LifePumpLink data revealing near 100% "uptime"

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Background

Design Outreach (DO) has designed a hand pump, the LifePump™, that can reach up to 150 meters deep and has a targeted operational hardware lifespan of 30 years, with five-year maintenance intervals under typical usage. Through data collected from the LifePumpLink™ – a remote monitoring data system developed in collaboration with SonSet Solutions – it is now possible to directly measure daily pump usage. The LifePumpLink collects and transmits data through a sensor attached to the LifePump. DO has developed a custom user interface and dashboard to present the data in a meaningful format and translate operational data into real-time actionable indicators, alerts, and recommendations. Development plans include a predictive maintenance analytics module, which would allow government water ministries, non-governmental organizations (NGOs), and private sector partners to account for wide variation in pump usage and anticipate and proactively plan preventative maintenance checkpoints.

Methods

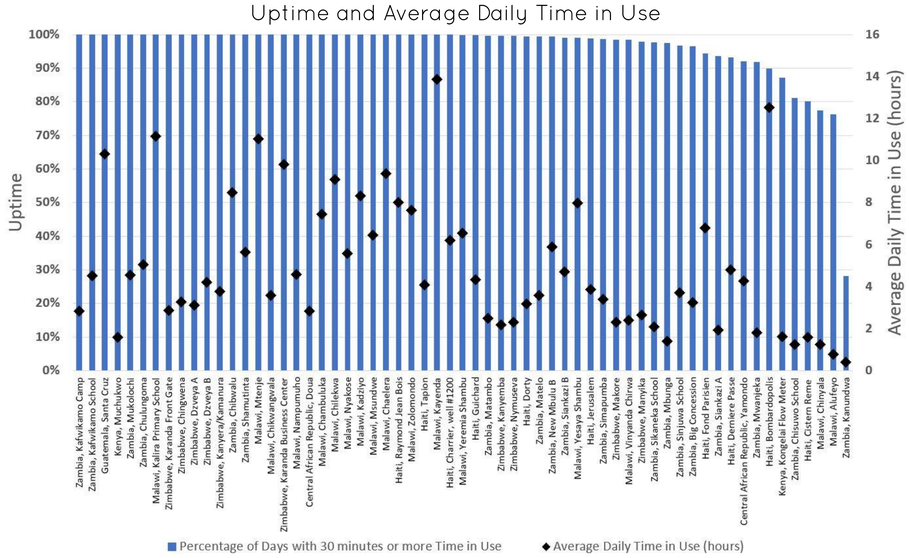
As of June 2021, sixty-one (n=61) LifePumps from Malawi, Zambia, Zimbabwe, Haiti, Central African Republic, Kenya, and Guatemala were monitored for an average of 288 days, with a minimum of 23 days and maximum of 867 days. Over half of the pumps in the study were monitored for more than 6 months. The study included a mix of recently-installed pumps and the original LifePumps installed in a World Vision pilot program from 2013 to 2017. Average pump age was 2.9 years (min = 0.3 years, max = 7.6 years). The average pump depth was 58.0 meters (min = 18 m; max = 150 m).

The LifePumpLink monitors provided a daily count of total number of pump rod rotations and time in use. The data in the current study represents over 720,000,000 pump rod rotations and nearly 98,000 hours of usage. The LifePumpLink dashboard includes a 'low usage' alert that is triggered when pump daily time in use is below 30 minutes. This was used to calculate percent uptime in this study.

$$Percent\ Uptime = \frac{Number\ of\ days\ LifePump\ was\ used\ at\ least\ 30\ minutes}{Total\ number\ of\ days\ LifePumpLink\ has\ been\ installed}$$

