The burden of mental disorder in Sierra Leone: a retrospective observational evaluation of programmatic data from the roll out of decentralised nurse-led mental health units

Helen Hopwood1†, Stephen Sevalie2†, Moshi Optat Herman3, Dawn Harris1, Katharine Collet4, Abdulai Jawo Bah5 and Fenella Beynon1

Abstract

**Background:** In sub-Saharan Africa the treatment gap for mental disorders is high. In 2009, 98.0% of people with mental illness in Sierra Leone were not receiving treatment, partly due to the absence of public psychiatric facilities outside the capital. In response, the Ministry of Health and Sanitation rolled out nurse-led mental health units (MHU) to every district. This study aims to retrospectively evaluate the uptake of these services by examining the pathways to care, diagnosis, management, and treatment gap, to provide insight into the functioning of these units and the potential burden of mental health disorders in Sierra Leone.

**Methods:** We evaluated the roll out of MHU using summary data from all units between 1st January 2015 and 1st January 2017, to establish the burden of diagnoses among service users, pathways to care, treatments provided, and treatment gaps. Negative binomial regressions examine bivariate relationships between diagnoses, treatments, and medication inaccessibility with demographics (age and sex), location (Freetown vs the rest and Ebola endemic regions vs the rest) and year.

**Results:** We collected data from 15 MHU covering 13 districts in 24 months. There were 2401 referrals. The largest age category was 25–34 (23.4%). The prominent diagnoses were epilepsy (43.5%, associated with children) and psychosis (17.5%, associated with males). Reported depression (8.6%) and suicide attempts (33 patients) were low. Ebola endemic regions reported higher rates of grief, trauma, and medically unexplained symptoms. In 24.7% of cases where medication was required, it was not accessible.

**Conclusions:** Nurse-led MHU can have a modest effect on the treatment gap in resource constrained environments such as Sierra Leone, particularly in epilepsy and psychosis.

Background

Mental health and substance use disorders constitute a high burden of disease, accounting for 23% of disability-associated burden (years lived with a disability, YLD) globally and 19% in sub-Saharan Africa [1]. The treatment gap is highest in low- and middle-income countries.
burden of mental illness in Sierra Leone and contribute towards understanding the mechanisms for addressing the mental health treatment gap in resource constrained environments.

Methods
Setting and participants
The MHU are clinics embedded within general government hospitals, including one general referral hospital, one children’s hospital, one military hospital, and 12 district hospitals. Medication supply is sporadic and largely relies on donations from non-governmental organisations (NGOs) [21]. Most MHU (13 of 15) are staffed by one nurse working alone. The clinics take referrals from the general hospital (both inpatient and outpatient), the community (including Primary Healthcare Units, NGOs, the Ministry of Social Welfare, Gender and Children’s Affairs, Ebola Survivor Units and the police), the Psychiatric Hospital and self-referrals by the patient or their families. The staff conduct outreach work to raise awareness about mental health disorders and create referral networks, for example by carrying out formal training sessions and radio campaigns. The referral criteria include signs of any mental illness, suicidality, intellectual disability or epilepsy. There are no criteria which might exclude a person from accessing the MHU.

Data
Data were extracted from monthly M&E reports which were submitted by each of the 15 MHU to an NGO providing support to the MHU between 1st January 2015 and 1st January 2017. Each report included summary data for the month on new and follow-up patients (patients that were already known to the clinic prior to that month), including basic sociodemographic details, diagnoses, referral sources, and interventions (psychological, social, or psychotropic medication) (Appendix 1). The diagnostic categories of the mhGAP including mental, neurological and substance misuse disorders were used as opposed to ICD or DSM criteria because this aligned with the MHU staff’s training; furthermore, the mhGAP has been designed to simplify clinical management in resource-constrained environments [20]. Where reports were missing for a given month, these were retrospectively filled from clinic registries.

Analysis
The analysis begins with a descriptive summary of total monthly records including patients’ demographics, diagnoses, pathways to care, treatments, treatment gaps, differences across facilities and missing data. Additional analysis identified statistically significant differences using bivariate regressions in total monthly counts of
diagnoses and treatments by patients’ demographic characteristics (age groups and total number by sex), location in Freetown vs other districts, location in areas with high Ebola endemcity (Freetown, Kenema, Bombali, and Kailahun) vs low Ebola endemcity, and time (2015 vs 2016). The aggregate monthly counts and subsequent proportions were summed by facility. There was one clinic per district other than Freetown which had three facilities, whose counts were combined to examine variations across districts. We used negative binomial regressions because the outcome variables (total monthly counts per clinic of diagnoses and treatments) took non-negative integer values. Series of bivariate negative binomial regressions estimated counts of diagnoses (epilepsy/seizures, substance abuse, intellectual disability, psychosis, depression, other, and medically unexplained somatic complaints) and interventions (psychological, social, medication, medication not available, and medication unaffordable). The total monthly caseload was used as the exposure variable. Analysed data encompass new patients—to describe the characteristics of people accessing the service—except in the case of interventions, which includes new and follow-up patients to provide insight into the range of treatments that can be provided on an on-going basis.

**Results**

Over the 2-year period, 285 data sheets were generated. The total number of new patients reported was 2401. Some reports were found to have missing data which could not be retrospectively filled from clinic records. The median proportion of available data per category of the data sheet was 70.9% (IQR 64.4–86.3%), with more data missing from certain categories (sex, age, diagnosis, social intervention and medication not affordable) and certain MHUs (Kenema, Koidu, Magburaka and Moyamba), as shown in Appendix 2.

**Patient demographics and diagnoses**

For the available data, sex was recorded for 1045 patients, of whom 51.5% (538) were female.

68.9% (942 of 1367) of patients were aged between 0 and 34 and 17.0% (233) were under 15 (Fig. 1).

Epilepsy/seizures were most frequently diagnosed (43.5%, 426 of 979), followed by psychosis (17.5%, 171) and ‘other psychological complaints’ (14.5%, 142), which is a diagnosis of exclusion if no other mental health disorder is present, encompassing stress, grief and trauma. Moderate-severe depression (8.6%, 84) was seen less commonly (Fig. 2).

The number of patients in age group 0–14 was positively associated with the number of epilepsy diagnoses (p < 0.0001, Table 1). Intellectual disability diagnoses were positively associated with age group 0–14 (p = 0.008) and negatively associated with groups 25–34 (p < 0.0001) and 35–44 (p = 0.004). Psychotic disorders showed a positive relationship with age groups 25–34 (p = 0.05) and age 75 and above (p = 0.04). Depression was positively associated with age group 55–64 (p = 0.02).

The incidences of psychosis (p = 0.003), depression (p = 0.01) and substance abuse (p = 0.02) were positively associated with the number of males (Table 1). All other diagnoses were not associated with sex.

A total of 33 patients presented to services having attempted suicide or self-harm (1.4% of 2401).

**Patient numbers and pathways to care**

The median number of new patients per open clinic per month was 4.0 (IQR 1.0–10.0), and the total number per clinic per month ranged from 0 to 93.

91.7% (1398 of 1524) were outpatients and the remainder were inpatients in the general hospital. The most common referral sources were self (39.2%, 661 of 1686) and another department within the hospital (33.0%, 556). 17.6% (297) patients were from ‘other’ sources including NGOs, Primary Healthcare Units, and the police. 8.4% (141) were from Ebola Survivor Clinics, 1.8% (30) were referred by the Ministry of Social Welfare, Gender and Children’s Affairs, and one patient was referred by the Psychiatric Hospital.

**Mental health treatments**

The median number of contacts (new and follow-up) per clinic per month was 15.0 (6.0–38.0). Across the study period there were 4160 psychological interventions, 2800 psychotropic prescriptions, and 1118 social interventions. The median number of psychological interventions per clinic per month was 6.0 (IQR 1.0–18.0). Comparative figures for psychotropic prescriptions were 3.0 (0.0–13.5) and for social interventions 0.0 (0.0–4.0).

Social interventions were positively associated with age group 0–14 (p = 0.001) and negatively associated with age groups 35–44 (p = 0.006) and 45–54 (p = 0.002, Table 2). Medication and psychological interventions were less strongly associated with age.

The number of females was negatively associated with the number of psychotropics prescribed (p = 0.02). Other interventions were less strongly associated with sex.

The total number of prescriptions required was 3719. 24.7% (919 of 3719) were for medications that were inaccessible to the patient. The medication was unavailable in 52.8% (485) of these 919 cases, and unaffordable in 47.2% (434).

However, while no clinic was exempt from these problems, the few clinics with the highest numbers of contacts accounted for the majority of medication problems.
For example, one MHU represented 74.0% (359) of all 485 cases of medication unavailability, which is 70.3% of all 511 prescriptions in that unit. Another MHU represented 43.3% (188) of the 434 cases in which patients could not afford medication, which is 40.6% of all 463 prescriptions in that clinic. Medication inaccessibility was less significant in clinics that had fewer contacts.

