Severe Illness Management Support
Final Report
July 2015

1 Introduction
Beginning in July 2014, Walimu implemented the Severe Illness Management Support (SIMS) project in four facilities, Bwera Hospital, Kagando Hospital, Kilembe Mines Hospital and St. Paul Health Centre IV (HCIV), in Kasese District, Uganda. The project aimed to improve triage, emergency care and care for the severely ill, with an emphasis on HIV-infected patients. A private foundation (64% of total funds), and the IMAI-IMCI Alliance (36% of total funds) provided the initial project funding, through April 2015. With remaining funds and additional support from the World Health Organization, the program has been extended through July 2015.

1.2 SIMS Approach
SIMS grew from a simple observation: in low-income countries, most patients die of curable conditions because they are not identified and treated early enough. Often the essential resources to care for patients exist, but the necessary systems and provider behaviors for appropriately treating patients are missing. Drawing on a strong peer-reviewed evidence base which demonstrates that training alone is insufficient to change behaviors and systems, SIMS is a multi-pronged post-training quality improvement program designed to follow the WHO IMAI Quick Check+ (QC+) training course in triage, emergency care and management of the severely ill. SIMS includes five components 1) development of a hospital improvement plan and bi-weekly collaborative improvement meetings for an implementing team at the hospital; 2) data audit on vital signs measurement and severe illness management to provide a reliable metric of progress; 3) on-site mentoring by clinical experts and support-supervision visits by a program manager; 4) provision of essential equipment, including vital signs monitoring tools and oxygen equipment; and 5) access to guidelines on patient management, via mobile devices and print materials.

1.3 Objectives
Through this project, we aimed to improve the management of severely ill patients at four hospitals in the Kasese District, Uganda, and to provide a proof of concept for the SIMS approach by achieving the following objectives:

Objective 1: To determine the impact of the SIMS program on process measures related to the identification and appropriate management of severely ill patients.

Objective 2: To identify barriers to high-quality care of severely ill patients and to test interventions for improving adherence to evidence-based or consensus-based care for severely ill patients in resource-constrained settings.

1.4 Interventions
The project focused on five of the most common conditions leading to life-threatening severe illness among patients with HIV: shock, septic shock, severe respiratory distress, altered consciousness, and convulsions. We evaluated diagnosis and management of these conditions utilizing standards set by the WHO in its acclaimed Integrated Management of Adolescent and Adult Illness (IMAI) Program.

Under Objective 1, training on Quick Check+ for clinical, auxiliary, and management staff of all four hospitals was conducted prior to commencing the SIMS program. Concurrently, Walimu used standardized quantitative and qualitative approaches to assess triage and hospital processes related to diagnosis and management of severely ill patients and the capacity of each health facility to deliver high-quality care for the severely ill. In collaboration with local health facility managers, site-specific objectives were set on how these could be realigned to achieve this objective.
Under Objective 2, a theory-informed, multi-faceted intervention was tested to establish whether it could improve uptake of QC+ guidelines for managing severely ill patients. The multi-faceted SIMS intervention included the following components:

1. **Hospital improvement plan and bi-weekly collaborative improvement meetings.** During training, hospital teams developed improvement plans. Following training, an implementing team met bi-monthly to review progress on the implementation plan and performance from the data audit.

2. **Data audit on vital signs measurement and severe illness management.** In order to provide a reliable metric of project progress, data assistants collected process information using a standardized data collection tool on each patient admitted to the medical wards. Data were analyzed and fed back to hospital staff through bi-weekly printed reports distributed during collaborative improvement meetings and weekly SMS messages sent to individual clinical providers.

3. **On-site mentoring and support-supervision visits.** Expert clinical mentors visited each facility to track progress and run case management drills. A program manager visited each hospital 1-2 times a month to track progress on the implementation plan.

4. **Provision of essential equipment.** After a collaborative process with hospital staff whereby the hospital prioritized its needs for specific essential equipment, the project provided essential equipment for vital signs monitoring and management of emergency conditions, including pulse oximeters, blood pressure monitoring devices, thermometers, nebulizers, suction pumps, and oxygen cylinder heads.

