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\textbf{ABSTRACT}

The rapid growth of Internet and increasing interest in its usage has led to an acceleration of digitisation of printed documents and making available born digital documents online. Zambia’s research output is primarily in print and not much is disseminated globally. It is against this background that innovations for digital libraries have been started in several African countries, including Zambia. The overall objective of the African Digital Health Library Zambia was to increase the health content that is held in the University of Zambia Institutional Repository by digitising publications produced by various institutions in Zambia, with a vision of capturing over 6,000 current and historical materials. Equipment was acquired and sensitisation meetings were held with various stake holders to ensure successful project initiation and sustainability. Scanning and uploading of documents was done after a technical expert had trained both Library and Information Technology staff on Dspace software. Marketing the digital library within the institutions and nationally was also conducted. In June 2018 there were 266,838 downloads of materials. Challenges of collecting required materials from relevant stake holders and convincing them to make available their content were encountered in the process. Enhanced collaboration and sensitisisation of stakeholders were essential in ensuring the successful implementation of the project.

\textbf{Key words:} Africa Digital Health Library, Institutional Repository, Health Information, Health Library, Health Research, University of Zambia, Zambia.
**Introduction**

Digital Libraries have received wide attention in recent years, allowing access to digital information from anywhere across the world (Ambati et al., 2006). This has been hastened by rapid growth of the Internet and increasing interest in its usage, leading to digitisation of printed documents and making available born digital documents online. Instead of libraries being the many source of information, scientists now have access to vast information via the internet (Shuman, 2001). Ghosh and Kumar (2006) further argues that even though a lot of literature can now be accessed freely on the Web, significant amounts of research is still not available freely to scientists from developing countries, including Zambia. Equally, although a lot of research has been conducted in Zambia, the spatial location of this research output is disjointed and difficult to access making its dissemination locally and internationally problematic. The invisibility of unpublished University of Zambia (UNSAW) and other higher learning institutions in Zambia research materials on the Internet may influence its ranking on the world university rankings and reduce its profile and rating. The Ministry of Health (MOH) on the other hand produces health related publications during its operations and programmes, however, these publications are not easily accessible and visible to the public.

Considerable effort and institutional resources are spent on conducting this research, whose results need to be effectively distributed, making them accessible for reuse so that evidence is built on previous results. It is for this reason that many academic institutions are nurturing institutional initiatives to promote open access to the research output being conducted in their institutions through establishing institutional repositories. Repositories are “digital archives of intellectual products created by the faculty, researchers, staff and students for access to the world over. These digital libraries may contain publications, such as, articles, conference papers, research reports, theses, dissertations, seminar presentations, working papers and other scholarly items. This way, intellectual contributions of researchers are shown to the whole community of researchers across the world (Ghosh and Kumar, 2006).

In the health sector, this helps support the research and development of vaccines and medicines for communicable and non-communicable diseases that primarily affect developing countries and eventually result in the attainment of Sustainable Development Goal 3 which aims to “Ensure healthy lives and promote wellbeing for all at all ages” (World Health Organisation, 2019). Adjei, Mensah and Amaofu (2019) asserts that an institutional repository is a recognition that the intellectual life and scholarship of an academic institution will increasingly be represented, documented, made visible and shared in digital form, and that the primary responsibility of academic institutions are to be the custodians of this information by preserving it and making it available over a variety of platforms (Lynch, 2003). It is therefore, noteworthy that institutional repositories help in ensuring long-term preservation and availability of digital materials while increasing their visibility (Anenene and Oyewole, 2017).

