(iii) cultivation of the researchers and specialists in the above fields.[1]

In order to attain this mission, a research project was launched in 2005 in collaboration with the Kenya Medical Research Institute (KEMRI). The HDSS was started as a major part of this collaborative project. The Mbita HDSS site is located in an area which has one of the highest HIV prevalence rates and the some of the poorest health indicators in Kenya. Malaria is the leading cause of morbidity and mortality among children in the region. Its specific objectives are as follows:

(i) to establish baseline data on the demographic, socio-economic, environmental and health characteristics of the communities in Mbita district in Kenya;
(ii) to document all births, deaths, in-migrations, out-migrations, socio-economic status, pregnancy outcomes and causes of death at given intervals;
(iii) to investigate and evaluate interrelationships between health and socio-economic interventions and their impact on morbidity and mortality;
(iv) to provide a platform for scientific studies in the prevention, management and control of parasitic, viral, bacterial, degenerative and life-style-related diseases;
(v) to provide a platform for education and training and multidisciplinary research for health professionals, graduate students and researchers.

What does it cover now?

The project integrates different scientific and operational research projects which are aimed at solving problems not only in the HDSS site but also in areas where similar challenges prevail, especially with regard to the goals specified in the UN Millennium project.[2]

Intensive baseline data were collected during the first survey and thereafter most data collections have been done to update vital events (births, deaths, migrations and pregnancies). Additionally, structured questionnaires are administered from time to time to get a better understanding of the health situation in the area. Examples of the type of health data collected are summarized in Table 1.

The HDSS also serves as a platform for other research projects which have been listed elsewhere.[3]

Where is the HDSS area?

The Mbita HDSS is located on the shores of Lake Victoria in Homa Bay County, one of 47 Counties in Kenya. It is a mostly rural area found between latitudes 0° 21′ and 0° 32′ south and longitudes 34° 04′ and 34° 24′ east. It is about 400 km west of Nairobi, the capital city of Kenya and it covers 163.28 km^2. The field station in Mbita is located in the International Centre for Insect Physiology and Ecology (ICIPE) research compound.

Table 1 Summary of additional health data collected

TOPIC	YEAR				
	2008	2009	2010	2011	2012
Vaccination		✓	✓	✓	✓
Nutritional status of children		✓		✓	✓
Toilet and latrine coverage		✓	✓	✓	✓
Handwashing practices					✓
Acute illness and health seeking behaviour		✓	✓	✓	✓
Disability		✓			
Education level		✓	✓		
Employment		✓	✓		
Dental hygiene			✓		
Bed net use	✓	✓	✓	✓	✓
Water sources, storage and treatment		✓	✓		
School attendance		✓	✓	✓	✓

The population lives on subsistence farming, small-scale businesses, fishing and keeping domestic animals. Two wet seasons usually occur annually from March to June and October to November, but the periods vary to some extent each year.[4]

The administrative locations covered in this system are Rusinga West, Rusinga East, Gembe West and Gembe East as well as two islands, namely Takawiri and Kibuogi, as shown in Figure 1. Rusinga West, Rusinga East and Gembe West formed the original HDSS area from 2006, and Gembe East was added to the surveillance area in June 2008. The whole HDSS area, currently consisting of Rusinga West, Rusinga East, Gembe West and Gembe East, was subdivided into 21 field interviewer areas.

The residential unit is the compound which consists of one or more households together. Traditional houses are mud and grass thatch huts. Modern constructions, made of concrete and corrugated iron, tend to replace traditional houses. The households obtain their water from various sources such as the Lake Victoria, Ministry of Water taps, rivers, boreholes and open dams as well as rain water. There are 30 health facilities within the study zone, providing basic services to the study population. These include the main sub-district hospital, health centres, dispensaries and clinics.

Who is covered by the HDSS and how often have they been followed up?

