The (Re)-emerging and EPidemic Infectious Diseases (RAPID) Stigma Scales: a cross-outbreak scale development and psychometric validation study

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SUMMARY

Reducing stigma during infectious disease outbreaks is crucial for effective outbreak response. However, no validated stigma scales exist for use across outbreaks, and outbreak-specific scales are developed too slowly to guide timely interventions.

To enable more real-time monitoring and mitigation of stigma across outbreak contexts, we developed and validated the (Re)-emerging and EPidemic Infectious Diseases (RAPID) Stigma Scales. Field-testing and psychometric validation were conducted in communities affected by Ebola disease in Uganda, mpox in the UK, and Nipah virus disease in Bangladesh. Content validity was established through cognitive interviews and expert scoring.

1,008 respondents were included across the three countries. The final RAPID Community Stigma Scale (12 items) captures initial social stigma, provider/authority-related stigma, structural stigma, and enduring social stigma. The RAPID Self Stigma Scale (4 items) is unidimensional. Both scales demonstrated robust psychometric properties, including content validity, structural validity (factor loadings ≥ 0.6), and reliability (ordinal alphas: 0.79–0.92). Higher scores on both scales predicted greater hesitancy to report symptoms and seek care.

The RAPID Stigma Scales are validated tools for real-time assessment of stigma across outbreak settings, enabling responders to design targeted interventions to improve health outcomes and promote equitable care.

KEY WORDS

Communicable diseases, emerging; Disease outbreaks; Ebola; Hemorrhagic fever; Mpox (monkeypox); Nipah virus; Outcome assessment, healthcare; Policy; Psychometrics; Public health; Social stigma; Surveys and questionnaires

KEY POINTS

- Stigma associated with infectious disease outbreaks frequently complicates outbreak control and has lasting socio-economic impacts on affected individuals and communities.
- No measure has been designed and tested for assessing stigma across infectious disease outbreaks.
- This study presents the RAPID Community and Self Stigma Scales, designed for new and re-emerging infectious diseases.
- The RAPID scales demonstrated strong psychometric properties across three outbreak contexts (mpox, Ebola, and Nipah virus disease).
- This study offers researchers, practitioners, and policymakers a robust, adaptable tool for real-time stigma assessment in outbreaks, supporting data-driven strategies to reduce stigma and enhance public health responses.

INTRODUCTION

Stigma is a pervasive challenge in new and re-emerging infectious disease outbreaks.[1,2] It repeatedly obstructs timely care-seeking, discourages participation in outbreak research, and hinders community reintegration, as seen in recent outbreaks of COVID-19, Ebola disease, mpox, Zika virus disease, Middle East respiratory syndrome coronavirus, and Nipah virus disease.[1-4] These impacts, in turn, worsen health outcomes and complicate efforts to control outbreaks.[1,2] For example, stigma associated with Ebola disease has been shown to exacerbate disease transmission by encouraging the concealment of symptoms and unsafe burial practices.[5] Addressing stigma is therefore essential—not only to improve individual and community well-being—but also as a public health priority.

Stigma occurs when an individual or group are disqualified from full social acceptance due to an attribute, in this case association with an illness, that is perceived as shameful or discrediting in their society.[6] Stigma can be broadly categorized into external, or community stigma, which is driven by the attitudes of others, and self stigma, which arises when individuals internalise these perceptions.[7] In outbreak contexts, external stigma may be further divided into initial social stigma (related to social interactions at the time of the illness), enduring social stigma (related to social interactions following recovery), provider/authority-related stigma (for example from healthcare workers or leaders), and structural stigma (which is institutionally driven or systemic).[8,9]

Despite the profound public health and community impacts of stigma, existing tools for assessing stigma during outbreaks are limited in validity and applicability.[9] Stigma scales take time to develop and validate, meaning they are often unavailable during the active phases of an outbreak.[9] For example, the median time from the start of an outbreak to the publication of a relevant stigma scale is two years.[9] While there are several outbreak-specific scales developed for the recovery phase of outbreaks, such as those related to Ebola disease survivors,[10-16] timely stigma assessment during the active phase remains lacking. Without such assessment, early opportunities to minimise or reduce stigma are missed, as public health responses cannot be tailored to address the specific stigma dynamics as they emerge during outbreaks. Additionally, most tools are either highly disease-specific or lack validation across diverse outbreak settings, further limiting their utility in guiding stigma mitigation efforts in real time.[9]

Although the focus of most existing scales has been narrow, manifestations of stigma have been noted to be similar across diseases and geographic regions,[17] creating an opportunity for more transferable solutions. Developing cross-cutting stigma scales, which avoid disease-specific silos, has long been recommended.[17] This approach has been successfully implemented for chronic diseases,[18] but comparable efforts for acute infectious disease outbreaks are lacking.

Psychometrically validated, widely-used scales have proven to be powerful tools for understanding stigma linked to other health conditions, including HIV and mental illness.[19-22] These tools have informed the design and evaluation of targeted stigma reduction interventions, strengthening the evidence base for future public health responses.[19-22] However, such scales are poorly suited to acute infectious diseases, which are characterized

by distinct phases, including active illness, and post-recovery reintegration, and infection prevention measures, such as physical distancing or quarantine. This underscores the need for tools specifically designed and validated to address the unique challenges of acute infectious disease settings, ensuring that stigma interventions are appropriately directed.