These digital libraries with content of local relevance will encourage communities to make use of library services, especially if they are empowered to participate in the development of the content. As for students, by using the same content, they can learn scientific and scholarly practices in ways more consonant with that of scholarly communities (Greyling and Zulu 2010). The issue of relevance to the community in which the repository serves is critical to its success. That is why Kavulya (2006) emphasises the need to amass digital information content that is relevant to the communities in Sub-Saharan Africa and which is based on needs analysis to determine the requirements of local communities to meet the
needs of the entire region. For example, decision and opinion leaders, researchers and communities need access to a wide array of information resources covering health issues/conditions facing the region such as Ebola, Cholera, HIV and AIDS, and Malaria to mention the major ones. In most communities in sub-Saharan Africa, the communities are in need of information for their daily existence; this information may be to education, health, sanitation, culture, education, nutrition, justices, recreation and business (Mchombu and Mchombu, 2014; Kanyengo, 1998). This kind of information helps communities focus on their situations and how it can be changed thereby leading to health lives. It is against this background that innovations for digital libraries started in several countries, including Zambia. The Africa Digital Health Library (ADHL) is one such digital library that was implemented at the UNZA Medical Library in 2017, to assist researchers by facilitating the curation, use and dissemination of their intellectual output. This was an initiative taken up by Medical Librarians from five academic institutions in the Sub Saharan Africa: Kenya (Kenya Methodist University and University of Nairobi), Mali (University of Bamako), Nigeria (University of Ibadan), Zambia (University of Zambia) and Zimbabwe (University of Zimbabwe) (Kanyengo, 2018) to digitally preserve and disseminate all the significant health content locally produced in their respective institutions and countries in order to meet the health information needs of local communities. The project was funded by the Office of the Global AIDS Coordinator (OGAC) / United States Department of State and the United States National Library of Medicine, National Institutes of Health.

### Programme description

The overall objective of the ADHL Zambia was to increase the health content that is held in the Medical Library digital health repository of the University of Zambia. In order to achieve this objective, the Medical library locally digitises publications produced by the University of Zambia, Ministry of Health and other Public and Private Medical Universities as well as uploading of born digital records, facilitating access to information in the field of public health and medicine. The following were among some of the specific objectives of the project:

- “Build a digital health repository that is freely accessible online.
- Digitise a critical mass of content from the University which will consist of theses, dissertations, medical journals, reports, and publications from the Ministry of Health such as reports, policy documents and strategic documents.
- Promote the use of available open access health content among healthcare practitioners, researchers and students.
- Promote mentorship activities by UNZA Librarians to provincial librarians so as to ensure success of the project.
- Formulate and implement the IR policy.

The objectives were meant to guarantee the formation of an online indigenous digital library containing valuable health content from Zambians and on Zambia. Additionally, the digital library were to encompass materials produced by local health researchers and institutions to develop the content for this library which would in turn create an enabling environment for communities which are in the rural areas to become part of the global information society through their active participation. The project also had as one of its aims, the building of capacity of librarians in these institutions.
Project planning

The initial planning and background work commenced with development and approval of a proposal. A list of major stakeholders, project technical and functional team was made and project deliverables specified. Other specifications were dependencies, timelines and potential issues were defined in the project agreement. Project committees and teams were constituted, and a project manager was appointed for the smooth running of the project.

A meeting was held to discuss the responsibilities of all the personnel on the project and after this meeting, changes were made where it was really necessary with the approval of the funders. The members were happy to be part of the project but Individual Financial Support (IFS) i.e. monetary support to project was one of the contentious matter that arose out of the meeting. The issue concerning monetary support to project staff was later clarified by the project funders that project personnel were not budgeted for and that only the Information Technology Technical Support Specialist from the Institute of Development Studies (IDS), United Kingdom and the University Student Assistants would receive monetary support. This information was disseminated to all the project personnel who agreed to work on the project pro bono. After these agreements, the project was formally launched on 15th February, 2018 and implementation of project activities commenced.