A total of 45 referrals were made to the SLPH. Two MHU—neither based in Freetown—referred 82.2% (37) of these. Three MHU recorded all 31 incidents of signposting to services other than the Hospital, which included referrals to international NGOs and other departments within the general hospital.

MHU staff conducted 2595 home visits, ranging from 1 to 49 per clinic per month. The median number of home visits per clinic per month was 6.0 (3.0–15.0).

Ebola epidemic
A total of 327 Ebola survivors were seen over the 2-year period (80.1%, 262 in 2015 and 19.9%, 65 in 2016). One MHU saw 78.9% (258) of all Ebola survivors. There were
a further 74 patients who had not contracted Ebola, but someone in their family had suffered from the virus. Rates of ‘other’ (grief, trauma and stress, \( p = 0.001 \)) and medically unexplained somatic complaints (\( p = 0.005 \)) were significantly higher in the regions most affected by Ebola (Table 1).

### Variation by district

There was variation in total numbers of new patients and each diagnosis across districts (Fig. 3). The diagnoses with the highest variability were epilepsy/seizures (ranging from 0.0 to 93.5%, which was 315 of 337 patients seen in one clinic over 2 years), alcohol and other substance...
| Age groups | Epilepsy/seizures | Alcohol and other substance use disorder | Intellectual disability | Psychotic disorder (including mania) | Moderate-severe emotional disorder/depression | Other psychological complaint | Medically unexplained somatic complaints |
|------------|------------------|----------------------------------------|------------------------|--------------------------------------|---------------------------------------------|-------------------------------|----------------------------------|
|            | Incidence rate ratio | p-value  | Incidence rate ratio | p-value  | Incidence rate ratio | p-value  | Incidence rate ratio | p-value  | Incidence rate ratio | p-value  |
| 0–14       | 1.17*             | 0.00016 | 0.88*                 | 0.0091 | 1.13*               | 0.0081 | 0.94                  | 0.066   | 0.91*                 | 0.014   | 0.91*                 | 0.042   | 0.85*                 | 0.039   |
| 15–17      | 0.93             | 0.14    | 1.11                  | 0.066   | 1.08                 | 0.16   | 1.02                  | 0.60    | 1.03                  | 0.54    | 1.06                  | 0.38    | 1.05                  | 0.60    |
| 18–24      | 1.04             | 0.21    | 1.00                  | 0.98    | 0.98*                | <0.0001 | 0.98                  | 0.38    | 0.98*                 | 0.007   | 1.00                  | 0.93    | 1.08                  | 0.17    |
| 25–34      | 0.95*            | 0.042   | 0.88                  | 0.28    | 1.04*                | <0.0001 | 0.98                  | 0.049   | 1.00                  | 0.086   | 1.01                  | 0.72    | 1.02                  | 0.68    |
| 35–44      | 1.02             | 0.57    | 0.98                  | 0.54    | 0.89*                | 0.0044 | 1.02                  | 0.36    | 1.03                  | 0.37    | 1.10                  | 0.088   | 0.98                  | 0.78    |
| 45–54      | 1.00             | 0.94    | 0.93                  | 0.81    | 0.93                 | 0.27   | 1.04                  | 0.37    | 1.04                  | 0.44    | 1.05                  | 0.56    | 1.05                  | 0.61    |
| 55–64      | 0.87             | 0.099   | 0.92                  | 0.27    | 0.87                 | 0.11   | 0.96                  | 0.46    | 1.17*                 | 0.020   | 1.01                  | 0.95    | 1.36*                 | 0.0059  |
| 65–74      | 1.10             | 0.36    | 0.91                  | 0.32    | 1.09                 | 0.39   | 0.88                  | 0.067   | 1.11                  | 0.20    | 0.95                  | 0.73    | 0.93                  | 0.59    |
| 75+        | 0.93             | 0.65    | 0.91                  | 1.09    | 0.91                 | 0.69   | 1.39*                 | 0.037   | 0.92                  | 0.62    | 1.05                  | 0.84    | 0.79                  | 0.36    |
| Unknown    | 1.25             | 0.10    | 0.92                  | 0.69    | 0.92                 | 0.62   | 0.80                  | 0.099   | 0.75*                 | 0.046   | 1.00                  | 0.99    | 1.41                  | 0.20    |
| Constant   | 0.16*            | 0       | 0.12*                 | 0       | 0.03*                | 0       | 0.20                  | 0       | 0.03*                 | 0       | 0.07*                 | 0       | 0.02*                 | 0       |
| N          | 238              | 239     | 237                   | 239     | 233                  | 233    | 239                   | 239     |
| Sex        |                  |          |                       |           |                      |        |                       |         |
| Number of males | 1.04    | 0.11    | 1.05*                 | 0.022   | 0.99                 | 0.67   | 1.06*                 | 0.0026  | 1.03*                 | 0.011   | 0.99                  | 0.29    | 0.98                  | 0.31    |
| Number of females | 1.00   | 0.84    | 0.93*                | <0.0001 | 1.02                 | 0.64   | 0.95*                 | 0.00017 | 1.01                  | 0.54    | 1.03                  | 0.70    | 1.03                  | 0.13    |
| Constant   | 0.11*            | 0       | 0.12*                 | 0       | 0.06*                | 0       | 0.21*                 | 0       | 0.03*                 | 0       | 0.08*                 | 0       | 0.03*                 | 0       |
| N          | 215              | 216     | 214                   | 216     | 212                  | 212    | 216                   | 216     |
| Freetown vs the rest |                  |          |                       |           |                      |        |                       |         |
| Freetown (ref: the rest)  | 0.03*     | 0       | 0.23*                | <0.0001 | 0.31*                | 0.0005 | 0.29*                 | <0.0001 | 0.72                  | 0.33    | 0.85                  | 0.71    | 0.26*                 | 0.013   |
| Constant   | 0.31*            | 0       | 0.11*                 | 0       | 0.05*                | 0       | 0.24*                 | 0       | 0.06*                 | 0       | 0.09*                 | 0       | 0.04*                 | 0       |
| N          | 245              | 246     | 244                   | 246     | 240                  | 240    | 246                   | 246     |
| Ebola—districts with high endemicity vs the rest |                  |          |                       |           |                      |        |                       |         |
| High Ebola endemicity districts (ref: the rest) | 0.68     | 0.071   | 0.91                  | 0.72    | 0.33*                | 0.00019 | 0.67*                 | 0.031   | 1.01                  | 0.05    | 2.42*                 | 0.00045 | 2.65*                 | 0.0047  |
| Constant   | 0.32*            | 0       | 0.10*                 | 0       | 0.07*                | 0       | 0.24*                 | 0       | 0.05*                 | 0       | 0.05*                 | 0       | 0.02*                 | 0       |
| N          | 245              | 246     | 244                   | 246     | 240                  | 240    | 246                   | 246     |
| 2015 vs 2016 |                  |          |                       |           |                      |        |                       |         |
| 2015 (ref: 2016) | 0.72     | 0.23    | 1.45                  | 0.23    | 1.03                  | 0.93   | 0.96                  | 0.87    | 2.74*                 | <0.0001 | 1.78                  | 0.069   | 3.77*                 | 0.0018  |
| Constant   | 0.35*            | <0.0001 | 0.06*                 | 0       | 0.06*                | 0       | 0.19*                 | 0       | 0.02*                 | 0       | 0.05*                 | 0       | 0.01*                 | 0       |
Table 1 (continued)

|                          | Incidence rate ratio | p-value | Incidence rate ratio | p-value | Incidence rate ratio | p-value | Incidence rate ratio | p-value | Incidence rate ratio | p-value | Incidence rate ratio | p-value | Incidence rate ratio | p-value | Incidence rate ratio | p-value |
|--------------------------|----------------------|---------|----------------------|---------|----------------------|---------|----------------------|---------|----------------------|---------|----------------------|---------|----------------------|---------|----------------------|---------|
| N                        | 175                  |         | 175                  |         | 173                  |         | 175                  |         | 175                  |         | 175                  |         | 175                  |         | 175                  |         |

Epilepsy/seizures  Alcohol and other substance use disorder  Intellectual disability  Psychotic disorder (including mania)  Moderate-severe emotional disorder/ depression  Other psychological complaint  Medically unexplained somatic complaints
abuse (0.0 to 55.8%, 29 of 52), and psychosis (0.0 to 18.4%, 216 of 1176).

Medication was significantly more available (p < 0.0001) and more affordable (p < 0.0001) in Freetown compared to other districts (Table 2).

**Variation by time**

Of 2401 patients, 33.2% (798) presented in 2015, and 66.8% (1603) in 2016.

> Depression (p < 0.0001) and medically unexplained symptoms (p = 0.0002) were significantly more associated with year 2015 than 2016.

The number of Ebola survivors decreased between 2015 (80.1%, 262 of 327 Ebola cases) and 2016 (19.9%, 65).

Medication unavailability was significantly associated with year 2015 compared to 2016 (p = 0.02, Table 2). There was no change in medication unaffordability over time.

