policy makers with an
29
30 263 understanding of the political and cultural context which increases the chance of evidence
31
32 264 uptake [30, 31]. Locally-led studies are also thought to be better aligned with national
33
34 265 agendas [32] and address more applied implementation topics than foreign-led research
35
36 266 [17].

37
38
39 267 Most stakeholders now agree that research and capacity development should, at a
40
41 268 minimum, include the local research community in the design and conduct of research
42
43 269 studies [33]. Development actors are also advised to be more sensitive to the power
44
45 270 dynamics they create and ensure they strengthen, not weaken, the role of national
46
47 271 governments by responding specifically to their priorities [20, 29, 34] and including the
48
49 272 “recipients” in any agenda setting [35]. However, others argue that this situation will
50
51 273 inevitably continue so long as foreign countries are the majority financers of research in
52
53 274 LMICs [36]; only through greater national investment and commitment will LMICs have a
54
55 275 stronger voice to make relations more equitable [7, 9, 37]. Nevertheless, the vast majority
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3 276 of development efforts reportedly still focus on international collaborative research
4
5 277 meaning local investigator-led studies are largely ignored [38]. This is evidenced by only 3
6
7 278 papers in this review being focussed on supporting locally-led clinical trials, compared to
8
9 279 33 papers aimed at developing international clinical trials.
10

11 280 **3.3.2 Demand for stronger links between research, policy and practice**

12
13
14
15 281 Arguments for stronger links between research, policy and practice were present in
16
17 282 16% of sources. These emerged due to concerns that much research was failing to be
18
19 283 translated into policy [25, 39], and was too narrowly conceived and disease-specific to
20
21 284 have impact [40].
22

23
24 285 Accordingly, applied fields now deemed to be highly relevant to decision makers and
25
26 286 those that promote sustainable adoption and implementation of evidence based medicine
27
28 287 have been called for [30, 41, 42]. These include health policy and systems research [43],
29
30 288 health services research [44], implementation research, and operations research [45-47].
31
32 289 These arguments formed the backbone of the WHO strategy on “research for health”
33
34 290 which “gives priority to research and innovation that has the greatest potential to improve
35
36 291 global health security, accelerate health-related development, redress health inequities
37
38 292 and help to attain the Millennium Development Goals” [48] .
39

40
41 293 Despite these discussions, much research is still regarded as uncoordinated and
42
43 294 concentrating on a few high profile diseases [49] such as the “big 3”: HIV/AIDS, Malaria
44
45 295 and Tuberculosis. Furthermore, the majority of research is critiqued as largely technology
46
47 296 development focused, even though many argue that the impact of this research is low [44]
48
49 297 and more lives could be saved by improving service delivery of existing interventions [25,
50
51 298 43, 50].
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299 3.3.3 The importance of a systems approach to capacity development

300 The importance of taking a systems approach to HRCD was discussed in 24% of
301 sources. Conceived in the 1990s and popularized after the Ministerial Summit on Health
302 Research in Mexico in 2004 [25], systems approaches to HRCD emerged in response to
303 perceived failings of capacity development targeted at only one level. Particular
304 weaknesses cited included: lack of provision for trained individuals to use their skills [6]
305 leading to “brain drain” of LMIC researchers to HICs [51, 52]; exclusively focusing on high
306 performing individuals [53] rather than strengthening local institutions to develop
307 researchers [54]; absence of national bodies to coordinate priorities, develop policy, and
308 translate evidence into action [55]; and the fragmentation of capacity development
309 activities [56, 57].

310 Proponents of systems approaches argue that for capacity development to be effective
311 and sustainable [8, 58], new approaches to addressing all three levels of the national
312 research system are needed; macro, institutional and individual [58] (for definitions of
313 these levels, please see supplementary file 2). Macro-level capacity development should
314 include: priority setting, planning and coordinating research, governance and regulation,
315 and knowledge translation and dissemination [48, 57, 59]. Individual development should
316 include a broader range of stakeholders than just research producers (e.g. policy makers,
317 administrators, medical personnel and ethics board members) and teach a wider variety of
318 skills and disciplines, particularly “soft skills” such as organisation, management and
319 leadership [55]. Institutional development should focus on the ability to generate, retain
320 and utilise individual capacity through improving curricula, training support, mentorship,
321 and research resources [60-62].

322 Although presented as a complex task with long time frames [63], taking a systems
323 approach is said to result in more dynamic capacity development that produces
324 endogenous change, greater local ownership, and removal of perennial system barriers

1
2
3 325 [20] which helps countries to effectively target their own health needs [19]. This is in stark
4
5 326 contrast to previous approaches that established parallel structures to deliberately bypass
6
7 327 local systems because they were deemed to be chronically ineffective [24]. However,
8
9 328 despite the accepted importance of research systems development, little is known about
10
11 329 how health research systems can be formed [19], there are few successful examples of
12
13
14 330 research system strengthening, and little guidance is available [64].
15

16 17 331 **3.4 A summary of modern health research capacity development** 18 19 332 **modalities** 20

21
22 333 After attempts at aligning human, material and technical capacities failed in the 1980s,
23
24 334 research models that directed funds and technology through HIC institutions became the
25
26 335 preferred HRCD mechanism [5]. These mechanisms are now the most common approach
27
28 336 to HRCD. The justification for requiring LMICs to collaborate with HICs is that knowledge
29
30 337 transfer and HIC expertise are required to achieve capacity development [65, 66].
31
32 338 However, others argue that such development models propagate inequities in research
33
34 339 and development [17, 36]. Discussions on development modalities are therefore
35
36 340 contentious. The following sections summarise the justifications, benefits, drawbacks and
37
38 341 controversies of the main development modalities.
39