5. **Access to guidelines and standards.** Guidelines from the WHO IMAI program’s District Clinician Manual (DCM) were given to the hospitals on a tablet to enable easy access by the clinicians. Those who had smart phones were guided on how to access the guidelines using AgileMD, a free, downloadable mobile software application. Guidelines were also provided in printed form.

### 1.5 Evaluation Methodology

The evaluation employed both qualitative and quantitative methods. For the qualitative data, staff systematically reviewed minutes and reports of collaborative meetings and focus group discussions in order to assess SIMS implementation during the intervention period. The qualitative data were used to corroborate quantitative findings generated from collected patient data and analyzed in DHIS2 and R. The methodology followed the evaluation matrix attached in the appendix. For the quantitative data, the evaluation used an interrupted time series design in which outcome data were collected at multiple time points before and after the multi-faceted SIMS intervention was introduced. This quasi-experimental design allows discrimination between improvements related to the interventions and improvements related to underlying secular trends in the pre- and post-intervention periods.

### 2 Findings

#### 2.1 Demographics and clinical characteristics of target population

Between August 2014 and May 2015, 6132 patients were enrolled at three hospitals and one health center IV: Bwera (36.5%), Kagando (19.5%), Kilembe Mines (37.8%), and St. Paul HCIV (6.3%). 1791 patients were enrolled prior to the beginning of the intervention and 4341 following the intervention. The median age was 34 at Bwera, 39 at Kagando, 35 at Kilembe Mines, and 29 at St. Paul HCIV. Across the four hospitals, 58% of patients were female and 42% were male.

#### 2.2 Vital signs collection

Vital signs monitoring is essential to proper management of severe illness, as it helps identify severely ill patients and allows earlier treatment initiation. The frequency at which hospital staff monitored and
recorded six vital signs (blood pressure, temperature, oxygen saturation, respiratory rate, heart rate, and level of consciousness or AVPU) for patients was assessed throughout the project.

Vitals signs monitoring was poor in the pre-intervention period, averaging 10.4% across all 4 sites. There was no significant upward trend in vital signs monitoring at any site. In the post-intervention period, there was an absolute 34.0% (95% CI 32.9% to 35.0%) increase in vital signs monitoring across all four sites in the post-intervention period. All sites experienced statistically significant improvements, ranging from 11% to 34.8% (all with p<0.01).

All data on patient clinical presentation were abstracted from patient records. As a result, where data were missing from records on vital signs monitoring, we may underestimate the overall burden of severe illness. Out of all patient days, 53.5% had blood pressure measured, 40.8% had temperature measured, 20.2% had oxygen saturation measured, 14.4% had respiratory rate measured, 29.0% had heart rate measured, and 9.5% had level of consciousness measured. Available data, however, suggest an extremely high incidence of severe illness. At least 26.6% of patients experienced an episode of severe illness at some point during their stay.

### 2.3 Severe illness prevalence and outcome

Patients experiencing severe illness were more than 5 times as likely to die during their hospital stay as patients who did not experience an episode of severe illness (10.0% vs. 2.0%, p<0.01). Of the 234 patients who expired during the study, 64.1% had abnormal vital signs measured and recorded on at least one day of their hospitalization.

Table 1 reports estimates of the frequency of each severe illness condition. For each severe illness condition, frequency is reported as the number of patient days that meet definition of severe illness over all patient days. Most frequent were shock (7.5% of patient days, 17.9% of patients experiencing shock during their stay) and severe respiratory distress (4.1% of patient days, 8.6% of patients experiencing severe respiratory distress during their stay).

<table>
<thead>
<tr>
<th>Condition</th>
<th>Patient days with severe illness identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shock</td>
<td>7.5% (1850 of 24,685 days)</td>
</tr>
<tr>
<td>Septic shock</td>
<td>0.9% (219 of 24,685 days)</td>
</tr>
<tr>
<td>Severe Respiratory Distress</td>
<td>4.1% (1006 of 24,685 days)</td>
</tr>
<tr>
<td>Convulsions</td>
<td>2.2% (537 of 24,685 days)</td>
</tr>
<tr>
<td>Altered consciousness</td>
<td>0.1% (35 of 24,685 days)</td>
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</tbody>
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Table 2. Breakdown of HIV status by hospital