---

**Table 2** Comparison of the number of each category of intervention given with different demographic characteristics and year—relationships between the number provided with each treatment (psychological, social, medication, and those for whom medication with unavailable or unaffordable) and selected independent variables (number in each group: age, sex, residence within Freetown vs the rest, residence within districts with high Ebola endemicity vs the rest, and year 2015 vs 2016) using bivariate negative binomial regressions *p < 0.05

| Age groups | Psychological intervention | Social intervention | Medication provided | Medication not available | Medication not affordable |
|------------|---------------------------|---------------------|---------------------|-------------------------|--------------------------|
|            | Incidence rate ratio | p-value | Incidence rate ratio | p-value | Incidence rate ratio | p-value | Incidence rate ratio | p-value | Incidence rate ratio | p-value |
| 0–14        | 1.03          | 0.26      | 1.20*              | 0.00090  | 1.04           | 0.22      | 1.22*              | 0.029      | 1.15          | 0.17   |
| 15–17       | 0.94*         | 0.019     | 0.84*              | 0.0028    | 0.94           | 0.083     | 1.06           | 0.66      | 0.94          | 0.55   |
| 18–24       | 1.00          | 0.89      | 1.02              | 0.70      | 0.98           | 0.35      | 1.01           | 0.87      | 1.00          | 0.96   |
| 25–34       | 0.99          | 0.61      | 0.96              | 0.18      | 0.99           | 0.48      | 0.86*           | 0.0095     | 1.01          | 0.86   |
| 35–44       | 0.99          | 0.66      | 0.91*             | 0.0062    | 0.99           | 0.55      | 0.72*           | 0.022     | 1.03          | 0.61   |
| 45–54       | 1.00          | 0.95      | 0.76*             | 0.0020    | 1.00           | 0.98      | 1.08           | 0.52      | 1.01          | 0.92   |
| 55–64       | 1.03          | 0.56      | 1.00              | 0.97      | 0.90*          | 0.040     | 0.92           | 0.69      | 0.94          | 0.67   |
| 65–74       | 0.96          | 0.55      | 1.02              | 0.90      | 1.04           | 0.63      | 0.99           | 0.97      | 0.94          | 0.69   |
| 75+         | 1.09          | 0.31      | 1.41              | 0.14      | 1.17           | 0.19      | 0.41           | 0.081     | 0.80          | 0.61   |
| Unknown     | 1.07          | 0.36      | 1.24              | 0.19      | 1.09           | 0.36      | 0.60           | 0.17      | 0.86          | 0.61   |
| Constant    | 0.68*         | <0.0001   | 0.27*             | 0         | 0.55*          | <0.0001  | 0.14*          | <0.0001   | 0.03*         | 0      |
| N           | 231           | 230       | 231               | 190       | 183           |           |

| Sex         | Psychological intervention | Social intervention | Medication provided | Medication not available | Medication not affordable |
|-------------|---------------------------|---------------------|---------------------|-------------------------|--------------------------|
| Number of males | 1.01        | 0.21     | 1.03               | 0.21      | 1.02           | 0.18      | 1.14*            | 0.046     | 1.10*         | 0.22   |
| Number of females | 0.98      | 0.057    | 0.96               | 0.069     | 0.97*          | 0.021     | 0.88*            | 0.034     | 0.97          | 0.31   |
| Constant     | 0.66*         | <0.0001   | 0.17*             | 0         | 0.45*          | 0         | 0.10*            | 0         | 0.03*         | 0      |
| N            | 206           | 205       | 206                | 165       | 157           |           |

| Freetown vs the rest |
|----------------------|
| Psychological intervention | Social intervention | Medication provided | Medication not available | Medication not affordable |
| Freetown (ref: the rest) | 0.27*             | 0         | 0.24*             | 0.00050    | 0.16*         | 0         | 0.02*            | <0.0001   | 0.06*         | <0.0001 |
| Constant             | 0.71*             | 0         | 0.26*             | 0         | 0.52*          | 0         | 0.13*            | 0         | 0.07*         | 0      |
| N                    | 236               | 235       | 236                | 192       | 184           |           |

| Ebola—districts with high endemicity vs the rest |
|--------------------------------------------------|
| Psychological intervention | Social intervention | Medication provided | Medication not available | Medication not affordable |
| High Ebola endemicity districts (ref: the rest) | 0.70*             | 0.010      | 0.78               | 0.31      | 0.52*         | <0.0001  | 0.05*            | <0.0001   | 1.66          | 0.18   |
| Constant             | 0.74*             | <0.0001   | 0.26*             | 0         | 0.57*          | 0         | 0.18*            | 0         | 0.05*         | 0      |
| Observations         | 236               | 235       | 236                | 192       | 184           |           |

| 2015 vs 2016 |
|--------------|
| Psychological intervention | Social intervention | Medication provided | Medication not available | Medication not affordable |
| 2015 (ref: 2016) | 1.24          | 0.090     | 1.40               | 0.25      | 0.91           | 0.59      | 3.09*            | 0.016     | 0.51          | 0.13   |
| Constant     | 0.63*         | <0.0001   | 0.52*             | <0.0001  | 0.08*          | 0         | 0.09*            | 0         |               |       |
| N            | 166           | 164       | 165                | 141       | 139           |           |
Treatment gap
Coverage by the MHUs (based on prevalence estimates from other studies) is 0.2% of the population experiencing schizophrenia and bipolar disorder, 0.2% with alcohol and substance use disorders, and 0.4% with epilepsy (Table 3) [1, 11, 22].

Discussion
This study is the first insight since 2002 into people with mental health problems accessing services in Sierra Leone and show that the treatment gap remains high.
Table 3  Treatment gaps by diagnosis—estimated treatment gaps (proportion of untreated disease) by diagnosis category for epilepsy/seizures, substance use, psychosis, and depression, based on estimated prevalence data extrapolated from other studies