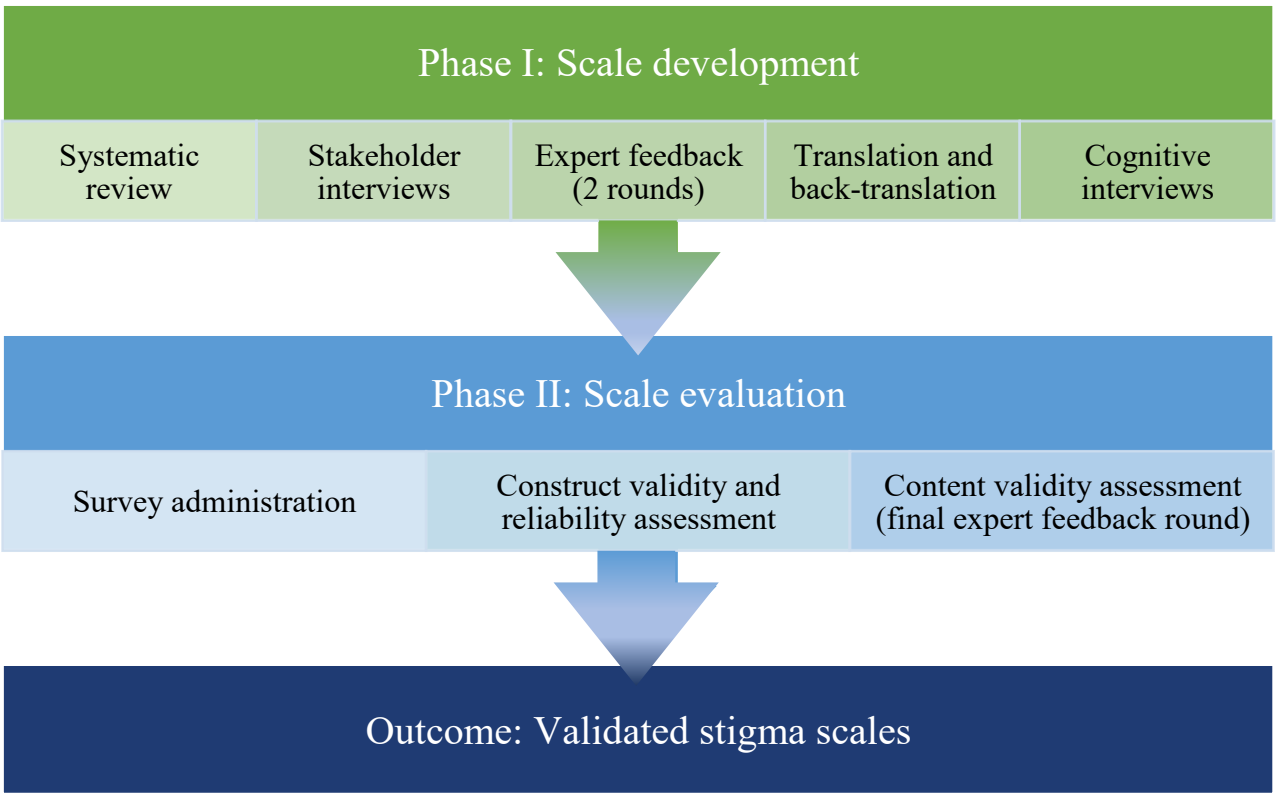
To address this need, we developed and validated the (Re)-emerging and EPidemic Infectious Diseases (RAPID) Stigma Scales. These scales are brief and transferable across a wide range of outbreak contexts. By addressing the limitations of existing tools, we provide a readily usable set of tools for stigma detection in outbreaks.

METHODS

Study design

The RAPID Stigma Scales were developed and validated in accordance with Boateng et al.'s Best Practices for Developing and Validating Scales for Health, Social, and Behavioural Research.[23] The methods involved two iterative phases (Figure 1).

Figure 1: *Overview of methods used in development and evaluation of the RAPID Stigma Scales*



Phase I: Scale development

Search strategy and selection criteria

The scale development process began with a systematic review of existing stigma scales used during infectious disease outbreaks.[9] For this review, we searched six databases (MEDLINE,

PsycINFO, CABI Global Health, Embase, Web of Science, and Cochrane Library) using terms related to "stigma," "infectious disease outbreaks," and "scale."[9] There were no language restrictions, and the search covered publications through January 31, 2023.[9] Eligible studies focused on acute outbreak diseases and scales needed, at minimum, evidence of face validity.[9] The results of this review have been published separately.[9]

Stakeholder interviews

The review was followed by in-depth interviews with 32 stakeholders with varied outbreak response experience to enhance the scale's usability and applicability across different settings. Insights from these sources, combined with health-related stigma theory,[6-8,24-26] were used to identify initial domains and potential items (see Supplementary material, page 2, for stigma variants considered in scale development).

Item generation

The initial selection and adaptation of items were conducted in discussion with eight members of the core research team, including two community co-investigators. We selected and adapted items based on three key criteria: a) conceptual relevance, b) cross-contextual applicability, and c) simplicity of language. Items were designed to be indirect or 'distanced' from the respondent (phrased in the third person) to reduce social desirability bias and sensitivity, and broaden the sampling frame, in line with stakeholder recommendations (further details in Supplementary material, page 3).

