1 **Community-based Field Implementation Scenarios of an SMS Reporting Tool for Lymphatic Filariasis**

2 **Case Estimates in Africa and Asia**

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Abstract

Background

Lymphatic filariasis (LF) is a neglected tropical disease (NTD) targeted for global elimination by 2020. Currently there is considerable international effort to scale-up morbidity management activities in endemic countries, however there remains a need for rapid, cost-effective methods and adaptable tools for obtaining estimates of people presenting with clinical manifestations of LF, namely lymphoedema and hydrocele. The mHealth tool '*MeasureSMS-Morbidity*' allows health workers in endemic areas to use their own mobile phones to send clinical information in a simple format using short message service (SMS). The experience gained through programmatic use of the tool in five endemic countries across a diversity of settings in Africa and Asia is used here to present implementation scenarios that are suitable for adapting the tool for use in a range of different programmatic, endemic, demographic and health system settings.

Methods

A checklist of five key factors and sub-questions was used to determine and define specific community-based field implementation scenarios for using the *MeasureSMS-Morbidity* tool in a range of settings. These factors included: i) tool feasibility (acceptability; community access and ownership); ii) LF endemicity (high; low prevalence); iii) population demography (urban; rural); iv) health system structure (human resources; community access); and v) integration with other diseases (co-endemicity).

Results

Based on experiences in Bangladesh, Ethiopia, Malawi, Nepal and Tanzania, four implementation scenarios were identified as suitable for using the *MeasureSMS-Morbidity* tool for searching and reporting LF clinical case data across a range of programmatic, endemic, demographic and health system settings. These include: i) urban, high endemic setting with two-tier reporting; ii) rural, high endemic setting with one-tier reporting; iii) rural, endemic setting with two-tier reporting; and iv) low-endemic, urban and rural setting with one-tier reporting.

43 **Conclusions**

44 A decision-making framework built from the key factors and questions, and the resulting four

45 implementation scenarios is proposed as a means of using the *MeasureSMS-Morbidity* tool. This

46 framework will help national LF programmes consider appropriate methods to implement a survey

47 using this tool to improve estimates of the clinical burden of LF. Obtaining LF case estimates is a vital

48 step towards the elimination of LF as a public health problem in endemic countries.

49

50 **Key Words:** Lymphatic filariasis, Morbidity mapping, SMS, mHealth, Lymphoedema, Hydrocele,

51 Community health workers

Background

53 The Global Programme to Eliminate Lymphatic Filariasis (GPELF) has two main components: to

54 interrupt the transmission of lymphatic filariasis (LF) through mass drug administration (MDA), and to

55 manage morbidity and prevent disability (MMDP) for those individuals suffering from the clinical

56 manifestations of the disease (1). As the GPELF moves towards the elimination goal of 2020, many

57 countries are scaling-up surveillance and morbidity management activities to satisfy the WHO dossier

58 components required for certification of LF elimination as a public health problem. For the MMDP

59 aspects of certification, country programmes must report information on the following: (i) the number

60 of LF patients in implementation units (IU), usually defined as a district (2); (ii) the number of facilities

61 providing the recommended package of care to IUs with known patients; and (iii) assessments of the

62 readiness and quality of care in these facilities (3). In 2014, only 24 out of 73 of endemic countries

63 (33%) reported having active MMDP components in their LF programmes and only 30 endemic

64 countries (41%) reported data on the number of lymphoedema patients (4). As there are limited

65 resources available, there is a pressing need for a rapid and adaptable tool for obtaining patient

66 estimates so that country programmes can appropriately forecast, plan and deliver a basic package of

67 care to those suffering from the disabling and debilitating clinical manifestations of LF in an affordable

68 manner.

69

70 There are a number of different methods available for obtaining patient estimates in endemic IUs;

71 these include house-to-house censuses, health facility surveys, cluster surveys, health worker and

72 community informants as well as Mass Drug Administration (MDA) and Transmission Assessment

73 Survey (TAS) registrations (3,5). The recently developed mHealth '*MeasureSMS-Morbidity*' tool offers

74 a rapid and scalable data reporting method which can be utilised to report data collected in any of the

75 aforementioned methods and can be adapted to meet country-specific requirements (6). The

76 *MeasureSMS-Morbidity* tool was developed at the Liverpool School of Tropical Medicine specifically

77 to improve and enhance national filarial disease patient estimates (6). Initially designed for use in

78   cross-sectional population surveys, the tool could also be used for ongoing reporting by health

79   facilities.