| MHU, district | Region/ district population | Diagnosis | No. patients treated with diagnosis | Reference data used to estimate expected prevalence | Est. no. people with diagnosis in district | Coverage (no. seen/ no. with diagnosis, %) | Treatment gap (100-Coverage) |
|---------------|----------------------------|-----------|-----------------------------------|---------------------------------------------------|------------------------------------------|--------------------------------------------|-------------------------------|
| All           | 7,396,000 Epilepsy/seizures 426 | Ba-Diop A et al., 2014 | Meta analysis                      | 0.0143                                            | 105,762.8                               | 0.40                                       | 99.6                          |
|               | Alcohol and other substance use disorder 83 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0052                                            | 38,459.2                                | 0.22                                       | 99.8                          |
|               | Intellectual disability 30 | Alemu W et al, 2012 | 2002 Sierra Leone needs assessment post-civil war | 0.01                                              | 73,960                                   | 0.04                                       | 100.0                         |
|               | Psychotic disorder (including mania) 171 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0114                                            | 84,314.4                                 | 0.20                                       | 99.8                          |
|               | Moderate-severe emotional disorder/depression 84 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0367                                            | 271,433.2                                | 0.03                                       | 100.0                         |
| 34 Military Hosp., Western Ar. Urban | 1,055,964 Epilepsy/seizures 0 | Ba-Diop A et al., 2014 | Meta analysis                      | 0.0143                                            | 15,100.3                                 | 0.00                                       | 100.0                         |
|               | Alcohol and other substance use disorder 29 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0052                                            | 5491.0                                   | 0.53                                       | 99.5                          |
|               | Intellectual disability 0 | Alemu W et al, 2012 | 2002 Sierra Leone needs assessment post-civil war | 0.01                                              | 10,559.6                                 | 0.00                                       | 100.0                         |
|               | Psychotic disorder (including mania) 15 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0114                                            | 12,038.0                                 | 0.12                                       | 99.9                          |
|               | Moderate-severe emotional disorder/depression 7 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0367                                            | 38,753.9                                 | 0.02                                       | 100.0                         |
| Total         | 51                                                   |            |                                    |                                                   | 81,942.8                                 | 0.06                                       | 99.9                          |
| Region/district population | Diagnosis                  | No. patients treated with diagnosis | Reference data used to estimate expected prevalence | Est. no. people with diagnosis in district | Coverage (no. seen/no. with diagnosis, %) | Treatment gap (100-Coverage) |
|----------------------------|----------------------------|-----------------------------------|--------------------------------------------------|------------------------------------------|----------------------------------------|----------------------------------|
| Bo Gov. Hosp., Bo 575,478  | Epilepsy/seizures          | 315                               | Meta-analysis                                    | 8229.3                                   | 96.2                                   | 3.83                             |
|                            | Alcohol and other substance use disorder | 1                                 | Charlston FJ et al., 2014                        | 2992.5                                   | 100.0                                  | 0.03                             |
|                            | Intellectual disability    | 2                                 | Alemu W et al., 2012                            | 5754.8                                   | 100.0                                  | 0.03                             |
|                            | Psychotic disorder (including mania) | 15                                | Charlston FJ et al., 2014                        | 6560.4                                   | 99.8                                   | 0.23                             |
|                            | Moderate-severe emotional disorder/depression | 4                                 | Charlston FJ et al., 2014                        | 21,130.0                                 | 99.0                                   | 0.20                             |
|                            | Total                      | 337                               | Ba-Diop A et al., 2014                          | 44,657.1                                 | 99.0                                   | 0.20                             |
| Bonthe Gov. Hosp., Bonthe 200,781 | Alcohol and other substance use disorder | 3                                 | Charlston FJ et al., 2014                        | 1044.1                                   | 99.9                                   | 0.15                             |
|                            | Intellectual disability    | 3                                 | Alemu W et al., 2012                            | 2007.8                                   | 99.9                                   | 0.15                             |
|                            | Psychotic disorder (including mania) | 9                                 | Charlston FJ et al., 2014                        | 2389.9                                   | 99.9                                   | 0.07                             |
|                            | Moderate-severe emotional disorder/depression | 5                                 | Charlston FJ et al., 2014                        | 7387.7                                   | 99.9                                   | 0.07                             |
|                            | Total                      | 59                                |                                                 | 15,500.6                                 | 99.9                                   | 0.07                             |
| MHU, district | Region/district population | Diagnosis | No. patients treated with diagnosis | Reference data used to estimate expected prevalence | Est. no. people with diagnosis in district | Coverage (no. seen/no. with diagnosis, %) | Treatment gap (100-Coverage) |
|--------------|---------------------------|-----------|-----------------------------------|---------------------------------|---------------------------------|---------------------------------|--------------------------|
| Connaught Hosp., Western Ar. Urban | 1,055,964 | Epilepsy/seizures | 11 | Ba-Diop A et al., 2014 | Meta analysis | 0.0143 | 15,100.3 | 0.07 | 99.9 |
| | | Alcohol and other substance use disorder | 8 | Charlston FJ et al., 2014 | Estimates for West sub-Saharan Africa region | 0.0052 | 5491.0 | 0.15 | 99.9 |
| | | Intellectual disability | 11 | Alemu W et al., 2012 | 2002 Sierra Leone needs assessment post-civil war | 0.01 | 10,559.6 | 0.10 | 99.9 |
| | | Psychotic disorder (including mania) | 49 | Charlston FJ et al., 2014 | Estimates for West sub-Saharan Africa region | 0.0114 | 12,038.0 | 0.41 | 99.6 |
| | | Moderate-severe emotional disorder/depression | 24 | Charlston FJ et al., 2014 | Estimates for West sub-Saharan Africa region | 0.0367 | 38,735.9 | 0.06 | 99.9 |
| Total | 103 | | | | | 81,942.8 | 0.13 | 99.9 |
| Sierra Leone China Friendship Hosp., Western Ar. Rural | 444,270 | Epilepsy/seizures | 6 | Ba-Diop A et al., 2014 | Meta analysis | 0.0143 | 6353.1 | 0.09 | 99.9 |
| | | Alcohol and other substance use disorder | 3 | Charlston FJ et al., 2014 | Estimates for West sub-Saharan Africa region | 0.0052 | 2310.2 | 0.13 | 99.9 |
| | | Intellectual disability | 1 | Alemu W et al., 2012 | 2002 Sierra Leone needs assessment post-civil war | 0.01 | 4442.7 | 0.02 | 100.0 |
| | | Psychotic disorder (including mania) | 11 | Charlston FJ et al., 2014 | Estimates for West sub-Saharan Africa region | 0.0114 | 5064.7 | 0.22 | 99.8 |
| | | Moderate-severe emotional disorder/depression | 3 | Charlston FJ et al., 2014 | Estimates for West sub-Saharan Africa region | 0.0367 | 16,304.7 | 0.02 | 100.0 |
| Total | 24 | | | | | 34,475.4 | 0.07 | 99.9 |
### Table 3 (continued)

| MHU, district | Region/ district population | Diagnosis | No. patients treated with diagnosis | Reference data used to estimate expected prevalence | Est. no. people with diagnosis in district | Coverage (no. seen/ no. with diagnosis, %) | Treatment gap (100-Coverage) |
|---------------|-----------------------------|-----------|-----------------------------------|-----------------------------------------------|-------------------------------------------|------------------------------------------|-----------------------------|
| Kambia Gov. Hosp, Kambia | 345,474 | Epilepsy/seizures 1 | Ba-Diop A et al., 2014 | Meta analysis | 0.0143 | 4940.3 | 0.02 | 100.0 |
| | | Alcohol and other substance use disorder 1 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0052 | 1796.5 | 0.06 | 99.9 |
| | | Intellectual disability 0 | Alemu W et al, 2012 | 2002 Sierra Leone needs assessment post-civil war | 0.01 | 345.4 | 0.00 | 100.0 |
| | | Psychotic disorder (including mania) 2 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0114 | 3938.4 | 0.05 | 99.9 |
| | | Moderate-severe emotional disorder/depression 1 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0367 | 12,678.9 | 0.01 | 100.0 |
| | | Total 5 | Ba-Diop A et al, 2014 | Meta analysis | 0.0143 | 26,808.8 | 0.02 | 100.0 |
| Kailahun Gov. Hosp, Kailahun | 526,379 | Epilepsy/seizures 18 | Ba-Diop A et al, 2014 | Meta analysis | 0.0143 | 7527.2 | 0.24 | 99.8 |
| | | Alcohol and other substance use disorder 23 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0052 | 2737.2 | 0.84 | 99.2 |
| | | Intellectual disability 2 | Alemu W et al, 2012 | 2002 Sierra Leone needs assessment post-civil war | 0.01 | 5263.8 | 0.04 | 100.0 |
| | | Psychotic disorder (including mania) 2 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0114 | 6000.7 | 0.03 | 100.0 |
| | | Moderate-severe emotional disorder/depression 5 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0367 | 19,318.1 | 0.03 | 100.0 |
| | | Total 50 | | | 40,847.0 | 0.12 | 99.9 |
| MHU, district | Region/district population | Diagnosis | No. patients treated with diagnosis | Reference data used to estimate expected prevalence | Est. no. people with diagnosis in district | Coverage (no. seen/no. with diagnosis, %) | Treatment gap (100-Coverage) |
|--------------|---------------------------|-----------|-----------------------------------|-----------------------------------------------|------------------------------------------|----------------------------------------|-------------------------------|
| **Kenema Gov. Hosp., Kenema** | 609,891 | Epilepsy/seizures | 0 | Ba-Diop A et al., 2014 | Meta analysis | 0.0143 | 8721.4 | 0.00 | 100.0 |
| | | Alcohol and other substance use disorder | 1 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0052 | 3171.4 | 0.03 | 100.0 |
| | | Intellectual disability | 1 | Alemu W et al, 2012 | 2002 Sierra Leone needs assessment post-civil war | 0.01 | 6098.9 | 0.02 | 100.0 |
| | | Psychotic disorder (including mania) | 4 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0114 | 6952.8 | 0.06 | 99.9 |
| | | Moderate-severe emotional disorder/depression | 6 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0367 | 22,383.0 | 0.03 | 100.0 |
| Total | 12 | | | | | 47,327.5 | 0.03 | 100.0 |
| **Kabala Gov. Hosp., Koinadugu** | 409,372 | Epilepsy/seizures | 4 | Ba-Diop A et al, 2014 | Meta analysis | 0.0143 | 5854.0 | 0.07 | 99.9 |
| | | Alcohol and other substance use disorder | 0 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0052 | 2128.7 | 0.00 | 100.0 |
| | | Intellectual disability | 3 | Alemu W et al, 2012 | 2002 Sierra Leone needs assessment post-civil war | 0.01 | 4093.7 | 0.07 | 99.9 |
| | | Psychotic disorder (including mania) | 26 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0114 | 4666.8 | 0.56 | 99.4 |
| | | Moderate-severe emotional disorder/depression | 22 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0367 | 15,024.0 | 0.15 | 99.9 |
| Total | 55 | | | | | 31,767.3 | 0.17 | 99.8 |
Table 3 (continued)