<table>
<thead>
<tr>
<th>Facility</th>
<th>Patients HIV+</th>
</tr>
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<tbody>
<tr>
<td>Bwera</td>
<td>12.7% (101 of 794, 1444 unknown)</td>
</tr>
<tr>
<td>Kagando</td>
<td>7.1% (46 of 648, 547 unknown)</td>
</tr>
<tr>
<td>Kilembe</td>
<td>17.6% (117 of 665, 1649 unknown)</td>
</tr>
<tr>
<td>St Paul HCIV</td>
<td>23.2% (16 out of 69, 316 unknown)</td>
</tr>
</tbody>
</table>
Despite the fact that all four facilities conduct Provider Initiated Routine Counseling and Testing for HIV, only 31.1% of patients had HIV status documented on discharge. Of those with known status, 12.9% tested positive. Table 2 provides a breakdown of HIV status by hospital. Patients confirmed to be HIV-positive were more likely to have an episode of severe illness (41.8% vs. 31.2%, p<0.01) and more likely to die in-hospital (14% vs. 3.7%, p<0.01) than HIV-negative patients.

2.4 Severe illness management
In addition to patient monitoring, SIMS aimed to increase adherence to WHO guidelines for management of each severe illness condition. As initial vital signs monitoring rates were low, and data were collected through chart abstraction and not direct observation of patient care, we cannot directly assess the impact of the project on patient management. We further consider severe illness management in the discussion section.

2.5 Intervention-Specific Findings

*Hospital improvement plan and bi-weekly collaborative improvement meetings*
Teams from each hospital developed a hospital improvement plan during the QC+ training. To plan and track implementation of the plan, hospitals held an average of eleven collaborative meetings. Meetings included staff trained in QC+, ward clinicians in charge, and management personnel. In each meeting, data audit feedback (described below) was shared. Improvement at the highest performing sites may have been attributable to utilization of collaborative meetings to develop interventions focused on the following issues: harmonization of patient monitoring charts, improved recording of patient data, continued education on how to monitor vital signs, and the institution of a culture of improvement.

Significant improvements were observed in each hospital’s processes. All the four sites created a designated area for managing emergencies at OPD. Emergency drugs are stored in these designated areas. On the wards, all four hospitals reserved two beds near the nursing area for patients who were severely ill.

Records processing also changed significantly at all four sites. All hospitals developed new charts for monitoring vital signs. Kagando completely overhauled its admission and patient monitoring charts. Bwera, the only government hospital, decided to print its own charts, as the ones that were supposed to be sent from the National Medical Stores in Kampala seldom arrived on time.

*Data audit on vital signs measurement and severe illness management*
On-site data assistants collected data daily. These assistants were trained and paid by Walimu and stationed at the facility. The program manager conducted data cleaning and audited the quality of data collection. Reports were produced bi-weekly and distributed during quality improvement meetings. In addition, SMS messages highlighting performance on selected indicators were regularly sent to hospital staff.

Data audit reports framed discussions and objectives of the hospital staff. In particular, they appeared to motivate hospital staff at all facilities to focus on improving basic monitoring by highlighting the initial low rates of monitoring across patients.

*On-site mentoring and support-supervision visits*
All hospitals had at least two mentoring visits, during which a clinical mentor reviewed hospital processes and supported the development of improvement plans for the hospital. Hospitals received regular support-supervision visits, during which the Walimu program manager monitored progress and assisted in project implementation. Each hospital also had at least one support supervision visit during which hospital staff developed a cascade of care, or sequence of appropriate steps to manage a particular condition, that was tailored to their hospital. Based on the cascade of care, Kagando Hospital was able to source funds from partners to provide oxygen concentrators to close barriers in management of severe respiratory distress.
**Provision of essential equipment**

The project provided equipment to each hospital for vital signs monitoring and emergency treatment. Hospitals received the following vital signs monitoring equipment: pulse oximeters, blood pressure machines, thermometers, and glucometers. In addition, hospitals received the following equipment for emergency treatment: nebulizers, suction pumps, and oxygen cylinder heads.

Provision of equipment appeared to have a significant effect. For instance, at baseline, hospitals generally were constrained in terms of oxygen management. Only two of the four sites had pulse oximeters and these were stationed on the maternity wards only. Three hospitals had oxygen cylinders with oxygen but actually lacked cylinder heads required to deliver and control the flow of oxygen. Post-intervention, all hospitals had access to pulse oximeters and functioning oxygen cylinders on general medical wards.