80

81   *MeasureSMS-Morbidity*' enables trained health workers to use their own mobile phones to send

82   patient data in the form of a simple short message service (SMS) to a smartphone, which is locally

83   situated and acts as a server. Provided the smartphone is connected to a mobile phone network,

84   health workers will receive an automated response to the data received; once the smartphone is

85   connected to the internet via WIFI or a local network connection, this patient information is then

86   relayed to a central cloud-based server (6). By empowering health workers, this tool gives country

87   programmes a rapid method of collecting and collating information on LF patients including their

88   location, age, gender, clinical condition (hydrocele, lymphoedema, or both), severity of the condition

89   (mild, moderate, or severe) and episodes of acute attacks. First piloted in Malawi and Ghana (7), this

90   tool has now been refined and scaled-up for programmatic use in various settings to search and report

91   cases in endemic areas across Africa and Asia, covering a population of over 30 million people. The

92   aim of this communication is to use our experiences in implementing community-based patient

93   searching in Africa and Asia to present implementation scenarios for the tool that could be utilised by

94   national LF programmes in order to scale-up searching and reporting of LF clinical cases.

95

96   **Methods**

97   **Checklist of factors**

98   Several key development factors have been used when considering the design and planning of the

99   *MeasureSMS-Morbidity* survey in any given setting. The five key factors (feasibility of the tool,

100   endemicity, population demography, health system structure, and integration with other diseases)

101   are summarised with corresponding questions in Table 1.

102

1. Feasibility of the Tool

LF programme acceptability

In-country support and logistic capacity are critical factors in deciding the feasibility and usage of an mHealth tool such as *MeasureSMS-Morbidity* for estimating patient numbers. At the country level, *MeasureSMS-Morbidity* must support the programme needs and a technical capacity must be present in-country to manage the survey for it to be both scalable and cost-effective. The availability of funds and resources is also an influencing factor in this decision due to the number of personnel that will be required to take part in the surveys.

Related questions to determine the acceptability of the tool are:

- ✓ Does the use of the tool support the programme needs?
- ✓ Are there appropriate in-country personnel to implement the survey and manage data?
- ✓ Are funds and resources available to implement the survey and SMS reporting?

Community access and ownership

As a community-led mobile phone technology tool, health worker access to and knowledge of mobile phones is essential for implementation of *MeasureSMS-Morbidity*. Mobile phone ownership at the health worker level both country-wide and in specific IUs should be anticipated. For the survey data to be successfully reported, the availability of network coverage in survey areas is an important factor in deciding how the reporting system will be structured. For instance, is it feasible to send SMS from all survey locations, or is a central reporting system needed?

Like network coverage, access to a reliable power supply is crucial in deciding the feasibility of the tool as data reporters must be able to charge their mobile phones in order to send the SMS. In areas where prolonged power cuts lasting several days are common, an mHealth tool may not be the most appropriate method of obtaining patient estimates in a pre-defined time period.

129

130   Related questions are:

131   ✓ Do health workers have access to, and knowledge of mobile phones?

132   ✓ Is there adequate network coverage in the selected IUs?

133   ✓ Are there reliable power supplies in the selected IUs?

134

135   **2. Endemicity**

136   In order to utilise available resources effectively and equitably within the LF programme, the IUs with

137   a higher level of historic endemicity should be prioritised, so that patient care can be targeted

138   effectively within these areas. Data may be collected and reported two ways, either one tier system

139   in which the healthcare worker both collects and reports the data with SMS, or a two tier system in

140   which a community healthcare worker is the data collector, and collects the data on paper forms; the

141   paper forms are delivered to a healthcare worker (supervisor) who then sends the data via SMS. If a

142   high number of patients in anticipated in an IU, a one tier reporting system may be the most

143   appropriate method due to the high number of SMS that will be required to be sent; meaning one

144   health worker will act as both the data collector and data reporter. A two tier system where a centrally

145   located health worker collates the data from multiple data collectors to send the SMS for all patients

146   in a defined area may result in a high work load for the data reporters.

147

148   In areas where the prevalence of clinical disease is likely to be low, a house-to-house survey will not

149   be cost-effective (cost per case identified). If MDA has not been implemented in these low endemic

150   IUs, then patient registration during a campaign is not possible. Therefore, a less intensive method is

151   appropriate in these areas where fewer patients are anticipated, and it may be possible to conduct a

152   survey using a team of data reporters who visit the IU and gather information through a combination

153   of health facility data, healthcare worker informants and community informants. In low endemic IUs

154 where other clinical diseases are being mapped, it may be possible to integrate the surveys so that a

155 house-to-house census can be utilised, thus reducing the risk of under-reporting.