| MHU, district | Region/district population | Diagnosis                              | No. patients treated with diagnosis | Reference data used to estimate expected prevalence | Est. no. people with diagnosis in district | Coverage (no. seen/no. with diagnosis, %) | Treatment gap (100-Coverage) |
|---------------|---------------------------|----------------------------------------|------------------------------------|-----------------------------------------------|------------------------------------------|------------------------------------------|----------------------------|
| Koidu Gov. Hosp., Kono | 506,100                  | Epilepsy/seizures                      | 27                                 | Ba-Diop A et al., 2014 | Meta analysis                                | 0.0143                          | 7237.2                          | 0.37                         | 99.6                         |
|               |                          | Alcohol and other substance use disorder | 7                                  | Charlston FJ et al., 2014 | Estimates for West sub-Saharan Africa region | 0.0052                          | 2631.7                          | 0.27                         | 99.7                         |
|               |                          | Intellectual disability                | 0                                  | Alemu W et al., 2012 |                          | 0.01                            | 5061.0                          | 0.00                         | 100.0                        |
|               |                          | Psychotic disorder (including mania)  | 18                                 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0114                          | 5769.5                          | 0.31                         | 99.7                         |
|               |                          | Moderate-severe emotional disorder/depression | 0                                  | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0367                          | 18,573.9                        | 0.00                         | 100.0                        |
|               |                          | Total                                  | 52                                 |                          |                                          |                                  |                                  |                              |                              |
| Makeni Gov. Hosp., Bombali | 606,544                  | Epilepsy/seizures                      | 4                                 | Ba-Diop A et al., 2014 | Meta analysis                                | 0.0143                          | 8673.6                          | 0.05                         | 100.0                        |
|               |                          | Alcohol and other substance use disorder | 6                                  | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0052                          | 3154.0                          | 0.19                         | 99.8                         |
|               |                          | Intellectual disability                | 2                                  | Alemu W et al, 2012 |                          | 0.01                            | 6065.4                          | 0.03                         | 100.0                        |
|               |                          | Psychotic disorder (including mania)  | 16                                 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0114                          | 6914.6                          | 0.23                         | 99.8                         |
|               |                          | Moderate-severe emotional disorder/depression | 4                                  | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0367                          | 22,260.2                        | 0.02                         | 100.0                        |
|               |                          | Total                                  | 32                                 |                          |                                          |                                  |                                  |                              |                              |
### Table 3 (continued)

| MHU, district | Region/ district population | Diagnosis | No. patients treated with diagnosis | Reference data used to estimate expected prevalence | Est. no. people with diagnosis in district | Coverage (no. seen/no. with diagnosis, %) | Treatment gap (100-Coverage) |
|---------------|-----------------------------|-----------|-----------------------------------|-----------------------------------------------|------------------------------------------|-----------------------------------------|-----------------------------|
| Moyamba Gov. Hosp., Moyamba | 318,588 | Epilepsy/seizures | 1 | Ba-Diop A et al., 2014 | Meta analysis | 0.0143 | 4555.8 | 0.02 | 100.0 |
| | | Alcohol and other substance use disorder | 1 | Charlston FJ et al., 2014 | Estimates for West sub-Saharan Africa region | 0.0052 | 1656.7 | 0.06 | 99.9 |
| | | Intellectual disability | 0 | Alemu W et al., 2012 | Needs assessment post-civil war | 0.01 | 3185.9 | 0.00 | 100.0 |
| | | Psychotic disorder (including mania) | 3 | Charlston FJ et al., 2014 | Estimates for West sub-Saharan Africa region | 0.0114 | 3631.9 | 0.08 | 99.9 |
| | | Moderate-severe emotional disorder/depression | 1 | Charlston FJ et al., 2014 | Estimates for West sub-Saharan Africa region | 0.0367 | 11,692.2 | 0.01 | 100.0 |
| Total | 6 | Epilepsy/seizures | 0 | Ba-Diop A et al., 2014 | Meta analysis | 0.0143 | 24,722.4 | 0.02 | 100.0 |
| | | Alcohol and other substance use disorder | 0 | Charlston FJ et al., 2014 | Estimates for West sub-Saharan Africa region | 0.0052 | 5491.0 | 0.00 | 100.0 |
| | | Intellectual disability | 5 | Alemu W et al., 2012 | Needs assessment post-civil war | 0.01 | 10,559.6 | 0.05 | 100.0 |
| | | Psychotic disorder (including mania) | 1 | Charlston FJ et al., 2014 | Estimates for West sub-Saharan Africa region | 0.0114 | 12,038.0 | 0.01 | 100.0 |
| | | Moderate-severe emotional disorder/depression | 2 | Charlston FJ et al., 2014 | Estimates for West sub-Saharan Africa region | 0.0367 | 38,753.9 | 0.01 | 100.0 |
| Total | 8 | | | | | 81,942.8 | 0.001 | 100.0 |
Table 3 (continued)

| MHU, district | Region/ district population | Diagnosis                                      | No. patients treated with diagnosis | Reference data used to estimate expected prevalence | Est. no. people with diagnosis in district | Coverage (no. seen/ no. with diagnosis, %) | Treatment gap (100-Coverage) |
|---------------|----------------------------|------------------------------------------------|-------------------------------------|---------------------------------------------------|------------------------------------------|------------------------------------------|----------------------------|
| Pujehun Gov. Hosp., Pujehun | 346,461 | Epilepsy/seizures | 0 | Ba-Diop A et al., 2014 | Meta analysis | 0.0143 | 4954.4 | 0.00 | 100.0 |
|              |                         | Alcohol and other substance use disorder | 0 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0052 | 1801.6 | 0.00 | 100.0 |
|              |                         | Intellectual disability | 0 | Alemu W et al, 2012 | 2002 Sierra Leone needs assessment post-civil war | 0.01 | 3464.6 | 0.00 | 100.0 |
|              |                         | Psychotic disorder (including mania) | 0 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0114 | 3949.7 | 0.00 | 100.0 |
|              |                         | Moderate-severe emotional disorder/depression | 0 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0367 | 12,715.1 | 0.00 | 100.0 |
| Magburaka Gov. Hosp, Tonkolili | 531,435 | Epilepsy/seizures | 0 | Ba-Diop A et al., 2014 | Meta analysis | 0.0143 | 7599.5 | 0.00 | 100.0 |
|              |                         | Alcohol and other substance use disorder | 0 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0052 | 2763.5 | 0.00 | 100.0 |
|              |                         | Intellectual disability | 0 | Alemu W et al, 2012 | 2002 Sierra Leone needs assessment post-civil war | 0.01 | 5314.4 | 0.00 | 100.0 |
|              |                         | Psychotic disorder (including mania) | 0 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0114 | 6058.4 | 0.00 | 100.0 |
|              |                         | Moderate-severe emotional disorder/depression | 0 | Charlston FJ et al, 2014 | Estimates for West sub-Saharan Africa region | 0.0367 | 19,503.7 | 0.00 | 100.0 |
|              |                         | Total | 0 | | | 41,239.4 | 0.00 | 100.0 |
Patient characteristics
Men and women accessed services equally. The number of males was associated with numbers with psychosis, depression and substance abuse. The largest age category was 25–34 years (23.4%). However, globally half of mental health disorders start by the mid-teens and three quarters by the mid-twenties, and in Sierra Leone 48.3% of the population is aged under 18 [23, 24]. This emphasises the need for robust systems that are suitable for younger people.

Epilepsy/seizures accounted for the highest proportion of diagnoses seen. This is unlikely to indicate a greater prevalence amongst the general population compared to mental health conditions, but may reflect improved referral mechanisms and health literacy resulting from organisations including the Epilepsy Association of Sierra Leone. An estimated 1.43% of the population in West Africa have active epilepsy [22]. There is only one neurologist in Sierra Leone, and MHUs may be playing an important role in reducing the treatment gap [11].

Psychosis was the most frequently diagnosed mental health disorder, surpassing more common disorders such as depression (17.5% and 8.6% of MHU patients respectively).

The under-representation of depression in newly established services replicates studies elsewhere [25]. The comparative population prevalence rates for psychosis and depression are 1.14% and 3.67% respectively in Western Africa [1]. It is possible that patients with less visible disorders such as depression may not prompt the same level of concern as psychotic disorders, that there may be differences in perceptions about treatment, and that affective disorders are not viewed in the same explanatory model as psychotic disorders [26, 27]. Whilst we expect the rates of depression to be much higher, it is important to consider factors that promote resilience such as social support through community acceptance [28, 29].

The 327 Ebola survivors attending MHU represent 3.3–6.9% of the total survivors (4750 laboratory-confirmed, 10,000 estimated) [30, 31]. Studies in Ebola sequelae show prevalence rates of 10.9–49% for depression, and up to 34% for post-traumatic stress disorder [32–36]. The MHU appear to be helping reduce the treatment gap for mental health disorders among Ebola survivors, particularly for people with grief, stress and trauma, and medically unexplained somatic complaints. The majority presented in 2015 (80.1%) compared to 2016 (19.9%), indicating mental health problems may present as early sequelae of Ebola [19]. However, this result may be affected by targeted health initiatives to screen Ebola survivors mental health problems. This could explain the differences in data between districts, which are not fully accounted for by endemcity.

Low numbers of reported suicide and self-harm attempts in this study (33 in 2 years) could be further explored to evaluate if this is an issue of reporting or reflects a true picture. The WHO estimates the suicide rate in Sierra Leone is 9.7 per 100 000, higher than the sub-Saharan average of 7.5 [37]. This would equate to 733.0 per year in Sierra Leone, and for every completed suicide there are 50 attempts [38]. Among psychiatry patients the suicide attempt rate is 15–50% [39]. The results from this study should be interpreted in a context of wider social, cultural and stigma related issues around suicide in Sierra Leone.

Patient numbers and pathways to care
The increase in service uptake by year is likely a reflection of service establishment due to the successive opening of MHU. The last MHU (the CAMH Unit) opened in March 2016.