**Provision of guidelines and standards.**

Each hospital received a tablet with a mobile version of the IMAI District Clinician Manual loaded. In addition, clinicians with smartphones were provided access to the same mobile app. In all hospitals, the teams opted not to make the tablet publicly available on the ward but rather to assign it to specific clinicians. Feedback from the collaborative improvement meetings indicated that most staff members were unable to access the guidelines on their phones as they did not have smartphones. Although the cost of this intervention was relatively small compared to other components, the efficacy of this intervention is unproven, and it may be held in reserve in future iterations of SIMS until smartphone penetration increases.

**2.5 Factors influencing the effectiveness of the interventions**

**Influence of internal factors**

Management style and organization culture: The degree to which management was involved in the project appeared to influence outcomes. Sites where the hospital senior management had greater involvement were more responsive to process changes. Kagando and St. Paul, where the Principal Nursing Officer and/or head Administrator led quality improvement initiatives, showed greater improvement compared to Kilembe, where the management was less enthusiastic. Attitudes and orientation of the staff appeared dependent on the tone set by management. At Kagando, management held staff accountable for performance and improvement was greater compared to hospitals with less strict management, such as Bwera.

Resources: Higher resource availability at times appeared to have a paradoxical effect. Bwera, Kagando, and St. Paul were more responsive to identifying possible solutions to barriers to care, such as realigning the cascade of care for severe respiratory distress, despite larger resource constraints. By contrast, Kilembe, which had significant equipment in stock, was less responsive, rationing care instead of prioritizing process improvements.

**Influence of external factors**

Patient population: The patient load at Bwera is higher, where services are free. This in turn increased the burden on staff and available resources. We conclude this likely constrained vital sign measurement and other key management tasks, as the hospital staff was frequently overwhelmed. By contrast, patients pay for services at Kagando and St Paul, providing staff and management a greater incentive to maintain the appearance of quality services.

**2.6 Sustainability of the overall SIMS approach**

No hospital in this project had the resources to sustain the full SIMS approach after project conclusion. However, all hospitals adopted some aspects of the approach, described below. In addition, we believe that with ongoing technical assistance from Walimu, it may be possible to sustain data collection and audit, a feature of the program we believe is particularly important in sustaining improvements.
1. Monitoring charts. Two hospitals, Kagando and St Paul, have fully overhauled their admission and patient monitoring charts to include more vital signs and fluid admissions. Bwera and Kilembe have also made minor adjustments to their charts.

2. Learning wards rounds. St Paul HCIV has adopted use of learning ward rounds once a week. This meeting brings together multiple cadres from the health center to fill knowledge gaps.

In addition, in conversations with officials from Uganda Ministry of Health (MoH) and the World Health Organization, Uganda Country Office, we have found interest for expanding and formalizing the SIMS approach to quality improvement. As the program grows and matures, we are optimistic that in collaboration with MoH we can continue the intervention at hospitals throughout the country.

3 Discussion

Impact of SIMS on process measures
SIMS was highly successful at improving the monitoring of patient vital signs, a fundamental requirement for high quality management of the severely ill. Prior to the intervention, vital sign measurements were often limited to blood pressure and temperature. SIMS appears successful at shifting norms at hospitals towards collection of all vital signs on all admitted patients, a change that should increase the recognition and treatment of severely ill patients.

Identifying barriers to high-quality care and testing interventions for improved management
SIMS may have contributed to improved management of severe illness, but further data collection is necessary to establish an effect. Qualitative findings, however, suggest that the SIMS interventions effectively target the key barriers to appropriate management. Improper management was often due to multiple causes, including knowledge, resource and process constraints. SIMS appears effective at removing each of these constraints, improving knowledge of basic practices, such as fluid administration for shock patients, increasing essential resources, such as availability of pulse oximeters, and fixing processes, such as the cascade of care for severe respiratory distress.