156

157 The key questions relating to endemicity are:

158 ✓ Are the survey locations high or low endemic?

159 ✓ Is a high number of patients anticipated?

160

161 **3. Population Demography**

162 The scale and density of the population in an IU will impact the nature of the survey to obtain patient

163 estimates. In short, irrespective of endemicity, it will determine the number of data collectors and/or

164 reporters, and the length of time required to survey the population.

165

166 A large, urban population may result in health facilities having sizeable catchment populations that

167 require a vast number of man-hours to cover the catchment population. By engaging data collectors

168 as an additional tier of the reporting system, it will be possible to reach the whole population within

169 a shorter time-frame. In rural settings, where populations are more dispersed, but catchments of

170 healthcare workers are more defined, the survey time will be dependent on the length of time

171 required to physically reach the population.

172

173 Key questions related to population demography are:

174 ✓ Is the IU urban or rural?

175 ✓ Is the catchment of healthcare workers clearly defined?

176

177 **4. Health System Structure**

178 *Human Resources*

179   In planning the use of the *MeasureSMS-Morbidity* tool it is important to consider if there is an in-

180   country healthcare structure in place that can be utilised for data collecting and reporting, such as a

181   community health worker (CHW) network, and if so, how can this be harnessed. In both one- and

182   two-tier reporting systems, it is important to identify the most appropriate data collector and data

183   reporter to ensure case identification and reporting is accurate.

184

185   The key question when considering which personnel should be defined as the data collectors and

186   reporters is:

187   ✓ Is there an in-country healthcare worker structure in place that can be utilised for data

188   collection and reporting?

189

190   *Community access to healthcare*

191   The population demographics may also influence the survey design based on the relationships of the

192   health workers with the population. In urban settings, the population will have access to a greater

193   number of healthcare providers, and may access a range of healthcare facilities, in comparison to rural

194   settings, where a limited number of healthcare facilities are available to the population (8). Hence, in

195   rural areas, people are more likely to have a close relationship with the healthcare workers in their

196   local area due to repeated access. This may influence the selection of the healthcare workers who

197   will take part in the survey as it is important to select the healthcare workers that will have the greatest

198   knowledge of patients' conditions to act as the data collector. Additionally, where healthcare workers

199   have defined catchment areas, these should be utilised to harness the existing relationships between

200   healthcare workers and the catchment population, as well as the pre-existing knowledge of conditions

201   with said population. Where healthcare workers do not have a defined catchment, or catchments

202   overlap, catchments should be assigned based on population size and timeframe for the survey to

203   ensure the entire population is covered and that there is no duplication of reporting of cases.

204

205   The key question when considering the healthcare system structure in the IU is:

206   ✓ What access to healthcare do the population in the IU have?

207   ✓ Do healthcare workers have a defined catchment population?

208

209   **5. Integration with other diseases**

210   *Co-endemicity*

211   Integrated mapping of clinical disease can be cost-effective and allow for efficient use of resources.

212   Appropriate examples include LF and leprosy co-endemic areas and; LF and podoconiosis co-endemic

213   areas as exemplified in the integrated disease mapping of LF and podoconiosis in Ethiopia (9). In co-

214   endemic areas, it allows the disease to be more precisely identified. This is particularly important for

215   diseases in which the same clinical symptoms arise; for example, lymphoedema as a clinical

216   manifestation for both lymphatic filariasis and podoconiosis patients.

217

218   The key question is:

219   ✓ Can the data collection and reporting be integrated with other diseases endemic in the IU?

220

221   **Field implementation**

222   The checklist has been utilised as a programmatic tool to develop LF clinical case estimates in a total

223   of 17 IU in five LF endemic countries, to survey a total of 22 million people (table 2). The methods of

224   implementation from these IU will be reviewed.

225

226   # Results

227   **Implementation scenarios**

228   Four implementation scenarios were identified and the suitable approaches for using the

229   *MeasureSMS-Morbidity* tool; this being based on experiences of programmatic implementation in 17

230   IUs in Bangladesh, Ethiopia, Malawi, Nepal and Tanzania. Scenarios 1-3 use a house-to-house census

231   data collection method in endemic IUs, and model four implemented in low endemic IUs using active

232   case finding to locate patients. Within the four scenarios data collection and reporting that may be

233   conducted using either one- or two-tier reporting.