40 41 42 342 **3.4.1 Vertical research projects** 43

44
45 343 One of the earliest and most persistent research models arising from the HIC fund
46
47 344 channelling mechanism was vertical research projects [5]. This involves a HIC research
48
49 345 collaborator working in a LMIC to conduct applied, normally short-term research projects
50
51 346 with narrow objectives [54]. The theoretical advantage of a vertical strategy is that it
52
53 347 maintains focus on a specific scientific mission [67]. This allows the necessary capacity to
54
55 348 be developed more rapidly and can quickly produce research outputs [5] even where
56
57 349 major expansion of R&D is required [35]. These approaches now account for the biggest
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1
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3 350 share of health research funding [58]. Examples include product development partnerships
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5 351 such as The Global Alliance for TB Drug Development, and many commercial or non-
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7 352 commercial clinical trials [68].
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10 353 HRCD is often included in these programmes, but development of capacity is usually
11
12 354 not the primary objective [59]. Rather it is designed to develop capacities that will benefit
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14 355 the successful completion of the project [60] and result in high quality research outputs
15
16 356 [54]. Vertical projects often have strong expatriate leadership and are frequently managed
17
18 357 by external institutions [54], which is argued to result in parallel structures that bypass local
19
20 358 research institutions [69]. Where individual-level development is provided, it is typically
21
22 359 short term and project specific [70].
23

24
25 360 Critics of vertical projects argue that local researchers often only have support roles
26
27 361 [16], samples may be shipped abroad for analysis [23] and there can be little investment
28
29 362 in local institutions because they are bypassed [15, 69]. Therefore when these short-term
30
31 363 projects finish, research sites and individuals are rarely left with the skills or resources to
32
33 364 run their own studies [41, 68]. Another criticism is that vertical approaches force the
34
35 365 research community to work separately on overlapping issues [71] leading to
36
37 366 fragmentation of national research systems [55].
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40
41 367 Proponents of vertical interventions are however mindful that there is a trade-off
42
43 368 between the speed and quality of research, and capacity development [72]. They argue
44
45 369 that in the case of health emergencies, investment should be made in excellent research,
46
47 370 not excellent capacity development.
48

49 371 **3.4.2 Centres of excellence**

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52 372 A common modality for developing long-term capacity to conduct advanced research in
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54 373 LMICs is “centres of excellence”. These have taken various forms, but the approach
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56 374 generally concentrates investment within a few institutions that show potential to excel and
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1
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3 375 become high quality self-sustaining sites. These models are reportedly useful because
4
5 376 they increase the likelihood of high quality research and renewed investment in an
6
7 377 otherwise challenging environment [52, 55, 73].
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9
10 378 Early forms of this concept were criticised as being “annexed” research sites,
11
12 379 effectively led and managed by expatriate staff [74]. Others argue that they create parallel
13
14 380 research structures outside of the national system that further depletes the local resource
15
16 381 pool by diverting investment and human resources towards these better funded sites [17,
17
18 382 24, 44]. More recent forms of “centres of excellence”, such as those championed by the
19
20 383 European and Developing Countries Clinical Trials Partnership, strive for greater Southern
21
22 384 leadership and better integration with local research systems [75].
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24

25 385 **3.4.3 North-South partnership**

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27

28 386 Another common development model is North-South partnerships. They are distinct
29
30 387 forms of collaboration between HIC and LMIC researchers because unlike “centres of
31
32 388 excellence”, they are usually project specific rather than institution building, and they put
33
34 389 more emphasis on sustainable research, shared leadership and mutual benefit than
35
36 390 vertical research projects. However, depending on the nature of the partnership, these
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38 391 demarcations can become blurred.
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40

41 392 Since the millennium, North-South partnerships and have been heavily promoted by
42
43 393 organisations such as The Global Forum for Health Research [6] and The European and
44
45 394 Developing Countries Clinical Trial Partnership (EDCTP) [75]. Such partnerships are said
46
47 395 to be responsible for increasing resource flows to LMICs [31] and have been advocated
48
49 396 for: increasing scientific productivity [76], training of graduates, staff exchange and
50
51 397 knowledge sharing, exposure to cutting edge technology [52], strengthening local
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53 398 education programmes and moderate levels of institutional strengthening [6, 77, 78]. This
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55 399 is argued to result in more sustainable development [54], greater cost-efficiency and a
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3 400 broader research scope than exclusively expatriate-led or locally-led research could
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5 401 achieve alone [17, 20].
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7 402 Despite their popularity, a greater proportion of the literature is dedicated to discussing
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9 403 problems with North-South partnerships than their benefits. Many authors still feel that
10
11 404 despite much guidance for entering into partnerships [12, 17, 53, 79, 80], too few benefits
12
13 405 are accrued by the Southern partner [9, 12, 23, 24, 81] because they are forced to
14
15 406 collaborate with HIC institutions to meet funding requirements [82]. Accordingly, LMIC
16
17 407 partners are reported to sometimes receive little financial benefit, go unrecognised in
18
19 408 publications, and release intellectual property rights [9, 12]. Proposed amendments to this
20
21 409 model have involved adapting partnerships to be driven by LMIC demand [60], led by the
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23 410 Southern partner [20] or supporting more South-South partnerships [28, 83].
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28 411 **3.4.4 Networks and consortia**

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30 412 Networks and consortia development models emerged in the mid-1990s. By the mid-
31
32 413 2000s they were used to tackle whole programmes of research [60] and are now very
33
34 414 popular with funders [60]. Actors adopting network models are highly diverse and can
35
36 415 sometimes be hard to separate from partnership models or vertical programmes. However,
37
38 416 they all involve linking multiple research departments, groups or institutions.
39

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41 417 Networks are considered advantageous because they encourage less-hierarchical
42
43 418 leadership and competitive and individualistic attitudes. They are therefore reportedly
44
45 419 useful for working cooperatively on shared problems at regional or global levels [84, 85].
46
47 420 Because networks facilitate information exchange and pooling of resources to achieve a
48
49 421 critical mass [86], they are seen as particularly important where groups may be isolated
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51 422 [87] or when one group alone would have insufficient capacity to address an issue [88].
52
53 423 Networks are also thought to: help focus on common research priorities [60, 89]; increase
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55 424 knowledge exchange and speed diffusion of innovations [57, 64]; and help forge long term
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relationships [5, 87], and sustainability [37, 86, 90, 91]. However, some authors point out that most networks focus on highly thematic research projects [60] and only develop capacity of individual research groups, not research systems [87].