Expert feedback

Items were refined through two rounds of feedback in a Delphi process with a multidisciplinary panel of experts representing all World Health Organization (WHO) regions. Ten experts per WHO region, specialising in outbreak response and/or stigma research, identified through a literature search and institutional networks, were invited to contribute via email.

A total of 41 experts contributed to at least one feedback round (See supplementary material, page 4, for expert panel characteristics). During these rounds, experts scored the clarity, relevance, and comprehensiveness of draft items, survey instructions, and response options using a 4-point content validity index (CVI) score (e.g., relevance scored from 1 = not relevant to 4 = highly relevant) and provided qualitative feedback for lower scores. The format and items were revised following each round based on consistent feedback (Supplementary material, page 5).

Forward-back translation

The draft scale was translated into Luganda for use in central Uganda, and Bengali for use in Bangladesh, following ISPOR guidelines, including forward-back translation and reconciliation.[27]

Cognitive interviewing

Items were further refined through cognitive interviews with community members affected by Ebola disease in Uganda, mpox in the UK, and Nipah virus disease in Bangladesh. These contexts were chosen to ensure applicability across diverse geographical settings and outbreak dynamics, including variations in modes of disease transmission and case fatality

ratios. We used a combination of think-aloud and probing methods with the scales iteratively adapted until no confusion or concerns were identified (Supplementary material, page 6). Saturation was reached after 10-16 interviews per site.

Phase II: Scale evaluation

Study population and sampling strategy

We tested the scales' construct validity and reliability in the same three outbreak-affected communities they had been piloted in, namely the Ebola disease outbreak in Uganda, the mpox outbreak in the UK, and Nipah virus disease outbreak in Bangladesh. A minimum of 300 respondents were recruited per site, consistent with established recommendations for scale validation, which propose a sample size of 10 participants per scale item or 300 participants irrespective of item number as the threshold for ensuring stable factor analysis.[23,28]

We used non-random quota sampling to ensure representation of recovered persons, household members/close contacts, healthcare workers, outbreak response staff, and other affected community members. Probability sampling was considered but posed a risk of underrepresenting the most affected subgroups and constrained by logistical challenges, particularly in geographically dispersed and resource-limited settings. Quota sampling ensured inclusion of key populations, particularly those with lived experience of the disease, while addressing these constraints. This approach was deemed appropriate given the study's focus on validating the scale across diverse and heterogeneous affected populations rather than generating broader representative estimates.

Respondents were eligible if they a) were 18 years or older, b) lived in an area affected by the outbreak, c) were aware of the outbreak of concern, d) spoke a language the survey was available in, and e) were able to provide informed consent.

Recruitment and administration

Recruitment and administration methods were tailored to the context of each study site. In the UK, recruitment was conducted online via Prolific, social media, sexual healthcare professional networks, and institutional mailing lists of local HIV and LGBTQ+ organizations, as these population groups were considered most affected at the time of survey administration.[29] All UK surveys were self-administered.

In Uganda and Bangladesh, respondents were recruited through survivor support services, community leaders, village health teams, and hospital leadership. Surveys were administered by local researchers following training. During scale administration, any items that respondents had difficulty with were flagged and the reason documented. Surveys were conducted online using Research Electronic Data Capture (REDCap) when feasible, with paper-based forms used in areas with limited internet access. Data collection occurred between March and September 2024.

Statistical analysis

We conducted psychometric analyses to ensure that the RAPID Stigma Scales reliably and accurately measured the underlying stigma constructs. All analyses were conducted using R version 4.4.2 (psych, GPArotation, lavaan, semTools, and survey packages), with statistical significance set at $p < 0.05$. The psychometric properties assessed are defined in the Supplementary material, page 7.

Data cleaning and missing data

Data cleaning involved removing ineligible respondents, incomplete surveys, and responses that failed either of the two attention checks in the online version of the survey (see Supplementary Material, page 8 for details on the attention checks). Missing data were minimal (≤0.5% across all variables) and primarily from paper-based forms used in areas with limited internet access. Missingness was therefore handled using listwise deletion for all analyses.

Descriptive and response distribution analyses

We described the study population using standard descriptive statistics, summarizing continuous variables with measures of central tendency and variability, and categorical variables with frequencies and percentages.

We treated Likert-scale responses as ordinal data, and scale mean scores as continuous data. We examined response distributions and flagged items for removal if they met the following predefined criteria: floor or ceiling effects >80%, skewness outside the range of -1 to 1, absolute kurtosis >7, adjacent item endorsement frequencies <10%, or inter-item correlations >0.8 (Supplementary material, page 9-10).[30]

Internal construct validity: exploratory and confirmatory factor analyses

We randomly split the dataset into two equally sized samples for exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), ensuring equal representation of the three outbreak contexts and adequate sample size for scale validation in each. We confirmed data suitability for factor analysis using the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity, considering KMO >0.8 and a significant Bartlett's test ($p < 0.05$) as sufficient evidence of factorability.[31,32] We conducted EFA with unweighted least squares extraction to account for the ordinal nature of our data, and Promax rotation since factor correlation was anticipated, with the optimal number of factors determined by parallel analysis and the Empirical Kaiser criterion. Items with cross-loadings >0.3 or communalities <0.4 were removed one at a time and the EFA rerun after each item removal until all items had single factor loadings >0.4. 95% confidence intervals for factor loadings were obtained via bootstrapping (n = 1000) with Procrustes rotation to align factors across resamples.