There is wide variation in the number of referrals into different MHU. These differences appear unrelated to district population and should be investigated further. Issues around staffing levels, geography, community access to mental health information, levels of education, traditional beliefs, stigma, and local opportunities to align resources towards mental health and epilepsy are likely contributing factors. These factors also might help explain the geographic variation in the types of disorders presenting to services.

The most common referral sources are self-referrals and referrals from other general hospital departments. A wide range of organisations are aware of, and referring to, the MHU. There are no data on how self-referred patients heard about the service. Possibilities include radio campaigns, word-of-mouth and healthcare professionals. Most patients are outpatients, indicating these services are making treatment available to people living in their homes.

Mental health treatments
Among clinics with the highest numbers of contacts there are sizeable problems with accessing medicines. These problems transcend all patient ages and sexes. Medication inaccessibility potentially undermines quality of clinical care and trust in the service. This highlights the need for the MOHS to include psychotropic medications in procurement plans, to strengthen supply chain mechanisms and prevent leaks within the supply [40]. It is possible that some patients accessing MHU may have
been taking medication prior to 2015. However, access to psychotropic medication in the country is scarce, except for unreliable supplies within the Psychiatric Hospital [41].

Whilst supply is more accessible in the capital city, medication often remained unaffordable. Innovative means of mental health financing may be required.

Few other psycho-social services are available, aligning with the low rates of signposting to other services. Treatment and rehabilitation frequently require the involvement of family and community, therefore the most common interventions applied are likely to be psychoeducation and attempts to engage wider supports. These activities are captured in the number of social and psychological interventions. Psychological interventions beyond psychoeducation would mostly have consisted of counselling and problem-solving therapy, which is appropriate to the level of training of MHU staff. Referrals from the MHU to the Psychiatric Hospital are low (45 in 2 years). It is possible that the nurses felt adequately prepared to handle most cases; patients or their families blocked the referral due to the challenges associated with travel, or were against admission for other factors including the hospital being under-resourced; or there was a preference for alternative forms of care. Since deinstitutionalisation, psychiatric inpatient facilities only provide 7% of psychiatric care globally [42].

Home visits formed a significant part of the workload. Home visits may be preferred by patients because of travel difficulties or stigma associated with the MHU or may be the only option to see people who are very unwell. As much as this is a good indicator of patient-centred care uptake, the increasing demand on mental health nurses’ time poses a risk towards the quality of services.

Treatment gap
Despite the positive trend in service uptake, coverage by the MHUs for the two most common disorders, epilepsy and psychosis, are only 0.4% and 0.2% respectively. This may slightly reduce the treatment gap for mental health disorders, which in 2009 was 98.0% (the remaining 2.0% treated by the Psychiatric Hospital and NGOs) [11]. In 2016, the treatment gap for childhood disorders was estimated at over 99.8% [43]. This demonstrates that services are still not meeting the needs of the population and further exploration of how to develop services is warranted. This is especially important given that the population has risen—by 2 million since the most recent epidemiological survey for mental health in 2002—and the burden of mental health disorders is expected to greatly increase over the next decade [1].

Challenges in service delivery
Efforts to increase service uptake are threatened by a multitude of challenges, ranging from problems with the wider health system to issues specific to mental health. These include: human resource constraints, inadequate medication supply chains and the availability of only one psychiatric inpatient facility. Of the 15 MHUs, 13 are each staffed by one nurse working alone. These staff are responsible for all clinical and service management. Staff ill-health can result in no patients being seen.

Mental health nurses are not fully integrated into the health system [21]. They receive low remuneration for their work and have limited opportunities for career progression, potentially impacting future attrition rates. There is limited potential for the MOHS to conduct training or supportive supervision, both of which are provided by NGOs. The MOHS has no specific budget for mental health outside SLPH, which has its own funding difficulties.

Patient-related factors that may have contributed to low rates of presentation at MHU include stigma, low mental health literacy, preference for traditional/faith-based healers, and inability to finance health cost highlighted by the number of patients who could not afford medications [7].
Wider efforts in task sharing
Through the support of partners the roll out of mental health services to primary care has led to training in Psychological First Aid and mhGAP intervention guidelines to general nurses, Community Health Officers and medical officers; aiming to improve mental health literacy, task-sharing and collaborative decision making [20, 44]. This initiative still needs active coordination and division of roles and responsibilities.

The MOHS has launched the new Mental Health Policy and Strategic Plan 2019–2023. Targets for training more mental health professionals are included. Research and M&E are at the forefront of the policy. As yet finance options are uncertain.

Limitations
The results are limited by the accuracy and completeness of the data. It is possible that missing data introduced bias into the results. For example, missing data on diagnoses could reflect recording errors, but may have resulted from staff struggling to reach diagnoses, which could be biased towards particular diagnoses. Certain clinics (with high numbers of new patients) contributed a greater proportion of missing data, possibly indicating capacity issues within these MHU around data collection. Issues with routine collection of health data in Sierra Leone are certainly not limited to mental health [31, 32]. M&E systems in sub-Saharan Africa are challenged by limited human and financial resources, weak information systems, and limited demand for M&E [45]. MHU clinical staff were responsible for the reporting of data used in this study, and many had only received limited training and support on M&E. As a result of this study, further training has been conducted to improve staff skills and capacity around data collection.

The summary reports in this study use diagnoses and treatments according to the broad categories of the mhGAP. Psychosis, for example, includes schizophrenia and bipolar disorder, which have different prognoses. It was not possible to assess the diagnoses for reliability. However, mhGAP was developed by experts in the field as a viable method of scaling up mental health treatment using non-specialist services [46]. The definition of some variables like psychological intervention and social intervention was not distinct. Data on individual medications were not available.

Despite data quality issues, this study is valuable due to the novel nature of the intervention and current paucity of data on mental health service provision and burden of mental health disorders in Sierra Leone. With limited funding for such research, the use of routine data provides an opportunity to gain insights on service provision and disease burden to inform decision-making. Integration of mental health data into the routine government M&E systems could promote improve data quality and availability in the longer term.

Conclusions
In resource-poor environments the roll-out of decentralised nurse-led MHU such as these new services in Sierra Leone can provide vital treatment, particularly to younger people, and people with epilepsy, psychosis, and psychological symptoms associated with stress, grief and trauma. The rate of depression was lower than expected indicating services were not meeting need in this area. The numbers of referrals and subsequent interventions increased during the study period but there is a need to further improve coverage and medication accessibility. The variation in the provision of clinical services warrants further exploration. This study addresses a research gap for the service utilisation of specialised nurse-led MHU in sub-Saharan Africa.

The results of this study have been disseminated to policy makers and clinical staff in Sierra Leone, to support the development of recommendations on training, mentorship, data collection and use. Findings were used to inform and advocate for the approval of the recently launched MOHS Mental Health Policy and Strategic Plan 2019–2023, which includes targets for training more mental health professionals and improving research capacity and M&E. Further evaluation following the roll-out of this plan will help to identify progress and bottlenecks to the provision of high-quality mental health services.
Appendices

Appendix 1 District Mental Health Unit Monthly Data Form

| Name of unit:                           |
|----------------------------------------|
| Month:       | Year:       |

New referrals to the MH unit during this month

| Total number of received referrals during this month |
|-----------------------------------------------------|
| Total number of new patients seen during this month |
| Total number of inpatient referrals:                |
| Total number of outpatient referrals:               |

Referred by

| Self-referrals:                           |
|-------------------------------------------|
| District Hospital:                       |
| Ministry of Social Welfare:              |
| Sierra Leone Psychiatric Hospital:       |
| Ebola Survivor Clinic:                   |
| Other (please specify):                  |

Total number of patients in current caseload

| Number of inpatients: | Number of outpatients: |
|-----------------------|------------------------|

Age and gender:

| Males: | Females: |
|--------|----------|
| 0-14:  | 15-17:   |
| 18-24:  | 25-34:   |
| 35-44:  | 45-54:   |
| 55-64:  |          |
| Age group |   |
|-----------|---|
| 65-74:    |   |
| 75+:      |   |
| Age unknown: |   |

Diagnosis according MH-GAP

1. Epilepsy/Seizures: 
2. Alcohol or other substance use disorder:
3. Intellectual disability:
4. Psychotic disorder (including mania):
5. Moderate-severe emotional disorder/depression:
6. Other psychological complaint:
7. Medically unexplained somatic complaint:

Ebola related cases

|   |
|---|
| Number of Ebola survivors seen |
| Number of those indirectly affected by Ebola seen (not survivors) |

Suicide or deliberate self-harm

|   |
|---|
| Number of patients who attempted suicide or carried out deliberate self-harm |

Contacts

|   |
|---|
| Number of patients seen during this month (face to face contact) |
| Number of home visits carried out and contacts with patients outside the unit |
| Number of contacts with family/social network/organizations without patient (indirect) |
| Number of phone calls with patients or others |