3.5 Specific development strategies

The reviewed literature contained a multitude of development strategies targeted at all levels of the health research system; macro, institutional and individual. These are presented in Table 2 and grouped according to the barrier that they address. The research barrier groupings were identified by the authors through thematic coding of the literature content. The popularity of the development strategies are indicated as a percentage of the reviewed sources that proposed them as a solution to a health research barrier.

Table 2: Summary of capacity development strategies designed to address specific barriers to health research

Barrier to research	Strategies designed to address barriers to research	Popularity (% of sources)
Fragmented research systems	<ul style="list-style-type: none"> Undertake a situational analysis & build on existing assets [28, 29, 57, 92] Collaboratively develop research agendas with LMIC stakeholders [55, 70, 75] Create a research coordinating body or scientific councils [29, 64, 93] 	Recently gaining popularity (12%)
Insufficient research funding	<ul style="list-style-type: none"> Establish a research finance system using innovative revenue generation [52, 94, 95] Provide long-term funding & flexible grants [8, 63, 96] Advocate for funding through shared causes & engaging with the media [68, 97] 	Growing popularity (21%)
Limited use of research evidence	<ul style="list-style-type: none"> Build capacities of policy makers to demand & scrutinise research [25, 84, 98] Develop evidence repositories & use Research-to-Action-Groups as knowledge brokers to package findings appropriately [39, 99] Create knowledge translation platforms to support evidence dissemination & dialogue between research producers and users [30, 39, 64, 100] 	Consistent popularity (11%)
Limited governance & regulatory capacity	<ul style="list-style-type: none"> Work research into a legislative framework [64, 101, 102] Clarify guidelines, map review capacity, & streamline procedures [74, 103] Strengthen regulatory & ethical review capacity [42, 64] 	Growing popularity (21%)
Insufficient networking	<ul style="list-style-type: none"> Develop and share a database of researchers and their expertise [31] Utilise or develop professional networks, especially web-based communities [42, 104] Organise conferences & working groups on locally important topics [2, 105] 	Very popular (26%)
Inefficient admin & research management	<ul style="list-style-type: none"> Train management & research support staff [29, 106] Set up a research support office to help with grant management, reporting & contracts, & develop information and finance systems [20, 28, 72] Develop transparent & accountable policies & procedures [69, 107] 	Unpopular but increasing (8%)

Inadequate material capacity	<ul style="list-style-type: none"> • Upgrade libraries & journal availability and invest in laboratories [28, 91, 108] • Improve Information Technology, particularly internet [6, 78] • Ensure stable power & water supplies [108] 	Widely recognised (20%)
Insufficient human capacity with research knowledge & skills	<ul style="list-style-type: none"> • Develop LMIC university research training capacity using “train the trainer” programmes, LMIC-HIC “sandwich” courses, or visiting research fellowships [20, 70, 92, 96, 109-111] • Make research principles & skills key components of undergraduate & continuing professional medical education [37, 70, 112] • Develop a variety of research roles: nurses, data managers, statisticians, laboratory personnel, managers, data collectors [9, 63, 70, 109, 113-115] • Increase distance learning via e-technologies or e-learning resources [26, 41, 70, 116, 117] • Training in major skills gaps: data collection, data management, data analysis & statistics, GCP, laboratory skills, computer literacy & ethics [46, 51, 54, 109, 118] • Training in core capabilities: protocol development, writing for grant applications & publication, grant management & budgeting, & policy dialogue [29, 45, 55, 63, 119] 	Extremely popular (41%). Training in core capabilities less popular (15%)
Insufficient practical research experience	<ul style="list-style-type: none"> • Supplement didactic training with research “learning by doing” opportunities [40, 47, 55] • Involve more LMIC institutional staff in research projects [54] • Exchange visits to advanced research sites to update skills [120] • Pilot or small grants for early stage researchers to gain experience [53, 121] 	Fairly accepted (11%)
Too few research leaders	<ul style="list-style-type: none"> • Develop leadership, project and human resource management skills [8, 72] • Opportunities for junior staff to take responsibility within a supportive environment [20] • In collaborative projects, local staff must be involved in the entire research process [122] 	Gaining popularity (13%)
Too few mentors & role models	<ul style="list-style-type: none"> • Support mentors with long term funded positions & recognition [73, 78] • Where mentoring is not available locally, institutional partnerships/exchanges or peer mentorship can be used [9, 11, 55] 	Popular (15%)
Lack of research culture	<ul style="list-style-type: none"> • Promote academic departmental leaders based on research experience [112] • Set up a departmental committee to promote research [123] • Journal clubs & seminars to develop interest in research & critical thinking [70, 120] 	Not popular (6%)
Low motivation to conduct research	<ul style="list-style-type: none"> • Protected research time & longer term contracts [54, 76] • Re-entry grants or guaranteed jobs to encourage “brain drain” diaspora to return home [109, 110] • Higher salaries or funded research time to off-set private-practice incentives [76, 124] 	Popular (18%)

437

438 3.6 Reported success and effectiveness of development efforts

439 Broadly, authors consider capacity to conduct health research in Africa to have
 440 increased considerably since the millennium [12] with potential to leverage further gains
 441 from current efforts [59]. This is best exemplified by increases in the number of clinical
 442 trials conducted in LMICs [103, 125] with reports of enhanced trial capacity [68],

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3 443 particularly laboratories [126] and quality standards [38, 117, 127], and greater LMIC
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5 444 inclusion [106, 128]. Such institutional strengthening is also thought to have helped
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7 445 reduce brain drain in specific cases [109]. Although some countries still lag behind in
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9 446 regulatory and ethical review capacity, several publications indicate that LMICs have made
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11 447 good progress [108, 129].