An anecdotal example suggests how SIMS might improve management of severe illness. Staff members at Kagando noted challenges with oxygen delivery. As appears to be often the case in such hospitals, Kagando had some capacity to provide oxygen, including oxygen cylinders, but a few key resources (pulse oximeters and oxygen concentrators) were missing and a key process (consistently refilling oxygen) was not well implemented. SIMS was introduced in September, and by October the hospital management became aware of challenges in managing hypoxemic patients through SIMS collaborative improvement meetings. This awareness led to procurement of three oxygen concentrators.

In August and September, monitoring was low and Kagando only identified 71 instances of severe respiratory distress. Even where patients were identified, they did not receive appropriate care: only 11 (15.5%) received oxygen. However, in October and November these numbers dramatically increased. Kagando, as it increased its monitoring, identified 882 instances of severe respiratory distress. Crucially, hospital staff responded to 596 (67.6%) of those instances with oxygen.

Summary of the SIMS pilot study
These findings illustrate the impact of quality improvement efforts, such as those comprising the multi-faceted SIMS intervention, on process measures required for the appropriate management of severe illness conditions. Moreover, our experience suggests that barriers to high-quality care are small and surmountable. Hospitals often have the resources and motivation to provide basic care for severe illness; they just need the right combination of encouragement and support to fix broken processes of care. Future efforts will validate the ability of SIMS to improve patient management and outcomes, but early indications suggest SIMS has strong potential to transform care.
While we were unable to demonstrate the impact of the SIMS program on mortality, other studies have demonstrated significant effects of improved severe illness management on patient mortality.² Putting these data together, the high burden of mortality potentially attributable to these conditions suggests a large effect on the quality of management might have an effect on overall hospital mortality. Ultimately, the SIMS model holds significant promise for the challenging task of improving hospital quality in developing countries.

Relevance of SIMS to hospitalized HIV+ patients

With only 31% of patients having documented HIV status upon discharge, our data reveal that a considerable number of severely ill patients who present to Ugandan hospitals are not receiving appropriate screening for HIV despite the presence of Provider Initiated Routine Counseling and Testing for HIV at these institutions. Yet, we also found that patients with confirmed HIV infection were more likely to have signs and symptoms of severe illness than patients without HIV. Therefore, an overall improvement in management of severely ill patients through improved processes of care in Ugandan hospitals will lead to improvement in the management of HIV+ patients. Such improvement can lead to improved survival of hospitalized HIV+ patients and can help to channel these patients into appropriate HIV care and treatment after they are discharged.

One example of how process of care improvement in severely ill HIV+ patients can lead to improved outcomes is in the management of HIV+ patients who have tuberculosis (TB) co-infection. Since 2007, there have been recommendations to empirically offer a full course of TB treatment to patients with severe illness, as defined by heart rate, temperature, respiratory rate, and inability to walk. Two studies suggest empirical TB treatment based on abnormal vital signs reduces mortality in HIV+ patients. Holtz et al. (2011) found this approach reduced mortality by 11%.³ In addition, in a study conducted by several members of the Walimu team, Katagira et al. (2012) found this approach reduced mortality by 17%.⁴ Importantly, previous research concluded that these guidelines are difficult to implement and should be reconsidered, after finding not a single chart included a complete vital signs assessment in a regional referral hospital in Mozambique.⁵ The SIMS approach demonstrates that rather than abandoning guidelines that appear to significantly reduce mortality, small investments in hospitals can create the necessary conditions for appropriate application of the guidelines and reduced patient mortality.

4 Future plans

The SIMS model appears to be effective at changing practitioner behavior. Further work is necessary to optimize the mix and implementation of interventions and develop strategies for better engaging hospital administration. In addition, although this study provided some qualitative evidence of impact on management of severe illness, further work is necessary to directly establish impact on patient management and patient outcomes.

Walimu plans to expand SIMS to 16 hospitals already slated for training in the IMAI Quick Check+ scale up over the next year. This will give Walimu the opportunity to further validate the SIMS model, with an aim of eventually scaling the project to hospitals across Uganda. The next iteration of SIMS will incorporate refinements developed throughout the course of this project and cover a longer time period. HIV status is itself an additional severe illness “vital sign”, and given the low testing rates and high mortality associated with HIV-associated severe illness, we will specifically focus on improving provider-initiated HIV counseling and testing and management of severe illness in HIV-infected patients.

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