Between 1 August 2006 and 15 December 2006, the baseline survey was conducted during which all

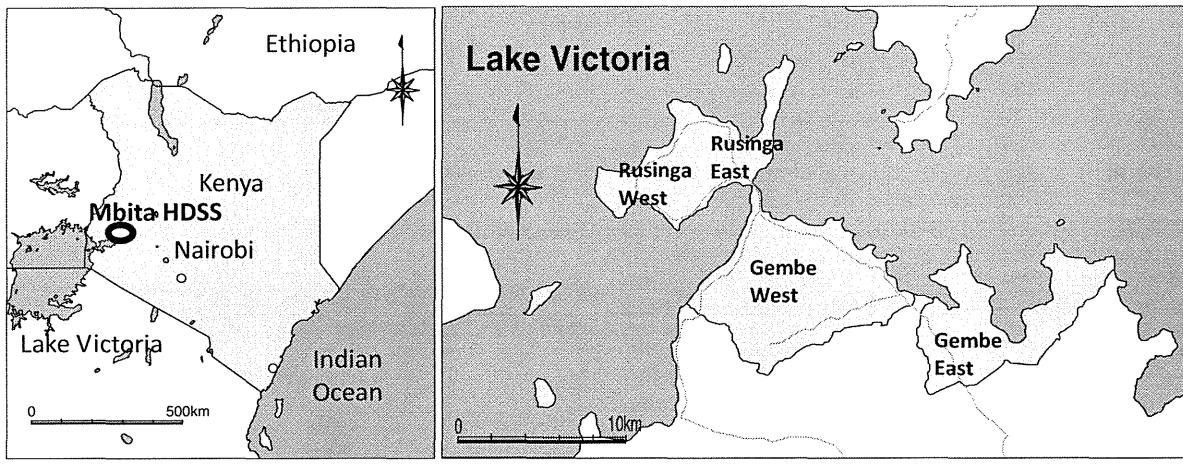


Figure 1 Map of Mbita HDSS

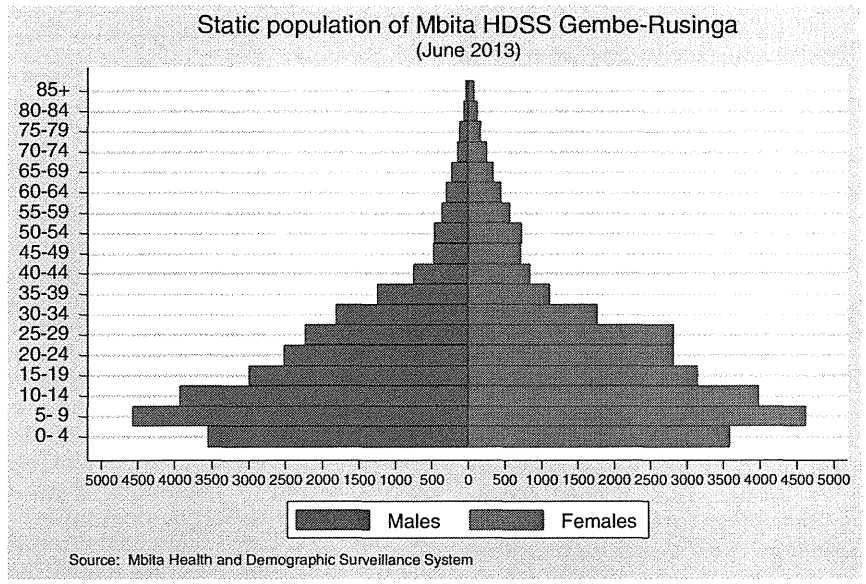


Figure 2 The static population pyramid of the Mbita HDSS as of June 2013

inhabitants were registered using the PDAs assigned to all field interviewers. Up to 31 May 2008, 40 472 residents in Rusinga East, Rusinga West and Gembe West locations in Mbita district had been followed up. After expansion of the surveillance area by addition of the Gembe East location from 1 June 2008, the population increased to 55 806 residents.