According to Kavulya (2006) digital libraries depend on Information and Communication Technologies (ICT) infrastructure to facilitate distribution processing, high-speed networks, information processing, storage and retrieval, user interfaces, geographical distribution, security, high quality presentation and perpetual availability of digital information. There was need therefore to use modern information and communication technology as a strategy of choice in achieving the intended objectives. Digitisation equipment such as Computers, Scanners, Laptops and other equipment including a computer server were procured. Kavulya (2006) asserts that for digital libraries to succeed, there is need for collaborative efforts; collaboration between different stakeholders such as those who create information and the people who use it for their needs. In this regard, library staff must also collaborate with other players in the information field such as researchers, Information Technology (IT) specialists, information seekers and information providers, content creators and publishers. In view of this a successful Sensitisation Meeting was held with a total of 15 Administrators from the Ministry of Health Head Office and the Zambia National Public Health Institute, a department of the Ministry of Health. Additionally, Lecturers, Assistant Deans Research and Assistant Registrars from the School of Medicine, School of Nursing Sciences, School of Public Health, and School of Health Sciences of the University of Zambia. All participants pledged to support the project by providing the needed content whenever requested, perhaps understanding the need for collaboration and working together to achieve a mutual goal. Collaboration and knowledge sharing not only contributes to the preservation of information but also bring about cross-cultural understanding and tolerance and improvement of social cohesion in the community (Greyling and Zulu, 2010).

During the meeting with administrators, a number of concerns were raised, one being security of the information stored on the server. However, this was clarified that all IT related security were the responsibility of the IT Security department in the Centre for Information and Communication Technology (CICT) at the University of Zambia. Co-operation and networking is key to the success of any project and that is why Kavulya (2006) has contended that it could lead to wider access to collection and enhanced operations by sharing resources, hence reducing on duplication and offering more cost-effective services through capacity building initiatives. Prior to the
commencement of scanning and uploading of content on the online platform, a two day workshop was held at Nomads Court Lodge in Lusaka where ten (8) Provincial Nursing School Librarians, Five (5) Local University Librarians, one (1) representative from Ministry of Health Zambia National Public Health Institute, five (5) UNZA Medical Library staff, Two (2) IT personnel from UNZA Main Library and two (2) representatives from the University of Zambia Center for Information Communication and Technology (CICT) attended the workshop. At the workshop, a technical expert from the United Kingdom trained both Librarians and IT staff on the Dspace software. The initial aims of the workshop were to inform and raise awareness amongst workshop participants about ADHL, why it was initiated and the issues it was trying to solve as well as key features that ADHL would support such as visibility, discovery, and access of content to support programming, practice, policy and teaching for example; and linkages to other similar digital libraries in Africa, to enable workshop participants help define the ADHL in terms of the core requirements that would support the project objectives, and these were not limited to the look and feel, metadata fields, subjects, interoperability. Participants were taken through the existing platform highlighting the key areas such as content selection, cataloguing, copyright clearance, digitisation, required metadata, and ingesting the content into the platform. Participants were also taken through the platform’s interoperability and statistics capabilities. Nevertheless, this was not fully accomplished because ADHL Zambia platform had not yet been created during the time of the workshop hence this opportunity presented a chance to show the participants screenshots of what they were to expect once the archiving of materials into the ADHL Zambia Online Platform starts.

**Strategy**

The need for the ADHL is well articulated as “to create universal access for a digital library of theses, dissertations, and reports in the fields of public health, science and medicine. The existing University of Zambia library infrastructure was used as a platform on which the programme was launched so as to ensure sustainability. Both Print and Born digital content were input in the IR. Print content went through digitisation and OCR (Optical Character Recognition) process. Submissions of content were done at the source of the material with quality control checking and final publishing done by the UNZA Medical library. Since some institutions that attended the workshop had no capacity to digitise, the University of Zambia facilitated the selection of content. In terms of subject areas, the ADHL Zambia digital library included subjects such as; Tuberculosis, HIV/AIDS, Maternal and Child Health, Malaria, Public Health and Non-Communicable Diseases such as: Alzheimer’s, cancer, chronic kidney ailments, diabetes, osteoarthritis, osteoporosis and others. This was in line with the Ministry of Health Zambia National Health Strategic Plan for 2011-2015 that affirmed that Zambia’s disease burden is “mainly characterised by high prevalence and impact of communicable diseases particularly malaria, HIV/AIDS, STIs and TB and a high maternal, neonatal and child morbidity and mortalities. The country is also faced with a rapidly rising burden of non-communicable diseases” (Zambia Ministry of Health, 2011). Therefore clinical guidelines and standard operating procedures from MOH were also collected and put online in the digital health library. Student assistants from the University of Zambia Department of Library and Information Studies were used to digitise and submit born digital content. Fig. 1 illustrates the workflows.
UNZA ADHL Node