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14 448 The increase in research capacity is thought to have been driven by recognition of
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16 449 the importance of health research over the last 20 years [5], a revised strategic focus [30],
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18 450 and the expansion of networks and partnerships for addressing research needs [60, 67,
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20 451 91]. However, it is not possible to attribute success to these development approaches due
21
22 452 to lack of monitoring and evaluation data; in Africa, positive outcomes in the quality and
23
24 453 quantity of published research have been recorded [60, 109, 130], but their connection to
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26 454 development inputs and outputs is not established [131]. Operational research and sharing
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28 455 of on-the-ground experiences is thought to be a useful learning resource, but with the
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30 456 exception of a few examples [42, 132], little published material on operations is thought to
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32 457 exist [133]. This is argued to make it hard to learn from previous efforts and experience
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34 458 [60] and determine why and how successes were achieved [28].

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38 459 The paucity of monitoring and evaluation data is a recognised problem [5, 58, 60],
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40 460 with authors attributing it to long time-lags to achieve objectives [11], outcomes such as
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42 461 organisational culture being difficult to measure [11], lack of commonly agreed and
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44 462 conceptually robust indicators [59, 60, 102], and most evaluation data not being published
45
46 463 [131]. To remedy this situation, guidance on planning and implementing monitoring and
47
48 464 evaluation for health research has been developed [29], and one research group provides
49
50 465 online resources to help record and share operational guidance [41].

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54 466 It was also clear from the literature that significant capacity gaps remain in many
55
56 467 LMICs. Following the example of clinical trials, authors point out that early phase studies
57
58 468 are still lacking [134] and there are too few quality research sites to meet demand [103].
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3 469 Despite increases in some capacities, translation of findings into policy is considered an
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5 470 enduringly difficult outcome [60, 135] and LMIC leadership and authorship in studies is still
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7 471 thought to be too low [43]. Reportedly insufficient political buy-in for strengthening
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9 472 investment in health research has also raised concerns over the sustainability of capacity
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11 473 development achievements [7, 8]. Some authors argue that longer term projects and
12
13 474 planning for sustainability of research staff and services is needed [103], but little literature
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15 475 explores this [63].
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476 **4 Discussion**

477 **4.1 An evolution in health research capacity development thinking**

478 This literature synthesis has objectively presented the main HRCD modalities and
479 strategies, and shows that some development actors continue to operate research models
480 that are contrary to widely accepted views of best practice e.g. ex-patriate led parallel
481 research units. Nevertheless, the literature reveals that there has been steady progress in
482 health research capacity in LMICs. Development actors have continuously reassessed
483 their approaches and have become much more reflexive of their actions. National
484 stakeholders have taken on a stronger voice and greater ownership, and are generally in a
485 more self-sufficient position.

486 Overall, development actors now agree that there is no panacea or one-size-fits-all
487 model to HRCD. Instead a plurality of solutions exists, the choice of which should be
488 determined by the specific capacities constraints and research goals of LMIC institutions.
489 However, despite progress, major barriers to health research persist, there is little
490 evidence to support decision-making, and the sustainability of HRCD achievements is
491 questionable.

492 **4.2 Health research capacity development, reality or just rhetoric?**

493 The evolution in HRCD thinking appears promising, but the literature demonstrates that
494 good HRCD practices are not always enacted. While the requirement for short term
495 projects is recognised [5], the vertical model has been the dominant model for almost 20
496 years [58]. This would indicate that vertical approaches have been used in situations that
497 would be better served by longer term systems strengthening strategies [5]. However,
498 there are far fewer programmes dedicated to implementing systems approaches to
499 capacity development. Other examples include: focusing on a few high profile diseases,

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3 500 donor-led research agendas, compulsory requirements for collaboration with HICs, setting
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5 501 up parallel structures, and fragmentary competitive research. To make the HRCD rhetoric
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7 502 a reality, there is a need to understand why research models that do not enhance or
8
9 503 potentially inhibit locally-led research remain the *modus operandi*, even though there is
10
11 504 clear agreement that they are bad practice.

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14 505 The literature findings clearly and frequently show that the persistence of flawed
15
16 506 development strategies is driven by approaching capacity development within the context
17
18 507 of a dedicated research model. This creates a trade-off between doing good research and
19
20 508 doing good capacity development. Projects prioritising good research place research
21
22 509 outputs as the primary goal and assume capacity will be developed through limited LMIC
23
24 510 involvement in research activities. This means that specific development strategies
25
26 511 designed to improve capacity are not used. This “implicit” capacity development is known
27
28 512 to be largely ineffective [63, 72], yet is it regularly used. As a result, local research
29
30 513 systems may fail to develop or deteriorate [22], and development efforts are likely to
31
32 514 become multiplicative and fragmented [60, 92], despite overlapping interests and generic
33
34 515 requirements [104].

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38 516 The other main alternative is “explicit” capacity development. This refers to research
39
40 517 projects that place more priority on capacity development and use specific strategies
41
42 518 designed to address capacity gaps. There is wide recognition that this is a superior
43
44 519 approach and is more likely to improve capacity sustainably [11, 63]. However, because
45
46 520 the research component is usually more valued by the research community, capacity
47
48 521 development receives less attention and often focusses on developing project-specific
49
50 522 capacities, not addressing systemic deficiencies. Accordingly, the capacity development
51
52 523 component often becomes “bolted-on” and *ad hoc* [11, 28]; thus making it “implicit” in
53
54 524 disguise.

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3 525 Instead, the review findings suggest that conducting research to improve health in
4
5 526 LMICs, and developing health research capacity in LMICs, must be considered two,
6
7 527 sometimes diverging objectives. Recognising this leads to a third way; “dedicated”
8
9 528 capacity development. This implies that developing local capacity is as equally valued as
10
11 529 the research outputs and should be considered as carefully as the research designs. Due
12
13
14 530 to the additional resources this requires, previous efforts have been limited to individual
15
16 531 capacity development or centres of excellence [91]. However, some capacity development
17
18 532 actors are now attempting to do this at a more systemic level. Examples include: The
19
20
21 533 Special Programme for Research and Training in Tropical Disease’s (TDR)
22
23 534 implementation research programmes [3], ESSENCE on Health Research [136], and The
24
25 535 Global Health Network [137].
26
27