We performed CFA to confirm the factor structure identified in the EFA, using the weighted least squares means and variance-adjusted (WLSMV) estimator, which is appropriate for ordinal data and non-normally distributed data. We evaluated model fit using global fit indices including the scaled comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). We also examined residual correlation matrices and modification indices to assess local fit while considering theoretical justifications to avoid overfitting. We selected the final models based on statistical fit, parsimony, and interpretability.

To assess the impact of non-random sampling, we conducted a weighted CFA for each scale using the survey package. In these sensitivity analyses, sampling weights, based on estimated population sizes for each respondent category, were applied to account for unequal selection probabilities. Fit indices and factor loadings were then compared between the weighted and unweighted models (supplementary material, page 11-12).

Reliability and external construct validity

We assessed scale internal consistency using ordinal alpha (with Cronbach's alpha and hierarchical omega reported in the supplementary material). External construct validity was assessed through regression analyses testing predefined hypotheses, including relationships between stigma scores and outcomes such as symptom-reporting hesitancy (multiple linear regression), care-seeking hesitancy (multiple logistic regression), and acceptance of recovered persons (multiple logistic regression) (measure details in Supplementary material, page 13), as well as the relationship between community and self stigma (multiple linear regression). All models controlled for covariates, including age, gender, study site, urban/rural residence, healthcare worker status, prior diagnosis, close relationships with recovered individuals, and self-reported understanding of the illness. We excluded multicollinearity by examining variance inflation factors (all were <10).

Content validity

Content validity was initially established through the comprehensive scale development process, including the systematic review, stakeholder interviews, and expert feedback. It was further ensured through the cognitive interviews, which focused on optimising end-user clarity, relevance, and comprehensiveness across study sites. To calculate final CVI scores, we invited experts who participated in both initial Delphi rounds to complete a final round, rating the face validity, relevance, and comprehensiveness of each item/scale.

Ethical considerations

This study was approved by the University of Oxford's Medical Sciences Division Ethics Committee (reference: R87722/RE004), Makerere University School of Public Health Research Ethics Committee (SPH-2024-577), Uganda National Council for Science and Technology (SS2727ES), and International Centre for Diarrheal Disease Research, Bangladesh Research and Ethical Review Committees (PR-23128). No personal data were collected, and respondents provided informed consent prior to starting the survey. The details of relevant local psychosocial support networks were provided to respondents. The expert feedback (Delphi) process was deemed exempt from formal ethical approval following consultation with the University of Oxford's Medical Sciences Division Ethics Committee, as contributors were engaged as co-developers rather than as study participants.

Patient and public involvement and engagement

Two community co-investigators—one with lived experience of mpox and one with lived experience of Ebola disease—were actively involved from the study's conceptualisation to dissemination of results. Recovered patients and members of the public from the affected communities were also included as interviewees in the stakeholder interviews and expert panellists in the Delphi process. Cognitive interviews conducted with recovered patients and public from the affected communities also helped to direct and refine the scales. Across all

sites, study plans were discussed with key community members and leaders to ensure transparency and appropriateness before initiating recruitment and data collection.

Role of the funding source
The funders were not involved in study design, data collection, data analysis, writing of the manuscript, or the decision to submit for publication.

RESULTS

Respondent characteristics

A total of 1,038 respondents started the survey across the three sites. After excluding ineligible respondents (two respondents), incomplete surveys (12 respondents), and online surveys with failed attention checks (16 respondents), a total of 1,008 eligible respondents completed the draft scale items. At the interviewer-administered sites, three potential respondents declined to participate due to time constraints. Respondent characteristics are detailed in Table 1.

Table 1: Characteristics of respondents who completed the RAPID Stigma Scales across the three study cohorts

	Uganda (Ebola, N = 302)	**UK** (mpox, N = 406)	**Bangladesh** (Nipah, N = 300*)	**Total** (N = 1008*)
Age				
Median (IQR), [range], N	32 (13), [18-76], 302	32 (14), [18-78], 406	36 (13), [18-78], 298	33 (14), [18-78], 1006
Gender				
Woman	159/302 (52.6)	69/406 (17.0)	146/296 (49.3)	374/1004 (37.3)
Man	143/302 (47.4)	288/406 (70.9)	150/296 (50.7)	581/1004 (57.9)
Other[#]	0/302 (0.0)	49/406 (12.1)	0/296 (0.0)	49/1004 (4.9)
Nature of residence				
Urban	130/302 (43.0)	264/406 (65.0)	103/300 (34.3)	497/1008 (49.3)
Rural	172/302 (57.0)	142/406 (35.0)	197/300 (65.7)	511/1008 (50.7)
Proximity to illness[&]				
Personal lived experience of illness	51/302 (16.9)	13/406 (3.2)	30/300 (10.0)	94/1008 (9.3)
Close relationship with someone who had illness	208/302 (68.9)	37/406 (9.1)	81/300 (27.0)	326/1004 (32.5)
Healthcare worker	49/302 (16.2)	112/406 (27.6)	60/300 (20.0)	221/1008 (21.9)