The ADHL node at the University of Zambia is hosted within the UNZA institutional repository as a separate community. Under this new community, there is UNZA collection, which contains items mapped from other UNZA collections and also collections that host content from other participating institutions allowing for a single view of the ADHL from Zambia. Such an implementation also allows for future scalability of the node, for example, should one of the institutions later decide to have and host their own repository on their server, it will just be a case of harvesting their content from the UNZA repository into their own and then reconfiguring their collection in the UNZA repository to become a client. This process of harvesting the metadata from that repository maintains the integrity of the ADHL node as a ‘single’ node in terms of content collection view. See Figs. 2 and 3.
Implementation of the ADHL
The implementation of the ADHL at the University of Zambia Library took two aspects namely (a) Infrastructure stabilisation and (b) Operational streamlining.

Infrastructure stabilisation
At the start of the project, UNZA library was already running and using DSpace 5.5 for its IR, an older version with stability issues as well as security vulnerabilities. In view of these issues the Dspace software was then upgraded to DSpace 6.2 on a server physically located in the medically. This allowed for content to be migrated from UNZA central server as well as giving an opportunity for the project to take advantage of the new features of fixing bugs and security fixes of the earlier version. New features for configuration, setup and customisation to include Google Analytics to help with collecting usage statistics; social share buttons were also added to allow users to share the content they like with peers through their social media channels. Further migration enhanced discovery of content for indexing by search indexing crawlers such as those from Google and Bing text and sitemaps as well as registering the service to Google through the Google Webmaster tools. Open Archives Initiative – Protocol for Metadata Harvesting (OAI-PMH) was fixed to stop breakage of the access links within the records whilst permitting Provision of a clean URL - the DSpace was serving content on the Tomcat port 8080 rather than standard web publishing port 80 and this was implemented as it helps where users systems block ports not standard web publishing ports. Extra metadata fields in addition to the standard ‘out-of-the-box’ Dspace were provided to be displayed on the detail item page.

Operational Streamlining
Single Community (Node) was created to host all items that were processed through the project as doing it this way allowed for a single view of the ADHL library from Zambia and provides a single endpoint. Moreover an improved workflow process was instituted for handling submissions, checking and approving of items and full text to help improve the quality of the metadata going into the library. The older records that had ‘bad’ URIs (persistent identifiers) were identified and fixed while DSpace technical management skills were imparted to the CICT officers.
Advocacy and Promotion

Ghosh and Kumar (2006) contend that while the institutions in urban areas have reasonably good information provision facilities that support scholarly communications, institutions in far flung areas, especially rural ones are struggling to achieve the same. The ADHL was marketed within the institution and nationally; highlighting key areas that were important; content selection, metadata assignment; copyright clearance and training. See Table 1 for some of the activities.