Re-registration of residents was done between October and December 2008 with the incorporation of GPS units for mapping all structures within the HDSS site. The number registered was 54 782 from 12 897 households, a participation level of 96%. In December 2012, the HDSS had a population of 54 395 from 11 576 households, as shown in Figure 2. Other demographic characteristics are presented elsewhere.[3]

Follow-up surveys have been conducted in the pilot area since January 2007. Through these surveys we receive updated information on the baseline survey (new members and houses), migration of residents, pregnancies and deaths. Data are currently updated at 3-month intervals. The data collection rounds and changes within the HDSS since 2006 have been summarized in a flowchart in Figure 3. During every

follow-up survey, different types of questions are added to the routine update surveys summarized in Table 1. After successive rounds, collected data are checked and used for updating the database.

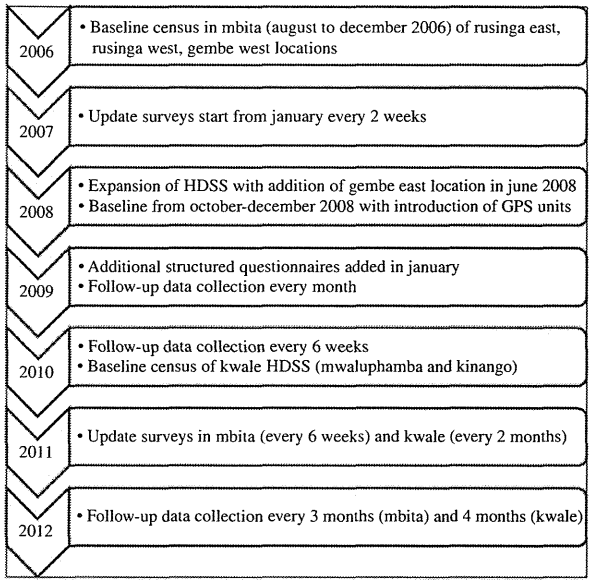


Figure 3 Flowchart of HDSS activities from 2006

What has been measured and how have the HDSS databases been constructed?

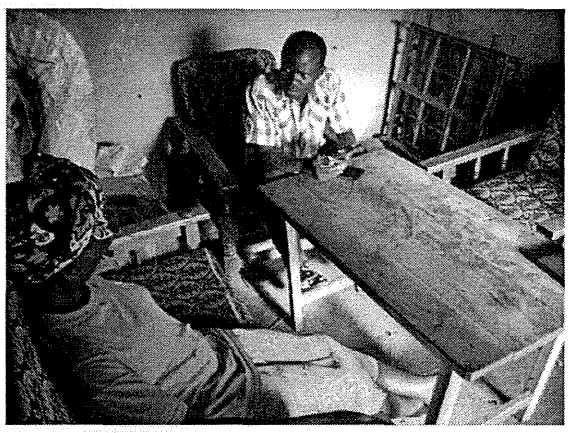
Data collection methods during the update surveys have been summarized elsewhere.[3–5] These are then transferred to the Mbita station server once a week. These data are then immediately sent to the server in Nairobi via a server at Nagasaki University. PDA data files are transformed and stored in the SQL server (MySQL version 4.12) at the local office and the Nairobi office. Daily data transfer is automated by programs developed by our HDSS team. Some data collected by PDAs are recorded automatically by the programs; for example date and time, geographical location and when and where field interviewers worked. Such information is used to monitor and manage the work progress of the field interviewers. The database program has built-in control and validation features.