234

235   ***Scenario 1. High endemic, rural, one tier reporting***

236   In rural, endemic IUs with small, sparsely distributed populations in which a high number of patients

237   are expected to be reported a one-tier system can be implemented (figure 1). This scenario was

238   implemented in selected IUs in Malawi and Ethiopia. In such a system, one person acts as both the

239   'data collector' and 'data reporter'. This system can be used in the absence of an established, tiered

240   CHW system, whereby the health workers at the facility level both collect and report the data.

241

242   A one-tier system can also be implemented in IUs where CHWs have access to mobile phones with

243   adequate network and power supplies and thus are able to collect and report data by SMS. A one-tier

244   system will improve efficiency of data reporting as the CHWs will not need to report to a central

245   location with patient information.

246

247   ***Scenario 2. High endemic, rural, two tier reporting***

248   In rural, endemic areas where there is an appropriate hierarchical health worker structure in place, a

249   two-tier method of reporting can be implemented. Additionally, in some IUs, it may become apparent

250   when planning, designing and piloting the survey that there are issues with limited mobile phone and

251   SMS use for the CHWs, limited literacy or that there are network issues or power issues that limit the

252   ability of the data collectors to send the data from the field. Such scenarios require two cadres of

253   health workers to be involved in the patient searching; those who 'identify' patients in the

254   communities (data collectors) and those who use SMS to 'report' the identified patients (data

255   reporters), resulting in a two-tier reporting system (figure 2). This scenario was selected for

256   implementation in Nepal, where an existing tiered network of health workers exists.

257

258   A two-tier system can be employed where a health worker who is centrally located and has consistent

259   access to power and network coverage is more appropriate to report the data by SMS. If, however,

260   high numbers of patients are identified, in a two-tier system with a centrally located data reporter

261   would have a large workload sending the SMS for all patients. This should be considered and

262   accounted for when planning the survey, for example, increased regularity of reporting of cases by

263   the CHW data collectors to the data reporter will reduce the number of SMS that need to be sent each

264   day by the data reporters during the survey. Alternatively, increasing the number of centrally located

265   data reporters will reduce the workload of each reporter.

266

267   ***Scenario 3. High endemic, urban, two tier reporting***

268   In endemic urban IUs with large populations in which a high number of LF patients are expected to be

269   identified, there is a need for a two-tier reporting system due to the high number of data collectors

270   that are required to cover the large population (figure 3). This scenario was selected and implemented

271   in Tanzania. This enables the population to be mapped in a reasonable timescale, with a reasonable

272   workload distributed between the data collectors and data reporters, and reduced training expenses

273   due to a smaller number of health workers requiring training in reporting.

274

275   If there is not an established system of CHWs, then selected health facility workers within the IU can

276   be trained as data reporters and report cases collected by other health workers from the health

277   facility. Training a selected number of healthcare workers to act as data reporters and oversee the

278   work of the data collectors reduces training time and costs, while ensuring the survey remains

279   effective. It is appropriate to use a two-tier reporting system in urban areas to increase the reach of

280   the survey in an efficient way.

281

282 ***Scenario 4. Low endemic, urban and rural, active case finding and one tier reporting***

283 In low endemic areas where few patients are anticipated, there is a need to make the patient searching

284 both more targeted, and more cost effective. Use of a smaller team of data reporters who conduct

285 'active case finding' using health workers and community members as key informants to identify

286 patients in the IU, is the most appropriate model (figure 4). This model can be implemented in both

287 urban and rural settings, and was selected and implemented in low endemic IUs in Bangladesh.

288

289 **Discussion**

290 Following the pilot of *MeasureSMS-Morbidity* in Malawi and Ghana (7), the use of a checklist of key

291 factors and questions enabled planning and design of the most appropriate scenarios of programmatic

292 implementation of patient searching and reporting using *MeasureSMS-Morbidity* in 17 IUs in five

293 countries. Based on experiences of utilising the checklist to design and implement the four scenarios,

294 a stepwise framework has been developed using the first four key factors (figure 5). The framework

295 can be used to determine the most appropriate method of implementation in other countries or IUs,

296 and highlights the adaptability of the tool.