28 536 **4.3 Implications for policy and practice**

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30
31 537 This systematic literature review provides an important synthesis of HRCD that should
32
33 538 prove useful for policy makers and practitioners alike. It identifies the strengths, limitations
34
35 539 and, controversies of the main development approaches and summarises strategies that
36
37 540 can be used to overcome specific research system barriers.
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39
40 541 Dedicated capacity development appears to offer the best approach for achieving the
41
42 542 WHO’s vision of all nations becoming producers and users of research [1]. However, a
43
44 543 key barrier to designing development strategies based on this thinking is the lack of
45
46 544 empirical evidence. Without operational and implementation research and quality
47
48 545 evaluation data, it is not possible to know the relative effectiveness of different
49
50 546 development strategies and difficult to predict if they will be appropriate for a given context.
51
52 547 The current experience of sharing data is a good start, but more systematic empirical
53
54
55 548 research is required. This should be done with the same rigorous attention to
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3 549 methodological design, analysis, and reporting standards as any other research
4
5 550 endeavour.
6
7

8 551 **4.4 Study strengths and limitations**

9
10 552 Previous reviews of capacity development have lacked sufficient reflexivity and
11
12 553 questioning of assumptions implicit in many strategies [40]. This systematic review
13
14 554 produced a nuanced and enquiring critique of HRCD approaches in LMICs and has
15
16 555 identified dedicated capacity development as a promising strategy for future HRCD efforts.
17
18 556 It also integrated diverse qualitative literature that largely lacked formal reporting
19
20 557 procedures or empirical base, allowing the inclusion of voices that are traditionally
21
22 558 excluded in other styles of systematic analyses.
23
24

25
26 559 Some academic articles may have been missed because PubMed was the only formal
27
28 560 database used and non-English language articles were excluded. However, the meta-
29
30 561 narrative method aims to develop overarching narratives through saturation of themes,
31
32 562 rather than include every eligible article, so using additional databases would add little to
33
34 563 the study. More problematic was the limited availability and inclusion of programme
35
36 564 evaluations and evidence supporting operational learning. While expert opinion and the
37
38 565 popularity of development strategies was presented, it was apparent that this is not a
39
40 566 reliable indicator of good development practice. Searching Google and Google Scholar,
41
42 567 hand searching literature collections, and snowballing references did identify the most
43
44 568 seminal papers, but some useful organisational documents will have been missed due to
45
46 569 poor grey literature indexing. Furthermore, most articles had a general focus or related
47
48 570 only to sub-Saharan Africa, meaning that context and research specific differences could
49
50 571 not be examined in detail. The focus of the literature on sub-Saharan Africa is likely due to
51
52 572 the high publishing rates of African authors and many papers' disease specific-focus on
53
54 573 high burden diseases of sub-Saharan Africa (HIV and Malaria). However, it may also be
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1
2
3 574 possible that the English-language search restriction excluded papers from authors
4
5 575 publishing about their region in non-English languages. Regardless, the HRCD evidence
6
7 576 gap in other developing regions is notable.
8

9
10 577 **It is also important to note that the literature search was carried out on June 20**
11
12 578 **2013, so only articles published prior to this date were included in the analysis. A**
13
14 579 **literature scan was carried out on December 14 2014 which found that the findings**
15
16 580 **were still valid up to this date. It is possible that due to the delay in publication of**
17
18 581 **this article further papers may have been published that could contribute to the**
19
20 582 **findings of this study. While this means that this systematic review may not contain**
21
22 583 **the most up-to-date literature, it is the opinion of the authors' and peer reviewers'**
23
24 584 **that the study findings continue to be valid and of important relevance to the global**
25
26 585 **capacity development community. These assertions are supported by the fact that**
27
28 586 **major health research capacity development agencies such as WHO-TDR and multi-**
29
30 587 **agency collaborations such as ESSENCE on Health Research continue to view the**
31
32 588 **issues raised in this paper as problematic. Indeed the 2016 revised version of**
33
34 589 **ESSENCE's Framework for Research Capacity Strengthening [138] reiterates the**
35
36 590 **importance of the guiding principles it set out in 2011, while a contemporary WHO-**
37
38 591 **TDR report on Key Enabling Factors in Effective and Sustainable Research**
39
40 592 **Networks [139] would suggest that these principles have not yet been achieved.**
41
42
43
44

45 593 The limited number of authors working on this review reduced the breadth of
46
47 594 perspectives involved during analysis which could have biased interpretation towards the
48
49 595 authors' particular knowledge paradigms and world views. However, this was mitigated to
50
51 596 some extent by drawing on perspectives and experiences from concurrent research
52
53 597 collaborators and participants, and seeking feedback from relevant experts at meetings
54
55 598 and conferences. While some context-specific differences in experiences were inevitably
56
57 599 raised, all individuals who were consulted considered the findings of this study to be
58
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1
2
3 600 relevant and consistent with their broad view of health research capacity development in
4
5 601 LMICs. Although it may have been desirable to have a second coder, this would not have
6
7 602 necessarily improved the validity of findings through inter-coder reliability comparisons
8
9 603 because regardless of the number of coders, the emerging coding scheme and findings
10
11 604 would always be subjective. Ensuring quality of interpretation relies, rather, on being
12
13 605 transparent in offering explanations of meanings rather than presenting definitive
14
15 606 causations, and explicitly acknowledging the subjective nature of the analysis and the bias
16
17 607 this creates. These principles were adhered to in the research process and the publication.
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21 608

22 23 609 **4.5 Conclusion**

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25
26 610 Despite gains in health research capacity and progress in development thinking, further
27
28 611 work is needed to develop sustainable health research systems in LMICs. One promising
29
30 612 option is dedicated capacity development in which capacity outcomes are as equally
31
32 613 valued as research outputs. However, more empirical research is needed to identify the
33
34 614 most effective strategies. If these issues are successfully addressed, health research in all
35
36 615 nations could become a reality, rather than just rhetoric.
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40 616

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631 The authors declare that they have no competing interests.