Outbreak support staff	61/302 (20.2)	18/406 (4.4)	30/300 (10.0)	109/1008 (10.8)
Other community member	55/302 (18.2)	262/406 (64.5)	115/300 (38.3)	494/1008 (49.0)
Self-reported understanding of disease				
Heard of it but don't know details	39/302 (12.9)	162/406 (39.9)	162/299 (54.2)	363/1007 (36.0)
Know basic details	152/302 (50.3)	212/406 (52.2)	111/299 (37.1)	475/1007 (47.2)
Know more than the basics	111/302 (36.8)	32/406 (7.9)	26/299 (8.7)	169/1007 (16.8)

*This table presents demographic and contextual characteristics of respondents who participated in the validation of the RAPID Stigma scales across the three study sites. Data are count/total (valid %). *Denominators vary with completeness of the data. N = total respondents, IQR = interquartile range, [&]respondents may be included in more than one category, [#]In the UK cohort this included 43 respondents who identified as non-binary and two respondents who selected prefer not to say.*

Exploratory analyses and development of the final RAPID scales

Twenty-four draft scale items were field-tested (Supplementary material, page 9-10). After iterative analysis, 12 items were retained for the RAPID Community Stigma Scale and four items retained for the RAPID Self Stigma Scale (Table 2).

Table 2: Final RAPID Community and Self Stigma Scale structure, items, and response options

Item No.	**Item**: People who have [X disease] are…	3 = Yes	2 = Probably	1 = Unlikely	0 = No
RAPID Community Stigma Scale					
Initial social stigma					
C1	looked down on	☐	☐	☐	☐
C2	gossiped about	☐	☐	☐	☐
C3	treated unkindly by the public (including online/on social media)	☐	☐	☐	☐
Provider/authority-related stigma					
C4	negatively judged by healthcare workers	☐	☐	☐	☐
C5	portrayed negatively in the media	☐	☐	☐	☐
C6	spoken about negatively by politicians	☐	☐	☐	☐
Structural stigma					
C7	denied certain rights	☐	☐	☐	☐
C8	at risk of losing work or education opportunities	☐	☐	☐	☐
C9	not welcome in certain places after recovery	☐	☐	☐	☐
Enduring social stigma					

C10	likely to have more difficulty finding a partner after recovery	☐	☐	☐	☐
C11	at risk of losing customers after recovery if they have a business	☐	☐	☐	☐
C12	rejected by their community	☐	☐	☐	☐
	RAPID Self Stigma Scale				
S1	Going to try to keep the diagnosis a secret	☐	☐	☐	☐
S2	Ashamed of the diagnosis	☐	☐	☐	☐
S3	Hesitant to seek medical care for their illness	☐	☐	☐	☐
S4	Likely to believe they deserved the illness	☐	☐	☐	☐

Scale instructions read 'Please answer the questions based on what you have experienced, seen, or heard in your community [in a defined time period appropriate for the outbreak and research aim]. For this survey, your community means all the people you regularly interact with.'

Three of the initial 24 items were excluded due to repeated clarity concerns raised during data collector debriefing sessions. An additional item was removed due to concerns about cross-contextual relevance and a correlation exceeding 0.8 with a more broadly applicable item (Supplementary material, page 10). All other items had acceptable response distributions.

The correlation matrix revealed conceptually distinct clusters among the community stigma items, while self stigma items displayed broader correlations (Supplementary material, page 14). This pattern aligned with the conceptualization of self stigma as a distinct construct stemming from community stigma, rather than as a subdomain within it. Consequently, we analysed the community stigma and self stigma items separately.

A significant Bartlett's test of sphericity and a KMO > 0.8 for both the community and self stigma EFA datasets confirmed their suitability for EFA (Supplementary material, page 15). Guided by the preliminary factor number analyses, EFA yielded a stable and interpretable four-factor, 12-item model for community stigma after five iterations and four-item self stigma model after two iterations (Supplementary material, page 15-17).

Construct validity and reliability

CFA and model comparison analyses supported a second-order model for community stigma (CFI (scaled) = 0.99, RMSEA = 0.04 (90% CI: 0.02–0.05), SRMR = 0.04) and unidimensional model for the self stigma model (CFI (scaled) = 1.00, RMSEA = < 0.01 (90% CI: 0.00-0.08), SRMR = 0.01) which was consistent with the *a priori* conceptual framework (see Supplementary material, page 18, for path diagrams, and page 19 for model comparisons). The fit indices remained acceptable when examined separately for the three sites (Supplementary material, page 20). Both scales demonstrated good internal structural validity (Table 3). Item-level statistics for each study cohort are available in the Supplementary material, page 21-22.