297

298 Integration with other disease conditions, the fifth factor, may not impact on the implementation

299 scenario as data on other conditions within the survey population can be recorded at the same time

300 as LF clinical conditions and only data for LF sent in SMS by the data reporters. When the survey is

301 integrated, the type of information that will be collected as well as the decisions that will be informed

302 by the survey data should be considered. For example, in collecting data on lymphoedema cases in LF-

303 podoconiosis co-endemic areas if the aim is to determine the prevalence of clinical disease for

304 morbidity management activities then lymphoedema only needs to be recorded and the CHWs are

305 appropriate data collectors in any implementation scenario. However, if the cause of the

306 lymphoedema is also of interest then a clinical officer may be required to make a differential diagnosis

307 of the lymphoedema and provide appropriate treatment for infection. If mapping of cases of clinical

308   disease due to LF is integrated with leprosy, the complexity of diagnosing leprosy means that CHWs

309   would be able to report suspect cases that would require follow up from a trained clinical officer, or a

310   clinical officer would need to be the data collector; if the latter is the selected model of

311   implementation, then the survey costs may increase. In cases where the data collectors and

312   implementation scenario is not impacted, integration may increase cost-effectiveness and efficiency

313   of the patient estimate surveys. Future development of the tool to enable additional diseases to be

314   reported by SMS will increase the efficiency and effectiveness of integration. Additionally, data

315   collected through an integrated survey using different approaches to those described here can be

316   extracted and sent by SMS by the data collectors.

317

318   Following the framework and considering four of the key factors, there are two main methods of data

319   collection and reporting that may be used. Firstly, the one-tier system in which the healthcare worker

320   both collects and reports the data with SMS. Secondly, a two-tier system in which a community

321   healthcare worker is the data collector, and collects the data on paper forms; the paper forms are

322   delivered to a healthcare worker (supervisor) who then sends the data via SMS.

323

324   Implementation of patient searching and reporting using *MeasureSMS-Morbidity* is not limited to the

325   four scenarios described, however these scenarios were the most appropriate and effective

326   mechanisms for implementation in the five countries tested to date. For example, where MDA is

327   implemented using house-to-house delivery, it may be possible to collect patient data during the MDA

328   registration or delivery (3,10). However, in IUs where community distribution posts are used to deliver

329   treatments to the community, using the MDA to record patient data may result in under-reporting as

330   relies on the patients presenting at the distribution posts and reporting their conditions.

331

332   A one-tier data collection and reporting mechanism, such as Scenario one is the simplest form of

333   *MeasureSMS-Morbidity*. When considering the population demographics and relationships with

334 healthcare workers, CHWs or community volunteers will often be the most appropriate personnel to

335 act as the data collector due to the closer relationships with the community. CHWs across the world

336 play a crucial role in health systems achieving their potential, regardless of a countries development

337 status (11). Integrating patient estimate surveys into these pre-existing health system structures is a

338 strength of the implementation of the *MeasureSMS-Morbidity* tool and is crucial for its feasibility and

339 success. As healthcare workers are usually already overburdened by community health activities (12),

340 it is important that the survey is timed appropriately so as not to compete with other health activities

341 and needs.

342

343 This system is feasible in rural IUs in which health workers have a defined population within the

344 catchment of their health facility. In rural scenarios, such as scenario 1, there are several factors that

345 are linked to community ownership and access which will influence whether it is appropriate for

346 health workers to be the data reporters, or to simply be the data collectors. Firstly, how familiar are

347 the local healthcare workers with sending an SMS? Experience has shown that in more rural settings,

348 SMS use is less common than in urban settings (13), and personnel may therefore need to be trained

349 in sending SMS, in addition to specifically reporting LF data through SMS. Secondly, how reliable is

350 the phone network coverage? In remote rural areas, the coverage may be limited, restricting the

351 frequency of data sending. Thirdly, how reliable is the power supply? If the survey is being

352 implemented in an IU which experiences frequent power cuts, and access to generators is limited, the

353 opportunities for charging a mobile phone will also be limited, again restricting the frequency of data

354 sending. If any of these factors are likely, then it is necessary to identify additional personnel who will

355 be more appropriate to act as the data reporters. As access to mobile phones is generally considered

356 to be greater in urban areas (14), health facility workers located in a more 'urban' area within an IU

357 with greater access to mobile phones and mobile phone network would be the appropriate data

358 reporters.

359

360   Two-tier reporting mechanisms such as Scenarios 2 and 3 will reduce the number of people that need

361   to be trained in SMS reporting, as data collectors will only need to be trained in the identification of

362   LF clinical conditions and only data reporters trained on sending the SMS. Additionally, implementing

363   a two-tier reporting system reduces the burden of the survey on healthcare service by sharing the

364   workload of data collection and reporting between healthcare workers. This is especially important

365   in areas with large population such as urban IUs, as implementing a two-tier reporting system will

366   reduce the number of households that each CHW will need to visit and therefore reduce the length of

367   time for the survey.