632 **Data sharing statement**

633 No additional data are available.

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Supplementary file captions

S1: Full list of papers included in the systematic review

S2: Key terminology and definitions used in this synthesis

S3: Typology of capacity development actors

For peer review only

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Figure 1: Search and study selection process

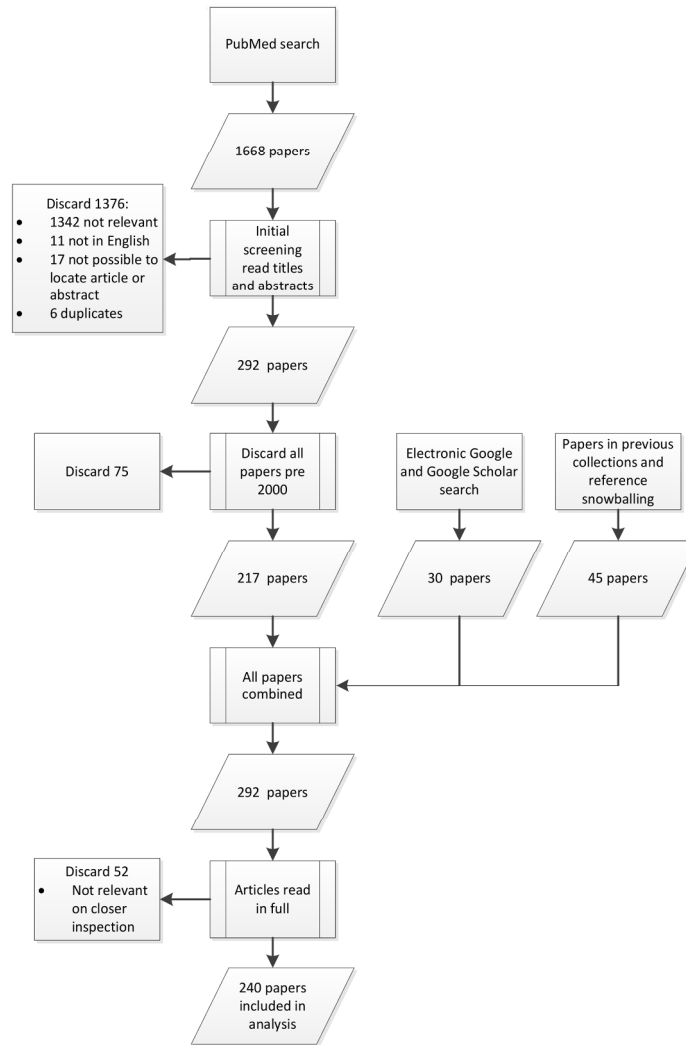


Figure 1: Search and study selection process

Figure 1

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Supplementary file S1: All papers included in the systematic review

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Supplementary file S2: Key terminology and definitions used in this synthesis

Term	Definition adopted	Examples	Comments and caveats
Health research capacity development (HRCD)	“Capacity development is defined as the ability of individuals, organisations or systems to perform appropriate functions effectively, efficiently and in a sustainable manner. When applied to health research, this translates to enabling both individuals and institutions to define health problems, set objectives and priorities, build sustainable institutions and organisations and identify solutions to key national health problems”. [1]	Conducted by a large numbers of actors including: private foundations, multi and bi-lateral funders, international organisations, consortia, research councils, universities, NGOs and Industry. Examples include Rockefeller Foundation, The Swedish International Development Agency and WHO TDR. Usually involves knowledge or resource transfer at individual, institutional or macro levels.	This definition by Magwaza et al. [1] was found to be the most straightforward and encompassing definition of health research capacity development. Although the term “capacity development” has some pejorative connotations (assumption that there is little extant capacity), in its broadest sense capacity development could involve both building new capacity and strengthening existing capacity. It also semantically links capacity development to the international development agenda.
Research system	Concept representing a system designed to coordinate and manage health research at all stages of the knowledge cycle with the goal of improving health and health equity. The research system can be conceptualised as the environment or ecosystem that research takes place in [2].	Research systems encompass health research structures, regulations, governance, ethics, infrastructure, priority setting, financial and resource planning, acquisition and allocation at national, regional or global levels [3]. They include and connect all other levels, including the supra-national level.	Research system is not to be confused with “System Level”. “System Level” is sometimes used to describe the Macro Level”.
Development modality	Modality refers to the methods or organisational setup used to deliver development interventions	May include basket funding to institutions, vertical support to projects, or horizontal capacity development, collaboration or partnerships [4].	Similar to research model. Modality is distinct from “strategy” which more specifically describes the development intervention.
Development strategy	Strategy refers to the selection and deployment of interventions aimed at resolving specific development barriers	Strategies can focussed at the individual, institutional, or macro level. Examples include training fellowships, building laboratories, or creating knowledge development platforms.	Modality is distinct from “strategy” which more specifically describes the development intervention.
Macro level capacity	The highest level of the national research system. Capacities at this level may be agenda setting, policies, national budgetary allocations, demand creation and strategic planning [5].	Government ministries such as Ministry of Health, Research or Education. Also includes regulatory and ethics bodies, funding bodies, top level administrative structures, professional associations and national registries.	Often used interchangeably with “System Level” [5]. However, this is confusing because the system encompasses individual, institutional, macro and supra-national levels.

Institutional level capacity	Refers to the ability of institutions to fund, manage and sustain themselves to perform all tasks required to deliver their services or goals. Common institutions include: universities, hospitals, and ministerial departments.	Elements of institutions include: human resources, material resources (computers and machinery), infrastructure (libraries and laboratories), service connections (internet, water, and power), service delivery and finance and management systems.	Based on the working definitions used by The Global Forum for Health Research and the World Health Organisation as they encompass the most common conceptualisations of the term [2, 5-7].
Organisational level capacity	The capacities of individual units within and governed by "institutions".	Usually include departments or research units within universities or research divisions within ministries of health	The term "institution" is often used interchangeably with "organisation". However, differentiating between these terms is useful because it distinguishes between the wider governing institution and organisational units within institutions [8].
Individual level capacity	Individual capacity development attempts to increase the capacities of individuals to perform their work effectively	Traditionally focused on producers of research. More recently extended to other stakeholders and includes "soft" skills training such as leadership.	Based on commonly accepted definitions used by The Global Forum for Health Research and the World Health Organisation [2, 5-7].