Table 3: Item-Level Descriptive Statistics and Validity Indicators for the Final RAPID Community and Self Stigma Scales

Item: People who have [X disease] are…	**mean (SD);** **median (range)**	**est.std (95% CI)**	**R^2**	**r-CVI**
RAPID Community Stigma Scale				
F1: Initial social stigma	1.85 (0.86); 2 (0-3)	0.80 (0.74-0.85)	0.63	0.98
C1: looked down on	1.79 (1.11); 2 (0-3)	0.76 (0.70-0.82)	0.58	1.00
C2: gossiped about	2.10 (1.00); 2 (0-3)	0.64 (0.58-0.71)	0.42	0.97
C3: treated unkindly by the public (including online/on social media)	1.65 (1.07); 2 (0-3)	0.82 (0.77-0.88)	0.68	0.97
F2: Provider/authority-related stigma	0.96 (0.84); 1 (0-3)	0.69 (0.64-0.75)	0.48	0.90
C4: negatively judged by healthcare workers	0.78 (0.95); 0 (0-3)	0.72 (0.65-0.79)	0.52	0.91
C5: portrayed negatively in the media	1.18 (1.12); 1 (0-3)	0.87 (0.82-0.92)	0.76	0.91
C6: spoken about negatively by politicians	0.92 (1.00); 1 (0-3)	0.78 (0.72-0.84)	0.61	0.88
F3: Structural stigma	1.36 (0.92); 1.33 (0-3)	0.89 (0.85-0.94)	0.80	0.96
C7: denied certain rights	1.21 (1.08); 1 (0-3)	0.80 (0.76-0.84)	0.70	0.97
C8: at risk of losing work or education opportunities	1.47 (1.07); 2 (0-3)	0.88 (0.85-0.92)	0.78	0.97
C9: not welcome in certain places after recovery	1.42 (1.07); 2 (0-3)	0.84 (0.80-0.87)	0.64	0.94
F4: Enduring social stigma	1.42 (0.97); 1.67 (0-3)	0.89 (0.86-0.93)	0.80	0.93
C10: likely to have more difficulty finding a partner after recovery	1.52 (1.10); 2 (0-3)	0.86 (0.83-0.90)	0.75	0.94
C11: at risk of losing customers after recovery if they have a business	1.55 (1.10); 2 (0-3)	0.88 (0.85-0.91)	0.78	0.88
C12: rejected by their community	1.20 (1.08); 1 (0-3)	0.86 (0.82-0.89)	0.73	0.97
Overall	1.40 (0.72), 1.42 (0-3)	NA	0.66	0.94
RAPID Self Stigma Scale				
S1: going to try to keep the diagnosis a secret	1.51 (1.14); 2 (0-3)	0.78 (0.73-0.83)	0.61	0.97
S2: ashamed of the diagnosis	1.47 (1.17); 2 (0-3)	0.82 (0.78-0.86)	0.67	1.00
S3: hesitant to seek medical care for their illness	1.36 (1.12); 2 (0-3)	0.77 (0.72-0.82)	0.59	1.00
S4: likely to believe they deserved the illness	0.86 (0.96); 1 (0-3)	0.60 (0.54-0.67)	0.36	0.94
Overall	1.30 (0.85); 1.5 (0-3)	NA	0.56	0.98

Mean, standard deviation (SD), median, and range are reported for each item, reflecting responses on a 4-point Likert scale (3 = Yes, 2 = Probably, 1 = Unlikely, 0 = No). Standardised factor loading estimates (est.std) with 95% confidence intervals (CI) are based on confirmatory factor analysis, with squared multiple correlations (R^2) indicating variance explained. The relevance content validity index (r-CVI) reflects expert ratings from the final panel of 34

experts; factor and overall scores are calculated as the mean (SD) and median (range) of all relevant items within each scale.

Residual correlations were generally small in both models, with two exceeding 0.10 but remaining below 0.15 in the community stigma model, and none exceeding 0.10 in the self stigma model (Supplementary Material, page 23). All modification indices were below 15, suggesting no major local misfit, and no model adjustments were required based on theoretical considerations.

In the sensitivity analyses, the weighted CFA models still met key strong fit thresholds (CFI > 0.95; RMSEA < 0.05), and all factor loadings remained above 0.5, suggesting that the non-random sampling had limited impact on the scale validity findings (Supplementary material page 11-12).

In terms of reliability, both scales demonstrated good internal consistency (ordinal alpha: 0.79–0.90 for Community Stigma subscales; 0.83 for Self Stigma) (Table 4). Additional reliability metrics are presented in Supplementary material, page 24.

Multiple regression supported the hypothesised relationships with behavioural outcomes, providing evidence of external construct validity. Higher scores on both scales predicted greater symptom-reporting hesitancy (community: $\beta = 0.21$, $p < 0.001$; self: $\beta = 0.19$, $p < 0.001$) and care-seeking hesitancy (community: OR = 1.63, $p < 0.001$; self: OR = 1.71, $p < 0.001$). Higher community stigma also significantly predicted lower acceptance of recovered persons ($\beta = -0.22$, $p < 0.001$) and higher self stigma ($\beta = 0.72$, $p < 0.001$) (Table 4, Supplementary material, page 25-30).