Interventions
Appendix 2

See Table 4.
Table 4  Missing data—the number and proportion (%) of data entries that were complete and accurate, by category of the data sheet and by MHU (*report availability indicates that the MHU was operational; reports not available for months when clinics were not open)

| Mental Health Unit                        | Total no. of monthly reports* | Reports available (complete and accurate) according to categories | N (%) |
|------------------------------------------|-------------------------------|------------------------------------------------------------------|-------|
|                                          |                               | Sex Age Diagnosis Ebola survivors New patients Referral sources Psychotropic medication Psychological intervention Social intervention Medication not available Medication not affordable Total availability by MHU |
|                                          | 22                            | 22 (100.0) 22 (100.0) 22 (100.0) 22 (100.0) 22 (100.0) 22 (100.0) 22 (100.0) 22 (100.0) 22 (100.0) 22 (100.0) 22 (100.0) 242 (100.0) |
| 34 Military Hospital                     | 22                            | 1 (4.3) 20 (87.0) 23 (100.0) 23 (100.0) 23 (100.0) 22 (95.7) 23 (100.0) 23 (100.0) 23 (100.0) 23 (100.0) 23 (100.0) 227 (89.7) |
| Bo Government Hospital                   | 23                            | 18 (78.3) 9 (39.1) 23 (100.0) 23 (100.0) 21 (91.3) 23 (100.0) 13 (56.5) 23 (100.0) 20 (87.0) 14 (60.9) 15 (65.2) 202 (79.8) |
| Bonthe Government Hospital              | 23                            | 15 (75.0) 14 (70.0) 12 (60.0) 19 (95.0) 19 (95.0) 14 (70.0) 19 (95.0) 19 (95.0) 19 (95.0) 14 (70.0) 8 (40.0) 172 (78.2) |
| China-Sierra Leone Government Hospital | 20                            | 16 (100.0) 16 (100.0) 16 (100.0) 16 (100.0) 12 (75.0) 16 (100.0) 16 (100.0) 12 (75.0) 15 (93.8) 15 (93.8) 165 (93.8) |
| Connaught Hospital                       | 22                            | 22 (100.0) 22 (100.0) 14 (63.6) 22 (100.0) 22 (100.0) 22 (100.0) 22 (100.0) 20 (90.0) 0 (0.0) 0 (0.0) 188 (77.7) |
| Kabala Government Hospital              | 22                            | 16 (100.0) 16 (100.0) 15 (93.8) 15 (93.8) 16 (100.0) 16 (100.0) 14 (87.5) 14 (87.5) 8 (100.0) 0 (0.0) 6 (75.0) 4 (50.0) 72 (81.8) |
| Kailahun Government Hospital            | 16                            | 1 (4.2) 1 (4.2) 1 (4.2) 21 (87.5) 21 (87.5) 7 (29.2) 14 (58.3) 13 (54.2) 7 (29.2) 13 (54.2) 12 (50.0) 111 (42.0) |
| Kambia Government Hospital              | 8                             | 8 (100.0) 8 (100.0) 8 (100.0) 8 (100.0) 8 (100.0) 7 (87.5) 7 (87.5) 8 (100.0) 0 (0.0) 6 (75.0) 4 (50.0) 72 (81.8) |
| Kenema Government Hospital              | 24                            | 11 (57.9) 6 (31.6) 8 (42.1) 19 (100.0) 17 (89.5) 6 (31.6) 19 (100.0) 17 (89.5) 6 (31.6) 5 (26.3) 5 (26.3) 119 (56.9) |
| Koidu Government Hospital               | 19                            | 6 (25.0) 5 (20.8) 4 (16.7) 24 (100.0) 24 (100.0) 23 (95.8) 19 (79.2) 22 (91.7) 7 (29.2) 21 (87.5) 21 (87.5) 176 (66.7) |
Table 4 (continued)

| Mental Health Unit | Total no. of monthly reports* | Reports available (complete and accurate) according to categories | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | Total availability by MHU |
|-------------------|-----------------------------|------------------------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------------------------|
|                   | Sex | Age | Diagnosis | Ebola survivors | New patients | Referral sources | Psychotropic medication | Psychological intervention | Social intervention | Medication not available | Medication not affordable |                           |
| Makeni Government Hospital | 20  | 20 (100.0) | 20 (100.0) | 20 (100.0) | 20 (100.0) | 19 (95.0) | 5 (25.0) | 15 (75.0) | 1 (50) | 18 (90.0) | 18 (90.0) | 176 (80.0) |
| Moyamba Government Hospital | 12  | 5 (41.7) | 4 (33.3) | 4 (33.3) | 11 (91.7) | 12 (100.0) | 7 (58.3) | 8 (66.7) | 11 (91.7) | 2 (16.7) | 6 (50.0) | 6 (50.0) | 76 (57.6) |
| Ola During Children's Hospital | 10  | 0 (0.0) | 9 (90.0) | 2 (20.0) | 10 (100.0) | 10 (100.0) | 9 (90.0) | 0 (0.0) | 10 (100.0) | 9 (90.0) | 10 (100.0) | 10 (100.0) | 79 (71.8) |
| Pujehun Government Hospital | 20  | 10 (50.0) | 10 (50.0) | 1 (5.0) | 19 (95.0) | 20 (100.0) | 16 (80.0) | 18 (90.0) | 19 (95.0) | 20 (100.0) | 13 (65.0) | 13 (65.0) | 159 (72.3) |
| Total availability by category | 285 | 177 (62.1) | 188 (66.0) | 179 (62.8) | 279 (97.9) | 277 (97.2) | 230 (80.7) | 227 (79.6) | 262 (91.9) | 168 (58.9) | 202 (70.9) | 194 (68.1) |
Acknowledgements
The authors would like to thank the mental health nurses of Sierra Leone for their hard work and contribution to the data for this study.

Authors’ contributions
HH made a substantial contribution to the study design and literature review, data collection, data entry and cleaning, conducted the data analysis for descriptive data, and made a substantial contribution to writing and editing the manuscript. SS made a substantial contribution to the study design, literature review and data collection, contributed to the data entry, cleaning and analysis, made a substantial contribution to the data interpretation, and writing and editing the manuscript. MOH conducted the statistical data analyses, contributed to writing and editing the manuscript and reviewed drafts of the manuscript. DH contributed to writing and editing the manuscript and reviewed drafts of the manuscript. KC supported the study design, contributed to writing and editing the manuscript, supported the data interpretation and advised on data analysis, and reviewed drafts of the manuscript. AJB contributed to the conception and design of the study. FB contributed to the conception and design of the study, contributed to the data analysis, and reviewed drafts of the manuscript. All authors read and approved the final manuscript.

Availability of data and materials
The datasets analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The Ethics and Research Committee of the MOHS, Sierra Leone granted ethical approval to conduct this study.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

Author details
1 King’s Sierra Leone Partnership, King’s Global Health Partnerships, King’s Centre for Global Health and Health Partnerships, School of Population and Environmental Sciences, King’s College London, Freetown, Sierra Leone. 2 34 Regimental Military Hospital, Freetown, Sierra Leone. 3 Kings College London Centre for Global Health and Health Partnerships, School of Population and Environmental Sciences, Faculty of Life Sciences and Medicine, King’s College London, London, UK. 4 School of Public Health, Imperial College London, London, UK. 5 Sustainable Health Systems, Freetown, Sierra Leone.