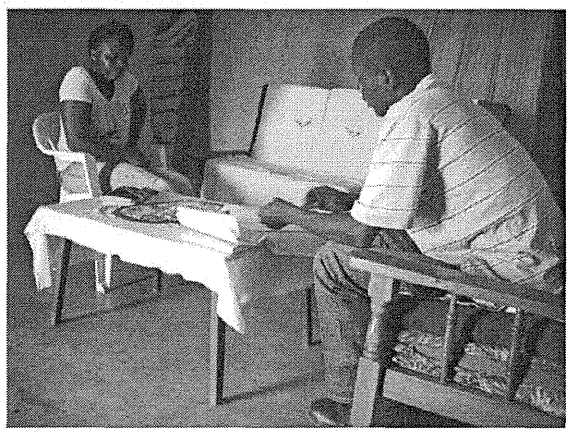
Once a death is recorded by a field interviewer, verbal autopsy data are also collected by trained field staff using detailed paper questionnaires in order to infer causes of death for deceased persons. Once field interviewers record a death, a grieving period of about 1 month is observed before a verbal autopsy is carried out. These data are stored in a database and the cause of death is inferred by a clinical officer.

Table 2 Information collected at each re-enumeration round of the Mbita HDSS

Subject	Information	Source
Compound	Coordinates of each house, family names, family owners, family identification number	PDA and self-report
Household	House identification number, household head, consent, new houses	PDA, self-report and FI
Member	Names of members, events (migration, pregnancy, death) newborns, dates of birth, gender.	Self-report
Death	Names of deceased, date of death, place of death	Relatives of deceased
Migration	Names of migrants, type of migration, migration dates, reason for migration, destination of migration	Relatives or neighbours of migrant
Pregnancy	Name of pregnant woman, update pregnancy status, outcome, date of and place of delivery, location of antenatal care	Self-report
Additional survey questionnaires		
Vaccination	Availability of Maternal and Child Health (MCH) card, vaccinations received, dates of vaccination	Self-report and MCH cards
Nutritional status	Breastfeeding status, complementary feeding status, types of complementary feeding	Self-report
Water usage	Water source, water treatment methods, water storage methods, rainwater harvesting	Self-report
Handwashing and toilet coverage	Human waste disposal methods, type of toilets, handwashing facilities, soap and water usage	Self-report
Bed net usage	Presence of bed nets, net type, source of bed net	Self-report
School attendance	Names of schools attended, type of school, school grades of children, reasons for non-attendance	Self-report
Dental health	Presence of dental problems, care of teeth, food types	Self-report

FI, Field Interviewer.





Collection of verbal autopsy data by a field interviewer manager

Group photo after a data dissemination seminar in 2012 involving staff from Mbita HDSS, other departments in NUITM-KEMRI, local administration and health officials

Key findings and publications

To combat malaria, the Kenya Ministry of Health and nongovernmental organizations (NGOs) distributed insecticide-treated nets (ITNs) to pregnant women and children under 5 years of age, either free of charge or at subsidized prices. However, residents of fishing villages started to use these bed nets for drying fish and fishing in Lake Victoria. Seven fishing villages along the lake were surveyed to estimate how widely bed nets were being used for fishing and drying fish.

When a sheet for drying fish was found, its material was categorized as papyrus, fishing net, bed net or other. Bed nets were further categorized as long-lasting insecticidal bed net (LLIN) or non-long-lasting insecticidal bed net (NLLIN). The size of each sheet in square metres was measured using a tape measure with the permission of the owner. Bed nets accounted for 15.0 to 83.8% of the total sheet area among the beaches. In total, 283 bed nets were being used for drying fish and 72 of the 283 bed nets were also being used for fishing. Of these, 239 were LLINs and 44 were NLLINs insecticidal bed nets. The most popular reasons for this use were that the bed nets were inexpensive or free and that fish dried faster on the nets. The misuse of bed nets for drying fish and fishing was found to be considerable in the study area. Many villagers were not yet fully convinced of the effectiveness of long-lasting insecticidal nets for malaria prevention.[4]