Table 4: Psychometric properties of the final RAPID Community and Self Stigma Scales

Psychometric property	*Criteria for acceptability*	**Community Stigma Scale (F1, F2, F3, F4)**	**Self Stigma Scale**
Content validity			
Face validity*	*> 0.8*	0.97	1.00
Relevance (r-CVI)	*> 0.8*	0.94	0.98
Comprehensiveness (c-CVI)	*> 0.8*	0.97	1.00
Clarity content validity	*Adequate: Assessed qualitatively through cognitive interviews*		
Internal construct validity			
Model fit (CFI scaled)	*> 0.95*	0.99	1.00
RMSEA (90% CI)	*< 0.06 (0.00-1.00)*	0.04 (0.02-0.05)	< 0.01 (0.00-0.08)
SRMR	*< 0.08*	0.04	0.01
Average variance extracted	*> 0.5*	0.68 (0.56, 0.63, 0.71, 0.75)	0.56
External construct validity			
Multiple linear regression → ***Symptom-reporting hesitancy*** β coefficient (95% CI), p-value	*> 0; p<0.05*	0.21 (0.15, 0.27), p<0.001	0.19 (0.13, 0.24), p<0.001

Multiple logistic regression → ***Care-seeking hesitancy*** Odds ratio (95% CI), p-value	*> 0; p<0.05*	1.63 (1.22, 2.19), p<0.001	1.71 (1.33, 2.21), p<0.001
Multiple linear regression → ***Social acceptance of recovered persons*** β coefficient (95% CI), p-value	*< 0; p<0.05*	-0.22 (-0.32, -0.12), p<0.001	NA
Multiple linear regression → ***Self stigma*** β coefficient (95% CI), p-value	*> 0; p<0.05*	0.72 (0.66, 0.77), p<0.001	NA
Reliability			
Internal consistency (ordinal alpha)	*0.70-0.95*	0.92 (0.79, 0.83, 0.88, 0.90)	0.83

**Face validity score = proportion of respondents who scored the statement "On face value, these items seem like a valid measure of external community stigma/self stigma" 3 (mostly agree) or 4 (strongly agree) on a 4-point Likert scale, r-CVI = relevance content validity index (average); c-CVI = comprehensiveness content validity index (average); CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; CI = Confidence interval; SRMR = Standardised Root Mean Square Residual; F1 = initial stigma subscale; F2 = provider/authority-related stigma subscale; F3 = structural stigma subscale; F4 = enduring stigma subscale; → = dependent variable*

DISCUSSION

This study introduces the RAPID Community and Self Stigma Scales, a set of tools developed and validated to identify stigma and support stigma reduction during new and re-emerging infectious disease outbreaks.

In contrast to existing outbreak stigma measures, which are tailored to specific diseases or cultural settings, the RAPID scales are explicitly designed to be transferable across a range of outbreak contexts. This is an important advancement because the initial phases of an outbreak are when stigma is often overlooked in the urgency of outbreak containment. However, this is also when stigma tends to be most severe and harmful due to heightened isolation and fear,[33,34] exacerbating psychological distress and discouraging care-seeking. By identifying stigma early, the RAPID scales can help mitigate these effects by enabling more timely and appropriate interventions. The scales may also be valuable in the later phases of an outbreak to evaluate the effectiveness of stigma reduction programmes or policies.

Cross-outbreak tool design offers several practical advantages. Infectious disease outbreaks often occur unexpectedly and are typically short-lived, despite their considerable impact. As a result, stigma tools developed during an outbreak are usually too late to inform timely interventions or lack validity if created hastily.[2,9] In contrast, reusing tools across outbreaks provides an opportunity for ongoing validation.

Moreover, outbreak response teams face limited resources and competing priorities, making it challenging to develop new tools during a crisis.[2] The approach used to develop the RAPID scales mirrors other areas of pandemic preparedness, such as vaccine development for

"disease X".[35] This allows work to be carried out ahead of outbreaks to facilitate fast, evidence-based interventions when they occur.[36]

The RAPID scales demonstrated robust psychometric properties, including strong content and construct validity, internal consistency, and predictive validity, in three geographically and culturally diverse contexts: mpox in the UK, Ebola disease in Uganda, and Nipah virus disease in Bangladesh. This is an improvement on existing stigma scales, which have not been validated across more than two outbreak contexts.[9] The scales are validated and available for use in three languages (English, Bengali, and Luganda).

The findings provide supporting evidence of predictive relationships between stigma and critical public health outcomes, such as hesitancy to report symptoms, delays in seeking medical attention, and reduced acceptance of recovered individuals, which have been seen in other studies.[5,37,38] These results reinforce the utility of the RAPID scales as tools, not only for measuring stigma, but also for predicting its impact on outbreak control. The scales' strong performance across diverse settings supports their cross-contextual applicability. It also supports observations about the shared nature of many stigma manifestations across different diseases.[17,26]

Despite these strengths, the study has limitations. In the UK, data were collected after the local outbreak's peak, and in Uganda, more than a year after the outbreak, potentially introducing recall bias. The sampling methodology ensured the representation of key subpopulations and addressed logistical constraints, facilitating validation with a heterogeneous group of respondents.[23,28] However, the non-randomized and non-proportional design limits the generalizability of the findings. Additionally, test-retest reliability was not assessed. In the UK, where retesting was most logistically feasible due to online data collection, it was prevented by the emergence of the Clade I mpox outbreak and shifting media narratives, which introduced uncertainties about the stability of findings.