368

369   House-to-house census methods used in highly endemic areas provide an accurate estimate of patient

370   numbers in an IU which enables countries to effectively plan and target resources equitably. However,

371   in low endemic districts, in which low patient numbers are anticipated, it is important to have a more

372   cost- and time-effective implementation scenario, such as Scenario 4. Use of patient records, health

373   worker and community informants are all alternative methods for developing LF patient estimates.

374   Scenario 4 combines these approaches using a small team of data reporters to enable more efficient

375   data collection. This scenario is appropriate for use in IUs in which low numbers of patients are

376   anticipated. While this method is not as vigorous as house-to-house patient searching, it will enable

377   the programmes to determine the level of access to care that is required within each IU. In highly

378   endemic districts in which high numbers of patients are anticipated, this method may lead to under-

379   reporting which may lead to inadequate levels of care being planned and provided.

380

Conclusion

381

382   The *MeasureSMS-Morbidity* tool can fill the need of that can be used with different approaches to

383   obtaining patient estimates. Using the data sent through SMS, the LF programme is able to map

384   prevalence of clinical disease and identify priority areas in need of MMDP interventions, thus ensuring

385   equitable access to care. Through experiences in five countries, four recommended implementation

386   scenarios and a framework for effective application of the tool have been developed. To date, the

387   tool has been used to report LF clinical case data obtained through house-to-house census, and active

388   case finding using community and healthcare worker informants.

389

390   Key factors have been described that should be considered when planning surveys in order to

391   determine the most appropriate and effective method for each IU. While the scenarios have been

392   developed based on experiences in African and Asian LF programmes, application of *MeasureSMS-*

393   *Morbidity* is not limited to these four scenarios; it is feasible to utilise the tool to report patient

394   information obtained through other survey types.

395

396   With only 41% of LF endemic countries reporting data on LF patients, and only 14% monitoring MMDP

397   activities at the IU level [3], mechanisms to support country programmes to collect and report such

398   data at the IU level, as required to meet elimination criteria, are essential to scale up MMDP activities.

399   Reporting of LF clinical cases using *MeasureSMS-Morbidity* is an adaptable and rapid reporting system

400   that can support country programmes to develop databases of patient estimates at any geographical

401   level. As countries scale-up surveillance and MMDP activities, a tool such as *MeasureSMS-Morbidity*

402   provides a mechanism to develop patient estimate databases within LF endemic areas, thus fulfilling

403   one component of the elimination requirements.

404

405

406   **Disclosure**

407   **Ethics approval and consent to participate**

408   Ethical approval for this study was obtained from the Research Ethics Committee at the Liverpool

409   School of Tropical Medicine, UK.

410

411   **Consent for publication**

412   Not applicable.

413

414   **Availability of data and material**

415   Data sharing not applicable to this article as no numerical datasets were generated or analysed during

416   the current study.

417

418   **Competing/Conflicting interests**

419   The authors declare no competing or conflicting interests.

420

421   **Funding**

425

426   **Authors' Contributions**

427   (1) Conception and design: all authors

428   (2) Administrative support: all authors

429   (3) Provision of study material or patients: all authors

430   (4) Collection and assembly of data: all authors

431   (5) Data analysis and interpretation: all authors

432   (6) Manuscript writing: all authors

433   (7) Final approval of manuscript: all authors

434

435   **Acknowledgements**

436 The authors would like to thank the country partners in Bangladesh, Ethiopia, Malawi, Nepal and

437 Tanzania for their support in the implementation of *MeasureSMS-Morbidity* surveys which has led to

438 the development of these scenarios.

439

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487   **Figure Legends**

488   *Figure 1: patient searching and reporting scenario 1 in a high endemic, rural IU in which one-tier*

489   *reporting is implemented*

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491   *Figure 2: patient searching and reporting scenario 2 in a high endemic, rural IU in which two-tier*

492   *reporting is implemented*

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494   *Figure 3: patient searching and reporting scenario 3 in a high endemic, urban IU in which two-tier*

495   *reporting is implemented*

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497   *Figure 4: patient searching and reporting scenario 4 in a low endemic, urban or rural IU in which active*

498   *case finding and reporting is implemented*

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500   *Figure 5: Framework for decision making on the implementation model used for the MeasureSMS-*

501   *Morbidity tool*

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513   **Table Legends**

514   *Table 1: Checklist of key factors and questions to address*

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516   *Table 2: Countries, and corresponding MeasureSMS-Morbidity IUs*

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