Mbita HDSS data have enabled the exploration of whether an individual's sleeping arrangements and house structure affect bed net use in villages along Lake Victoria. The study area included 100 houses chosen randomly from three villages within the HDSS. Net use at the household level was examined against several variables including bed availability, bed net availability, house size and number of rooms. It was found that bed net use by children between 5 and 15 years of age was lower than that among the other age groups. Net use was significantly associated with bed availability ($P=0.018$), number

of rooms ($P < 0.001$) and their interaction [bed availability × number of rooms ($P < 0.001$)].[6]

A study was carried out to evaluate the effects of insecticide treated nets, specifically LLINs, and their distribution by government and NGOs, focusing in particular on the effects on children sleeping without bed nets, who are supposed to be protected by the LLINs distributed around them. Using the Mbita HDSS database, 14 554 children younger than 5 years old were assessed over four survey periods between October 2008 and December 2010, and 250 deaths were recorded. The effects of bed net usage, LLIN density and the population density of young people around a child on all-cause child mortality rates were analysed using Cox proportional hazards models. It was hypothesized that the community effect of LLINs on children without bed nets would be more apparent if a child was sleeping with a higher density of surrounding LLINs, because fewer mosquitos are expected around a child with a higher density of LLINs. Furthermore, it was also hypothesized that a child who slept with higher density of surrounding young people had an increased risk of malaria infection leading to increased mortality, because young individuals often do not use bed nets at night, can be reservoirs of malaria parasites and distribute the parasites to other surrounding children via mosquitos. On the contrary, the results showed increasing linear trends for mortality risks among non-bed net users across LLIN density quartiles around each child as well as decreasing linear trends in risk across young population density quartiles among non-net user children.

A survey of handwashing utilities was done between March and April 2012. The study showed that 3005 (26.5%) of the households actually had a place to wash their hands and the type of handwashing facility that was most common was basins (74.3%). Others included leaky tins (recycled containers) 15.8%, plastic tins (3.7%), etc. The major source of water for handwashing was Lake Victoria for 95.1% of the households with handwashing facilities. A survey of human latrine coverage was also carried out during the same period; Figure 4 summarizes the findings.[7]

Another study was carried out to evaluate the risk factors for neurological impairment (NI) among children within the HDSS area. Data collected between April 2009 and December 2010 consisted of two phases. In phase one, a Ten-Question Questionnaire (TQQ) was administered to 6362 caregivers of children aged 6–9 years. The TQQ developed by the World Health Organization (WHO) is a convenient questionnaire focusing on the child's functional abilities and is used to detect NI among children aged 2–9 years in community settings [24]. TQQ has been used widely to screen for childhood impairment in low- and middle-income counties and its validity has been reported.[8] In phase two, all 413 children

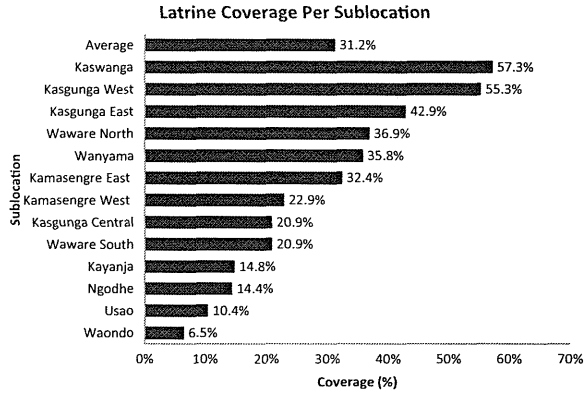


Figure 4 Data from Nagasaki University Mbita HDSS in 13 sub-locations in March–April 2012