The final scales also have limitations. The Self Stigma Scale's near-perfect fit indices may be partly due to the model's simplicity (a single-factor structure with four items and two degrees of freedom). However, the scale's strong theoretical grounding, high factor loadings, satisfactory reliability, and consistent performance across diverse contexts support its validity. Similarly, the brevity of the Community Stigma sub-scales (three items each) minimizes survey length which is important for end-users but may limit their comprehensiveness. Three-item scales have performed well in similar health domains, providing a precedent for the shorter sub-scales.[39] The indirect framing of scale items expands the potential use cases for the scale and reduces the sensitivity of the questions.[40] However, it primarily captures perceived stigma at the community level rather than individual experiences. This limits the scales' ability to assess personal stigmatisation.

Lastly, the focus on transferability means the scales may not fully capture context-specific manifestations of stigma. For instance, they do not address associative stigma—such as stigma directed at social identities perceived to be linked to the illness—which can be highly outbreak-specific (e.g., stigma towards people of East Asian appearance linked to COVID-19 or people identifying as LGBTQ+ linked to mpox).[1] Additional questions or adaptations should be used to address this when relevant.

Nonetheless, the RAPID scales, as practical, deployable tools, are a needed advancement in outbreak stigma assessment. They can be integrated into response frameworks and administered as part of rapid needs assessments to identify populations experiencing heightened stigma and predominant sources. This allows response teams to tailor communication strategies, psychosocial support services, and policy interventions accordingly. Health agencies, community organisations, and researchers can also use the scales to monitor stigma dynamics in real time, guiding targeted interventions such as community engagement initiatives, and training for healthcare workers to mitigate discriminatory practices.

The scales' brevity ensures feasibility in time-pressured settings and allows for incorporation into broader tools such as knowledge, attitudes, and behaviour surveys. In acute outbreak settings, where rapid decision-making is essential, the scales can help prioritise stigma-related concerns alongside clinical and logistical response efforts. With actionable insights into stigma trends, public health authorities can incorporate stigma mitigation into their response strategies, potentially reducing care-seeking delays, and enhancing trust in response efforts.

To facilitate straightforward interpretation, mean and median scores (0-3) are used for factor and scale totals to align with the original 4-point Likert scale (No/Unlikely/Probably/Yes). A key consideration in applying the RAPID scales is determining the threshold at which stigma warrants intervention. This decision should be guided by an understanding of trends and implications rather than fixed cut-offs. For example, even lower levels of perceived provider/authority-related stigma warrant action due to potential impact on healthcare access. Additionally, a sharp increase in scores may signal the need for urgent intervention, such as community dialogues, or policy adjustments to counteract emerging stigma-related harms.

In future applications, the selection of a sampling frame may be guided by the available affected population, given that the scales have been validated with a heterogeneous sample of affected community members. When using the scales with recovered individuals, it is recommended that psychosocial support or referral mechanisms be in place to mitigate potential distress. Prior to implementation in new contexts, end-users should review the items and, if necessary, pilot adaptations to ensure contextual relevance.

Future research could address existing limitations by assessing test-retest reliability and conducting measurement invariance analyses. The latter could allow for the comparison of mean scores across different diseases. Additionally, validating the RAPID scales in a broader range of outbreak contexts and conducting longitudinal studies will be crucial for confirming their transferability and responsiveness to changes in stigma over time. Such efforts would demonstrate the scales' utility in evaluating stigma-reduction interventions, further strengthening their application in public health responses. While heterogeneous sampling that encompasses the full spectrum of potential respondents is recommended during scale development, sub-analyses could offer valuable insights into stigma's extent in specific contexts, as well as its predictors and impacts**.**

A useful complement to this tool would be the development of stigma reduction guidelines tailored to different forms of stigma across various levels of outbreak response actors, ensuring that findings from the scale can directly inform targeted interventions. Lastly, although indirect responses are still likely to reflect individual experiences of stigma while making the questions less sensitive,[40] if required, the scale could be adapted in future research to directly capture personal stigma experiences.

In conclusion, the RAPID Community and Self Stigma Scales are the first validated and adaptable tools intentionally designed for assessing stigma across diverse outbreak contexts. By addressing a gap in stigma assessment, these scales offer researchers, practitioners, and policymakers a means to rapidly assess and mitigate stigma during infectious disease outbreaks. The integration of such tools into outbreak response frameworks has the potential to enhance public health outcomes, reduce the social and psychological burden of stigma, and foster more effective and equitable outbreak responses globally.

DATA AVAILABILITY

The individual participant data analysed during this study are available from the corresponding author on reasonable request for 5 years following publication. Data requestors will need to sign a data access agreement.

AUTHOR CONTRIBUTIONS

AP, AC, OK, TS, KH, HT, BJ, JS, NG, PO, and AR were involved in conceptualisation of the study. OK, KHD, AP, AC, YS, and NKM were involved in survey development and data collection in Uganda. TS, DIR, SIK, KIAC, WRA, and SMS were involved in survey development and data collection in Bangladesh. HT, WN and CO were involved in survey development and recruitment in the UK. AP, KKM, AC, PO, and AR had access to all the datasets and verified the underlying data. AP and KKM conducted all analyses. OK, TS, KHD, HT, FNA, SSA, EAM, LGB, HB, PCD, JD, ERG, ZH, MBH, EZ, SKM, GAM, SM, WN, CO, DIR, KR, SR, SS, HLS, MTS, ALS, YS, ES, RKJT, ST, TST, ST, XW contributed as expert Delphi panellists. AP wrote the first draft of the manuscript with review from all authors. All authors approved the final manuscript.

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