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Supplementary file S3: Typology of capacity development actors

Actor	Examples	History	Roles	Development strategies	Research focus
Private foundations or charities	Wellcome Trust, Gates Foundation, Rockefeller Foundation	Most are relatively new to HRCD but some well-established	Funding	Mostly individual-level development to undertake specific projects. Little investment in local institutions.	Mostly support research generation but recent moves to translation
Multi-lateral agencies	World Health Organisation, World Bank, African Development Bank, Global Fund	WHO TDR & HRP are some of the oldest actors in HRCD. Most relatively new to HRCD.	Governance, stewardship, agenda setting, advocacy & funding	Usually channel funds through independent or subsidiary organisations. WHO offers individual-level development. Traditionally did not support institutions & had little system interest. However, now taking the lead in system approaches & may channel funds though local institutions.	Typically support research generation but increasing emphasis on translation, & dissemination
Bilateral agencies	Swedish International Development Agency, Department for International Development	Generally the longest running financial supporters of HRCD, but some are newer.	Varied	Usually support individual & institutional development. Little system development until very recently.	Historical focus on knowledge generation but progressively more emphasis on knowledge utilisation & dissemination
Global organisations	Global Forum for Health Research, European & Developing Countries Clinical Trial Partnership	Mostly since mid-1990s but some older. Often formed by, or as, a subsidiary of multi-laterals.	Stewardship roles set & promote global agendas. Also have multi-lateral funding brokerage roles.	Act as a catalyst to support & direct diverse actors to common goals. Usually fund & work with networks & consortia. Organise forums. Historically supported individual & institutional development but now support HRCD at most levels & modes. Provide advice & strong advocacy roles.	Originally interested in knowledge generation & translation but now tackle all stages of knowledge cycle
Consortia & networks	Alliance for Health Policy & Systems Research, International Network for Clinical Epidemiology, Central African Network on TB HIV/AIDS & Malaria	Largely a recent phenomenon forming mid-late 1990s onwards	Development, advocacy or funding brokerage roles Global, regional or local reach.	Individual & institutional support for specific projects or organisations that are thematically focussed. Not traditionally institution-wide or system development but recently more attention to those areas. Mixture of horizontal & vertical initiatives.	Collectively they cover the entire knowledge cycle but most have specific focus.
Public private partnerships & product development partnerships	Medicines for Malaria Venture, International AIDS Vaccine Initiative, Global Alliance for TB Drug Development	Largely a recent phenomenon forming mid-late 1990s onwards. Over 70 formed between 1995 & 2003.	Thematically based on disease or intervention of interest. Product development "upstream" R&D research.	Development approaches usually concentrated on building capacity to run specific studies through vertical interventions. Recently a little more attention to individual level & infrastructure development.	Knowledge generation & strong emphasis on translation

LMIC research councils & institutes of health	South African Medical Research Council, The National Research Council of Sri Lanka	Much less common than in HICs but increasing & some well-established.	Varies widely but usually in accordance with national priorities & focus on specific conditions or projects.	Funding is often limited but appears to be increasing. Formation of research sites, particularly centres of excellence. Individual & institutional development. Often in collaboration with international networks. Early moves towards system development. May also carry out own research.	Mostly knowledge generation
LMIC Governments	South Africa, Brazil, Zambia	Highly variable often according to GDP but also economic policies. Some investing a lot, others not at all. Typically only recent investments in HRCD.	Variable but usually in accordance with national priorities. May be linked to infrastructure development.	Some ministries have their own research centres & develop capacity "in house". Others provide project grants or individual development. Governments may upgrade or create research institutions. Investment value typically small due to resource constraints or low priority of research. However, some countries investing heavily. More recent attention to macro level capacities.	Varied. Knowledge generation common but recently agenda setting, stewardship, demand creation & knowledge utilisation
LMIC academic & healthcare institutions	University of KwaZulu-Natal, Makerere University, Fundação Oswaldo Cruz	Varied history. Some very well established in research but most new to HRCD. May be public or private.	Variable. Research may be in accordance with national or global priorities, or investigator interest.	Mainly undergraduate & some graduate training. Provide institutional resources for research. Development of institutions usually reliant on governmental funds, unless private. Normally training & education takes precedence over research.	Knowledge generation
HIC research councils & institutes of health	Medical Research Council (UK), NIH (USA), Canadian Institutes for Health Research, Royal Society	Institutions with a long history but only recently (around 2000) expanding their role in HRCD	Varied. But no specific remit to conduct capacity development.	Provide various funding & scholarships for individuals to undertake post graduate training. Also fund specific research projects which may include institutional development. Normally work in collaboration with institutions from donor country. Usually not system level. Some encourage scientific excellence by forming links with other LMIC societies, but do not conduct HRCD directly.	May conduct research themselves. Mostly support knowledge generation but may have smaller investments in knowledge utilisation.
HIC academic & healthcare institutions	University of Oxford, Institut Pasteur, Johns Hopkins University	A long history of research in LMICs. Some project specific HRCD but only recently taking on more explicit capacity development.	Project focused around research goals. Mostly investigator-led but may follow national priorities.	Development is usually to facilitate a specific project. May involve developing research sites & staff. Often focus on centres of excellence. Individual development either in-country or at HIC universities. System development not common. Normally partnership with local groups which increases knowledge transfer.	Mostly knowledge generation. Specific projects may target knowledge utilisation & sometimes dissemination but much rarer.