who were TQQ-positive (had at least one positive response on the TQQ in phase one) and a similar number of controls ($n = 420$) who were randomly selected from children who were TQQ-negative (had no positive response on the TQQ in phase one) were examined for physical and cognitive status. In addition, a structured questionnaire was conducted with their caregivers. The prevalence for NI was estimated to be 29/1000. Among the types of impairments, cognitive impairment was found to be the most common (24/1000), followed by physical impairment (5/1000). In multivariate analysis, having more than five children [adjusted odds ratio (AOR): 2.85; 95% CI: 1.25–6.49; $P = 0.013$], maternal age older than 35 years (AOR: 2.31; 95% CI: 1.05–5.07; $P = 0.036$] were significant factors associated with NI. In addition, a monthly income of under 3000 Kenyan shillings (USD34) (AOR: 2.79; 95% CI: 1.28–6.08; $P = 0.010$) and no maternal tetanus shot during antenatal care (AOR: 5.17; 95% CI: 1.56–17.14; $P = 0.007$) were also significantly related with having moderate/severe neurological impairment.[9]

Future analysis plans?

Data on frequency of acute illness symptoms and health-seeking behaviour of people living in the HDSS have been collected six times during different seasons from 2009 to 2012. The HDSS team is planning to intensively analyse these data for publication. It is hoped that this will facilitate the understanding of the prevalence of these acute illness symptoms and responses to them, in order to change behaviour and improve health practices in the area.

HDSS data on school attendance have provided a platform for the initial stages of a 5-year study whose main objective is to improve health and sanitation of the community through a school health programme in primary schools. The data and results obtained from this project will provide an additional method for monitoring and evaluating the HDSS data.

Currently, detailed analysis of mortality (including neonatal, perinatal, under-five, maternal and adult mortality) data from 2009 to 2011 is being carried out using the InterVA4 tool initiated by INDEPTH. There are plans to compare the InterVA 4 causes of death with those obtained after clinical diagnosis of symptoms. Results obtained will be compared with those from the Kwale HDSS.

What are the main strengths and weaknesses?

The HDSS provides a platform from which researchers and students can conduct their research in order to provide useful scientific output on tropical infectious diseases and emerging/re-emerging diseases. The HDSS is currently supporting six PhD students and six master's students from universities in Kenya and Japan.

Another strength of the Mbita HDSS is the possibility of applying the methods in other areas. Our system, originally developed for the Mbita HDSS programme, was easily transplanted to the Kwale HDSS located on the Kenyan coast. The Mbita HDSS system has been also transplanted outside Kenya. In 2010 it was used to set up the Lahanam HDSS program in the Lao People's Democratic Republic, which is operated collaboratively by the National Institute of Public Health, Laos, and the Research Institute for Humanity and Nature, Kyoto, Japan, after being translated from English to Laotian.[3]

Table 3 below gives some details about Mbita and Kwale HDSS sites.

The participation rate in Mbita HDSS is about 96%. This is a major strength and shows how willing residents are to be part of the project. Communication with community members and local and administrative leaders, among other stakeholders, has played a big role in maintaining good relationships with Mbita HDSS.

Currently, unique member identification numbers as well as names on national identification cards are being used to identify residents. However not many adults in Mbita have these cards, which limits their use for identification. A further problem, for those without the identification cards, is that full names tend to be very similar, thus limiting unique identification. Biometric measures involving fingerprints are being piloted in an area within our sister HDSS in Kwale. If it succeeds, we may use it in Mbita.

A major challenge has been the high expectations among participants that participation will be rewarded, for example by cash payments from the community which cannot be met by the limited funds available to the HDSS project. Lack of such rewards tends to lead to respondent fatigue. However, efforts are being made to reduce this by partnering with other projects running within the HDSS to provide or improve certain services within the community.

Data sharing and collaboration

Results generated by the data collected are shared with the Mbita community residents and health workers as well as the local administration. There is also collaboration with the Ministry of Public Health and Sanitation as well as the Japan International Cooperation Agency (JICA) which has led to the establishment of two community units within the HDSS under the Community Health Strategy initiated by the Ministry of Public Health and Sanitation. Through the same partnership, a school health project was initiated in 2012 aiming at supporting pupils to promote health from the school in to the community.