References
1. Charlson FJ, Demakis J, Rutherford B, et al. Mental and Substance Use Disorders in Sub-Saharan Africa: Predictions of Epidemiological Changes and Mental Health Workforce Requirements for the Next 40 Years. PLoS ONE. 2014. https://doi.org/10.1371/journal.pone.0110208.
2. Araya R, Eaton J, et al. Global Mental Health 4: Scale up of services for mental health in low-income and middle-income countries. Lancet. 2011;378:1592–603.
3. Demytenaere K, Bruffaerts R, Posada-Villa J, Gasquet I, Koves V. Prevalence, Severity, and unmet need for treatment of mental disorders in the World Health Organization World Mental Health Surveys. JAMA. 2004;291:2581.
4. Shrivastava A, Johnston M, Bureau Y. Stigma of mental illness-1: clinical reflections. Mens Sana Monogr. 2012;10:70–84.
5. Fairall L, Bachmann MO, Lombard C, et al. Task shifting of antiretroviral treatment from doctors to primary-care nurses in South Africa (STRETCH): a pragmatic, parallel, cluster-randomised trial. Lancet (London, England). 2012;380:889–98.
6. Joshi R, Alim M, Kengep AE, et al. Task shifting for non-communicable disease management in low and middle income countries—a systematic review. PLoS ONE. 2014;9:e103754.
7. van Ginneken N, Thayan P, Lewin S, et al. Non-specialist health worker interventions for the care of mental, neurological and substance-abuse disorders in low- and middle-income countries. In: van Ginneken N, editor, et al., Cochrane database of systematic reviews. Chichester: John Wiley & Sons Ltd; 2013. https://doi.org/10.1002/14651858.CD009149.pub2.
8. Boothby N, Veatch M, Pentes M. Evaluating treatment of Axis I mental health disorders in Aceh. Indonesia Psychiatry. 2011;35:248–55.
9. Climent CE, Arango MV, Plutchick R. Development of an alternative, efficient, low-cost mental health delivery system in Cali. Colombia Soc Psychiatry. 1983;18:95–102.
10. Spencer M, Greville-Heygate F, Singer R, Rees J, MacDonagh R. Health Improvement Project Zanzibar: a new model of healthcare delivery. Trends Urol Men’s Health. 2015;35:59–9.
11. Alemu W, Funk M, Gakurah T, et al. WHO proMIND: Profiles on Mental Health in Development, Sierra Leone. Geneva; 2012. http://www.who.int/about/licensing/copyright_form/en/index.html. Accessed 26 Oct 2017.
12. Van Bortel T, Banayake A, Wure F, et al. Psychosocial effects of an Ebola outbreak at individual, community and international levels. Bull World Health Organ. 2016;94:210–4.
13. Betancourt TS, Board on Global Health, Institute of Medicine, National Research Council. The impact of war on child development and mental health: a longitudinal study of risk and resilience among former child soldiers in Sierra Leone: in forum on global violence prevention; social and economic costs of violence: workshop summary. https://www.resea rchgate.net/profile/Theresa_Betancourt/publication/320396855_THE_IMPACT_OF_WAR_ON_CHILD_DEVELOPMENT_AND_MENTAL_HEALTH_ALONGITUDINAL_STUDY_OF_RISK_AND_RESILIENCE_AMONG_FORDER_CHILD_SOLDIERS_IN_SIERRA_LEONE/links/59e111f10fe9b97f2eb2b5b83/TH. Accessed 26 Oct 2017.
14. Central Intelligence Agency. The World Factbook, 2017. https://www.cia. gov/library/publications/the-world-factbook/geos/sl.html. Accessed 24 Oct 2017.
15. UNDP Sierra Leone: sexual violence remains unpunished | UNDP; 2010. http://www.undp.org/content/undp/en/home/presscenter/pressrelease/2010/02/10/sierra-leonesequanoviolence-carrying-on-with-impunity.html. Accessed 24 Oct 2017.
16. Rees S, Silove D, Chey T, et al. Lifetime prevalence of gender-based violence in women and the relationship with mental disorders and psychosocial function. JAMA. 2011;306:513–21.
17. Enabling Access to Mental Health in Sierra Leone. Quarterly Newsletter, July 2011; 2011. https://enablingaccesstomentalhealthsl.files.wordpress.com/2011/08/newsletter-for-project1.pdf. Accessed 26 Oct 2017.
18. Ministry of Health and Sanitation. Mental Health Policy 2010–2015; 2010. http://www.moh.gov.sl/policies/mentalhealthpolicy2010-2015.pdf. Accessed 26 Oct 2017.
19. Saxena S. Atlas: Nurses in Mental Health 2007; 2007. http://apps.who.int/iris/bitstream/10665/43701/1/9789241563451_eng.pdf. Accessed 12 Feb 2018.
20. World Health Organization. WHO | mhGAP Intervention Guide for mental, neurological and substance use disorders in non-specialized health settings; 2010. http://www.who.int/mental_health/publications/mhGAP_intervention_guide/en/. Accessed 26 Oct 2017.
21. Harris D, Endale T, Lind UH, et al. Mental health in Sierra Leone. BJPsych Int. 2019;17:1–3.
22. Ra-Diop A, Marin B, Druet-Cabanan M, Ngoungou EB, Newton CR, Preux P-M. Epidemiology, causes, and treatment of epilepsy in sub-Saharan Africa. Lancet Neurol. 2014;13:1029–44.
23. UNICEF. Statistics | At a glance: Sierra Leone | UNICEF; 2013. https://www.unicef.org/infbycountry/sierraleone_statistics.html. Accessed 24 Oct 2017.

24. Kessler RC, Amminger GP, Aguilar-gaxiola S, Alonso J, Lee S, Ustun TB. Age of onset of mental disorders: a review of recent literature. Curr Opin Psychiatry. 2007;20:359–64.

25. Sciences AM. Model of decentralization and integration of mental health into primary health care a supplement to the mhGAP Program. 2017; 2.

26. Patel V. Explanatory models of mental illness in sub-Saharan Africa Soc Sci Med. 1995;40:1291–8.

27. Soroudi HR, Flisser AJ, Wilson ZDS. Explanatory models of mental disorders and treatment practices among traditional healers in Mpuumula, South Africa. Afr J Psychiatry African J Psychiatry. 2010;13:284–90.

28. Tol WA, Song S, Jordans MJD. Annual Research Review: resilience and mental health in children and adolescents living in areas of armed conflict—a systematic review of findings in low- and middle-income countries. J Child Psychol Psychiatry. 2013;54:445–60.

29. Betancourt TS, Brennan RT, Rubin-Smith J, Fitzmaurice GM, Gilman SE. Sierra Leone’s former child soldiers: a longitudinal study of risk, protective factors, and mental health. J Am Acad Child Adolesc Psychiatry. 2010;49:606–15.

30. World Health Organization. Ebola Situation Report - 28 October 2015 | Ebola, 2017. http://apps.who.int/ebola/current-situation/ebola-situation-report-28-october-2015. Accessed 24 Oct 2017.

31. Centers for Disease Control and Prevention. 2014 Ebola Outbreak in West Africa - Case Counts | Ebola Hemorrhagic Fever, 2016. https://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/case-counts.html. Accessed 26 Oct 2017.

32. Mory Keita M, Taverne B, Sy Savané S, et al. Depressive symptoms among survivors of Ebola virus disease in Conakry (Guinea): preliminary results of the PostEbOcGu cohort. BMC Psychiatry. 2017. https://doi.org/10.1186/s12888-017-1280-8.

33. Nanyonga M, Saidu J, Ramsay A, Shindo N, Bausch DG. Sequelae of Ebola Virus disease, Kenema District. Sierra Leone Clin Infect Dis. 2016;62:125–6.

34. Bowen L, Smith B, Steinbach S, et al. Survivors of Ebola Virus Disease Have Persistent Neurological Deficits. 2016 http://www.abstractsonline.com/pp8/?4046/presentation/8420. Accessed 9 Feb 2019.

35. Evlampidou I, Rabelo I, Fallah MP, et al. Psychological suffering among Ebola Virus Disease survivors in Monrovia, 2014–2015. Liberia. 2016. https://doi.org/10.7490/fl1000RESEARCH.1111850.1.

36. Qureshi AI, Chughtai M, Loua TO, et al. Study of Ebola Virus disease survivors in Guinea: Table 1. Clin Infect Dis. 2015;61:1035–42.

37. World Health Organization. GHO | By category | Suicide rates, crude—Data by country; 2017. http://apps.who.int/gho/data/node.main.MHSUI.CIDE?lang=en. Accessed 24 Oct 2017.

38. Schwartz-Lifshitz M, Zalisman G, Giner L, Oquendo MA. Can we really prevent suicide? Curr Psychiatry Rep. 2012;14:624–33.

39. John Mann J, Ellis SP, Waternaux CM, et al. Classification trees distinguish suicide attempters in major psychiatric disorders: a model of clinical decision making. J Clin Psychiatry. 2008;69:23–31.

40. Schöpperle A, Woodburn A. Analysis of challenges of medical supply chains in sub-Saharan Africa regarding inventory management and transport and distribution Project Thesis; 2013. http://1i4rh11vccjs3zh5v8cwkn2.wpengine.netdna-cdn.com/wp-content/uploads/2016/05/Medical-Supply-Chain-Challenges.Masterthesis.ASchöpperle.pdf. Accessed 11 Feb 2018.

41. Fitts JJ, Gbegbe F, Aber MS, Kaitibi D, Yokie MA. Strengthening mental health services in Sierra Leone: perspectives from within the health system. Health Policy Plan. 2020;35:657–64.

42. World Health Organisation. Mental health systems in selected low-and middle-income countries: a WHO-AIMS cross-national analysis WHO-AIMS, 2009. http://www.who.int/mental_health/evidence/who_aims_report_final.pdf. Accessed 24 Oct 2018.

43. Yoder HNC, Tol WA, Reis R, De Jong JTVM. Child mental health in Sierra Leone: a survey and exploratory qualitative study. Int J Ment Health Syst. 2016. https://doi.org/10.1186/s13033-016-0080-8.

44. World Health Organization, War Trauma Foundation, World Vision International. Psychological first aid: Guide for field workers, 2011. http://apps.who.int/iris/bitstream/10665/44651/1/9789241548205_eng.pdf. Accessed 24 Oct 2017.

45. Kuzek JZ, Rist RC. Ten Steps to a Results-Based Monitoring and Evaluation System;2004. https://openknowledge.worldbank.org/bitstream/handle/10986/14926/296720PAPER100steps.pdf?sequence=1&isAllowed=y. Accessed 5 Mar 2021.

46. WHO. WHO | Guideline development process. 2013. http://www.who.int/mental_health/mhgap/evidence/guidelines_process/en/. Accessed 6 Mar 2018.

Publisher’s Note
Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.