1 2 3 4 5 6	Industry	GlaxoSmithKline, IBM, local industries	Pharmaceutical companies important but IT companies increasingly involved. International & national industry involved.	Product development & innovation technologies. Mostly in Asia. Currently less reach to Africa.	Develop capacity through technology or "know how" transfer. Infrastructure strengthening, particularly IT. May fund individual training or institutional development. May also provide services at favourable rate or free. Usually work in partnership with other actors.	Knowledge generation & translation but also knowledge management. May work in other areas depending on company.
7 8 9 10 11 12 13	Non-governmental organisations (NGO)	Medicine Sans Frontiers, Drugs for Neglected Diseases Initiative, One World Health, local NGOS	Recent involvement in research & HRCD (post 2005)	Either highly applied research or product development R&D. Some work in partnerships with other actors.	Strengthen research within networks or embedded in health delivery. Usually individual or specialised institutional support. As part of civil society, have strong advocacy & moderation roles. Can mobilise resources towards non-profit activities.	All stages of knowledge cycle.
14 15 16 17 18 19 20 21 22	Academic journals	International Committee of Medical Journal Editors, Lancet, PLOS, Tanzanian Journal of Health Research	Long history of discussion on HRCD but becoming increasingly prominent in last 5 years.	Advocacy & opinion leaders. Role as moderators & amplifiers. Provide access to information & publishing.	Improve access to information & enable individuals to publish by changing publication & subscription policies. Promoting best practice & improving quality & reliability of publications. Encourage debate & advocate.	Knowledge dissemination



PRISMA 2009 Checklist

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Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	Page 1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	Pages 2-3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	Pages 5-6
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	Page 6 (end)
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	No formal protocol exists
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Section 2.1, page 7
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	Section 2.2., pages 7
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Box 1, page 8
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	Sections 2.2 & 2.3, pages 7. Also figure 1.
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	Section 2.4, pages 9
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	Section 2.4, pages 9.
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	Section 2.3. Page 8
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means)	Section 2.4,

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PRISMA 2009 Checklist

			pages 9
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	Section 2.4, pages 9

Page 1 of 2

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	Section 4.4., pages 27, and section 3.6, pages 22
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	NA
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Section 2.2., Pages 7. Figure 1.
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Section 3.2, pages 11. Table 2.
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	NA – See section 2.3, page 8.
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	NA
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	Sections 3.3. and 3.4, pages

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PRISMA 2009 Checklist

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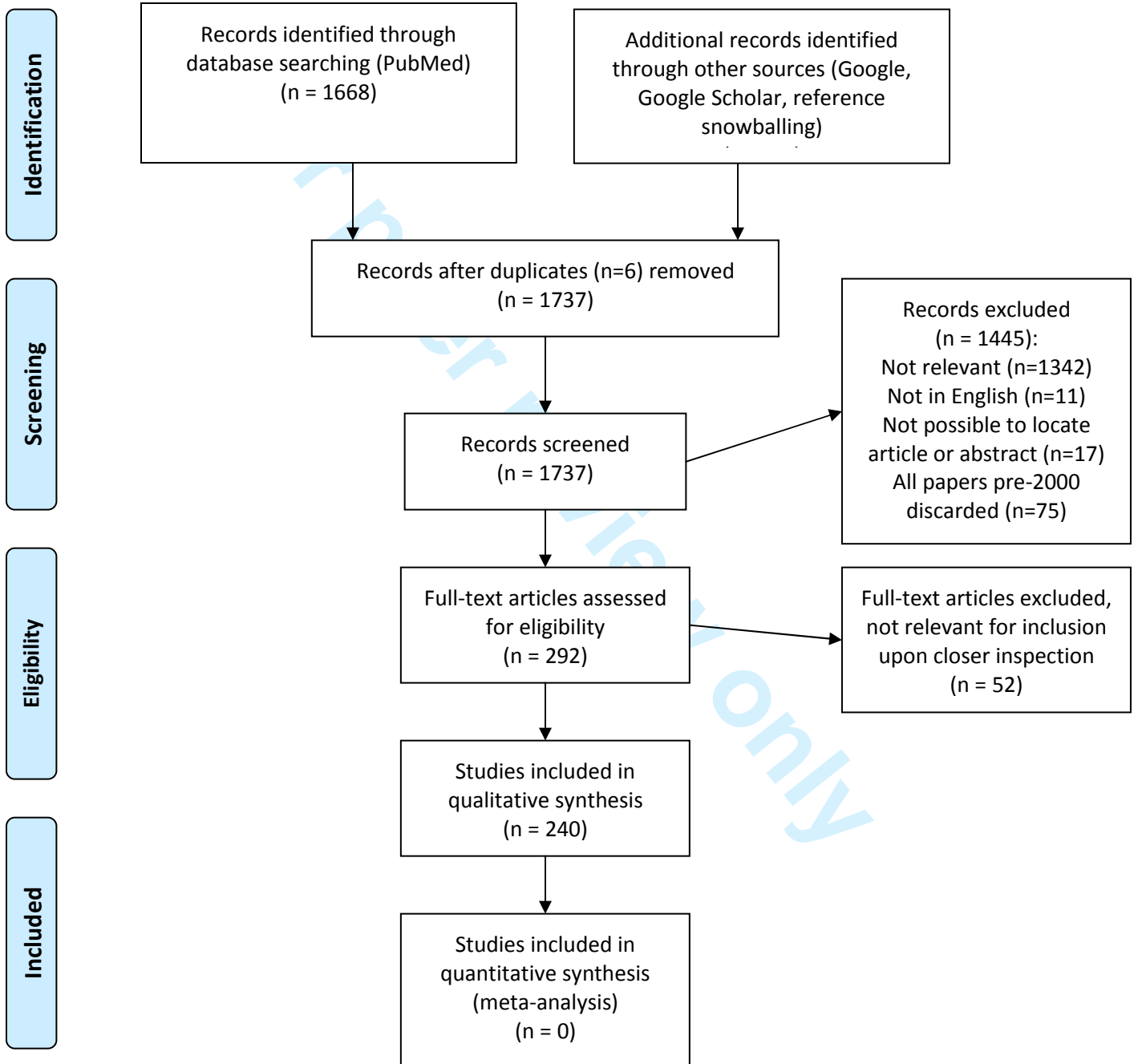
			12-22
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	NA – See section 2.3, page 8.
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	NA
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	Section 4.1, page 25, and 4.3 pages 27
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	Section 4.4, pages 28-29
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	Sections 4.2 pages 27 & 4.5 page 28
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	Funding statement, page 29

36 From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097.
 37 doi:10.1371/journal.pmed1000097

38 For more information, visit: www.prisma-statement.org.



PRISMA 2009 Flow Diagram: Health research capacity development in Low and Middle Income Countries: reality or rhetoric? A systematic meta-narrative review of the qualitative literature



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