Table 1. Promotional activities

<table>
<thead>
<tr>
<th>DATE</th>
<th>ACTIVITY</th>
<th>TARGETED AUDIENCE</th>
<th>CONDUCTED BY/OUTCOME</th>
<th>LOCATION/DISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>8th May 2018</td>
<td>Radio Interview on Zambian National Broadcasting Corporation (ZNBC) Radio 4</td>
<td>Radio listeners across the country</td>
<td>Assistant Librarian, increased awareness</td>
<td>ZNBC Studios Lusaka</td>
</tr>
<tr>
<td>5th Jun 2018</td>
<td>ADHL Exhibition</td>
<td>University Senior Management</td>
<td>Librarian, more support from management</td>
<td>Lusaka</td>
</tr>
<tr>
<td>17th to 20th Jul. 2018</td>
<td>Paper presentation at the Library and Information Association of Zambia (LIAZ) Annual General Conference</td>
<td>Library and Information Association of Zambia (LIAZ) Conference participants</td>
<td>Assistant Librarian, awareness among LIS professionals</td>
<td>Livingstone 487 kilometres from Lusaka</td>
</tr>
<tr>
<td>17th to 20th Aug. 2018</td>
<td>UNZA School of Medicine Golden Jubilee Celebration Exhibition</td>
<td>Lecturers, Doctors, Nurses and other health professionals</td>
<td>Medical Library staff, awareness among faculty, health professionals, researchers. Got content for the IR</td>
<td>Ridgeway Campus, Lusaka</td>
</tr>
<tr>
<td>1st to 6th Aug. 2018</td>
<td>Agriculture and Commercial Show Exhibition</td>
<td>General public</td>
<td>Librarians, increased awareness to the general public</td>
<td>Lusaka</td>
</tr>
<tr>
<td>4th Sept. 2018</td>
<td>Presentations, Mulungushi University and Livingstone Nursing School</td>
<td>Administrators, librarians, principal tutors, lecturers, nursing students, University students</td>
<td>Librarians, received content for inclusion in IR, Increased awareness among faculty, tutors and hospital staff</td>
<td>Livingstone 487 kilometres from Lusaka</td>
</tr>
<tr>
<td>18th Sept. 2018</td>
<td>Presentation, University of Barotseland and Lewanika School of Nursing.</td>
<td>Administrators, librarians, principal tutors, lecturers, nursing students, university students</td>
<td>Librarians, increased awareness to administrators, managers, medical and nursing students, faculty</td>
<td>Mongu - 598.9 km from Lusaka</td>
</tr>
<tr>
<td>19th Sept. 2018</td>
<td>Presentation Senanga School of Nursing</td>
<td>targeted administrators, librarians, principal tutors, lecturers, nursing students, university students</td>
<td>Librarian, Librarians, increased awareness to administrators, managers, medical and nursing students, faculty</td>
<td>Senanga - 700.9 km from Lusaka</td>
</tr>
<tr>
<td>9th Oct. 2018</td>
<td>Paper published in local newspaper</td>
<td>General public</td>
<td>University Librarian, increased awareness to the general public</td>
<td>Lusaka</td>
</tr>
</tbody>
</table>

Usage statistics

A well-established institutional repository has the potential to increase research impact and enhance the visibility of an institution (Sengendo, 2017). This is seen from the number of downloads and usage. Content usage after the addition of file downloads in June 2018 totalled 266,838. This number had gone up by 31st August 2019. See Fig. 4 and Fig.5 indicating that the ADHL Community is already being accessed the world over.
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Challenges, Lessons Learnt and Achievements

Several concerns were raised by some lecturers from non UNZA institutions during the visits and exhibitions on issues of copyright especially for papers already published by restrictive journals, while others felt that by providing their content, they will be promoting UNZA and not their institutions. Sengendo (2017) points out that fear and the need to protect copyright over the institutional scholarly work has been a great hindrance towards the establishment of IRs. These fears although justified could be partly due to unclear global copyright law on digital information (Kavulya, 2006). However, despite these fears, they were motivated and encouraged after being informed that the IR will provide the researcher with an opportunity to enhance demand for their work hence attracting more citations which are tied to their promotions and
that copyright laws will be adhered to. According to Kamila (2009) there is evidence that articles freely available on the Internet are cited, accessed, and used more often than print ones.

A number of lessons were learned including:

- Acquiring equipment for the project should have been done much earlier before the start of the project to avoid unnecessary procurement delays which almost made the project to be behind schedule. This led to the objectives of the first workshop not being fully met as participants were not able to have a look and feel of the project because the ADHL online platform needed to have been created first. However, the workshop presented an opportunity for the project team to show the participants the screenshots of what they were going to see once the platform became active.

- Taking all libraries on board well before the start of the project and sustaining their involvement in every step of the project contributed to the success of the project.

- Proper documentation of all the processes of the project was important to keep track of all activities implemented.

- Collaboration facilitated at different levels within a wide audience promoted social networking. Marketing of the IR especially to government ministries and other key stakeholders should start way before the project implementation as these partnerships were very critical to the achievement of project goals. This therefore called for continuous marketing and promotion of the project.