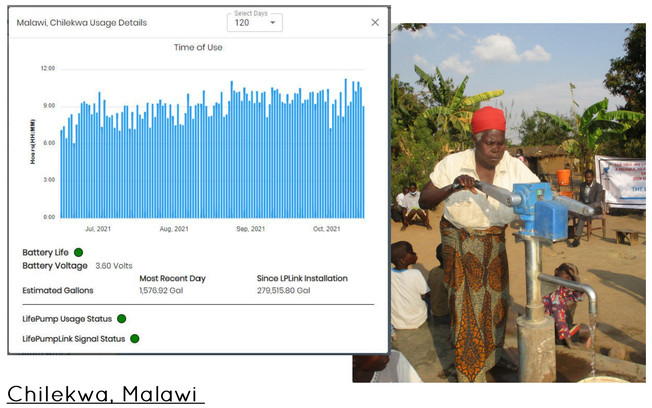
Results

Results demonstrated that 46 LifePumps experienced greater than 98% uptime as defined in the Methods section. Nine pumps experienced 90-98% uptime and six pumps experienced less than 90% uptime. Overall average uptime (n=61) was 95%. For LifePumps with less than 98% uptime, follow-up with field partners suggested that usage may be low on certain days due to availability of other water sources (rain, nearby boreholes), low yield boreholes, or in a few cases, LifePump-related maintenance (n=4). Communities with less than 98% uptime are shown in the table below.

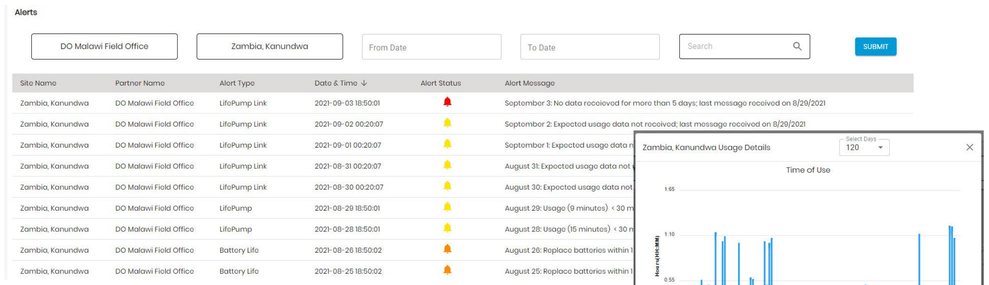


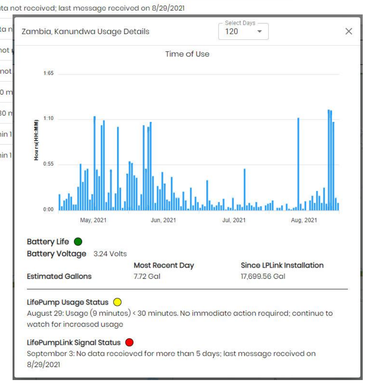
Conclusions & Next Steps

Results from LifePumpLink remote monitors have demonstrated that 95% uptime is possible, even in high-use and deeper pumps, when using appropriate and long-lasting hand pump technology. Design Outreach is positioned to provide the premiere solution for not only near 100% uptime but also resource management, both for staff deployment to communities with pumps, and for community funding for pump maintenance. DO has developed a custom dashboard and mobile app to present LifePumpLink data in a meaningful format, translating operational data into real-time actionable indicators, alerts, and recommendations. Design Outreach is also building a predictive maintenance analytics module which would allow government water ministries, non-governmental organizations, and private sector partners to better account for the wide variation in pump usage and to anticipate and proactively plan preventative maintenance checkpoints.



<u>Chilekwa, Malawi</u>
Pump Depth: 81 meters
Installation Date: Nov 17, 2013
Average Daily Usage: 9 hours 13 minutes
Narrative: 2nd LifePump ever installed; has been running 8 years nonstop with 1 preventative maintenance cycle completed





<u>Kanundwa, Zambia</u>
Pump Depth: 52 meters
Installation Date: Jan 23, 2015
Average Daily Usage: 23 minutes
Narrative: Lowest usage LifePump due to proximity to another water source. LifePump is used as 'back-up' water source and often triggers the dashboard low usage alert (see in alert history).

The red flag for LifePumpLink signal also indicates that the monitor has stopped sending signals, which is likely due to need for new batteries (see battery alerts on Aug 25/26).

Communities with <98% Uptime

Location	Non-mechanical reasons	LifePump maintenance
ZAM, Kanundwa	•	
MWI, Alufeyo	•	
MWI, Chinyala	•	
HAT, Cistern Reme	•	
ZAM, Chisuwo		•
KEN, Kongelai	•	
HAT, Bombardopolis		•
ZAM, Mwanjeka	•	
CAR, Yamondo	•	
HAT, Derniere Passe		•
ZAM, Siankazi A		•
HAT, Fond Parisien	•	
ZAM, Big Concession	•	
ZAM, Sinjuwa School	•	
ZAM, Mbunga	•	

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