- Library staff need to be equipped with adequate ICT skills to meet the requirements of an IR since the system uses modern technology, this was true for most librarians in Zambia.

The challenges encountered were mostly around technical skills to manage the repository as well as the application and on the user support.

Technical problems that were faced at the start of the scanning period and archiving of documents were resolved after consultation with the IT expert. These technical problems had to do with the server and other activities related to the server. Additionally, collection of required materials from relevant stakeholders and convincing them to make their content available had been a challenge as some of them were not cooperative. This was overcome by constant follow ups, presentations on the benefits of IR and usage statistics.

Despite the challenges faced when implementing the ADHL project, and notwithstanding the negativity in some instances, there are some interesting stories arising out of the implementation of the project. In Livingstone for instance, a faculty member who raised concerns over copyright issues of articles published in restrictive international journals was later very interested and sent his research papers to be archived on the ADHL platform. This was after being convinced that the ADHL would provide him with increased visibility resulting in increased citations leading to higher H-index; a criteria for promotion in most universities. Still in Livingstone, a Principle Tutor at a Nursing school sent his dissertation and an article for inclusion in the ADHL. Another lecturer at the University of Zambia, School of Nursing Sciences brought her published books/products of research on local health issues –Malaria, for archiving in the ADHL. She had argued that the few printed copies that were in the medical library have since gone missing. So she was convinced that archiving the last copies of her books would ensure permanent availability to a wider readership. In this regard, Kanyengo (2009: 41) has argued for the need for policy frameworks that “deal with permanent access and availability of digital information resources at institutional, country, regional and continental levels” especially in the digital context.
A former presidential physician requested to have his book entitled: “Too young to die”, a book on HIV/AIDS in Zambia to immediately be included in the IR. He believed that once it was archived onto the ADHL, it would remain permanently available for everyone as long as they had access to the internet. Another professor in the School of Medicine at UNZA requested for his Obstetrics and Gynecology Protocols to be made available online for easy accessibility in 2016 but Medical Library did not have such facilities of digitisation then, ADHL project therefore, presented an opportunity for it to be archived two years later.

**Way forward**

The project officially came to an end on the 30th of September, 2019. ADHL Zambia node has the equipment, skills, expertise, and personnel to continue on this noble task of acquiring, digitising and archiving health related research for the purpose of it being accessed easily by all who have access to internet. Even with the difficulties the project had in making a break through to the Ministry of Health research data, the project finally made a link with the National Health Research Authority (NHRA) of Zambia whose mandate is to capture all health research countrywide from all health organisations and to create multiple access to the research through a virtual library. The Authority since constituted a National Knowledge Translation forum and have invited the University of Zambia Librarian and the two UNZA medical librarians to be part of the Knowledge Translation Working Group. The Director of the NHRA is very supportive of the collaboration. In this regard, as a way forward, the project will work in partnership or rather in collaboration with the National Health Research Authority to continue archiving health research materials on the ADHL Zambia.

**Conclusion**

The Africa Digital Health Library is an opportunity for health researchers in Zambia to increase the visibility of their research and collaborate with others whilst building on their local research to solving regional health problems. ADHL will help improve not only individual research impact but also institutional research output/impact and national health research impact. The Zambia ADHL has now become part of the global health information society.

However, this impact will solely be dependent on the usage of the platform because the availability of information does not necessarily lead to access, and access does not guarantee use. Librarians therefore must be ready to play a vital role in the open access movement by hosting and marketing this very important process which is essential for attaining the health well-being of all. This can be achieved with the enhanced collaboration and sensitisation of stakeholders, critical to the implementation of the ADHL project. In this regard, the project is expected to provide valuable information services that are cost-effective and easily accessible to a diversity of users. The information contained on the ADHL Zambia platform is current, appropriate and needed for policy, clinical practice, academic and research in Zambia and beyond. Furthermore, the project can be used as a basis for building regional and thematic repositories such as those for agriculture, education, environment, tourism and other sectors. It is important that Zambia’s health research knowledge not only impact the health care delivery system, but also other sectors that are interrelated with health.
References