The Mbita HDSS became affiliated to The INDEPTH network in December 2009 and has been involved in data sharing with other HDSS sites since then. The HDSS signed a Memorandum of Understanding initiated in July 2012 to encourage collaboration among the Kenya National Bureau of Statistics, three other Kenyan HDSS sites that are affiliated to INDEPTH and four government ministries to analyse

Table 3 Characteristics of Mbita and Kwale HDSS sites

Characteristics	Mbita	Kwale
Start year	2006	2010
Population (June 2013)	54 027	53 268
Area covered	163.28 km^2	384.9 km^2
Administrative locations covered	Gembe East, Gembe West, Rusinga East, Rusinga West	Golini, Kinango, Mwaluphamba
Field office location	ICIPE, Mbita	Kwale District Hospital
County	Homa Bay	Kwale
Province	Nyanza	Coast
Field staff (n)	21	14
Update surveys duration	3 months	4 months

large sets of cross-sectional, longitudinal and verbal autopsy data.

Although the core HDSS is managed under the auspices of Nagasaki University, it is always open to other scientists who have an interest in the control of infectious diseases and who are willing to contribute to the development of communities in tropical areas.[10] Requests for collaboration may be made by contacting Masaaki Shimada on shimadam@nagasaki-u.ac.jp or Mohamed Karama on mhmdkarama@yahoo.com.

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Conflict of interest: None declared.

KEY MESSAGES

- The Mbita HDSS site is located in an area which has one of the highest HIV prevalence rates and the some of the poorest health indicators in Kenya. Malaria is the leading cause of morbidity and mortality among children in the region.
- Data collected from residents of the HDSS have been used to investigate the extent of bed net misuse in fishing villages as well as mortality risks between bed net users and non-bed net users.
- The Mbita HDSS is one of the two HDSS sites established by the collaborative effort of Nagasaki University, Japan, and the Kenya Medical Research Institute. The other is the Kwale HDSS located on the coastal area of Kenya, near the Indian Ocean.

References

[1] Institute of Tropical Medicine NU: Institute of Tropical Medicine, Nagasaki University. Nagasaki, Japan; 2012. Available from: http://www.tm.nagasaki-u.ac.jp/nekken/english/books/pdf/2012leaf-e.pdf (14 January 2013, date last accessed).

[2] UN Millennium Project. *Investing in Development: A Practical Plan to Achieve the Millennium Development Goals*. New York: United Nations, 2005.

[3] Kaneko S, K'Opiyo J, Kiche I *et al.* Health and Demographic Surveillance System (HDSS) in the Western and Coastal areas of Kenya: An infrastructure for epidemiologic studies in Africa. *J Epidemiol* 2012;**22:**276–85.

[4] Minakawa N, Dida GO, Sonye GO, Futami K, Kaneko S. Unforeseen misuses of bed nets in fishing villages along Lake Victoria. *Malar J* 2008;**7:**165.

[5] Kaneko S, Mushinzimana E, Karama M. Demographic Surveillance System (DSS) in Suba District, Kenya. *Trop Med Int Health* 2007;**35:**37–40.

[6] Iwashita H, Dida G, Futami K *et al.* Sleeping arrangement and house structure affect bed net use in villages along Lake Victoria. *Malar J* 2010;**9:**176.

[7] Nagasaki University Institute of Tropical Medicine-Kenya Medical Research Institute. *Nagasaki University Newsletter* 2013;**1** (January–April). Available from: http://www.tm.nagasaki-u.ac.jp/nairobi/contents/mbita/data/Mbita-Newsletter%202013-1.pdf (25 February 2013, date last accessed).

[8] Zaman SS, Khan NZ, Islam S *et al.* Validity of the 'Ten Questions' for screening serious childhood disability: results from urban Bangladesh. *Int J Epidemiol* 1990;**19:**613–20.

[9] Kawakatsu Y, Kaneko S, Karama M, Honda S. Prevalence and risk factors of neurological impairment among children aged 6–9 years: from population based cross sectional study in western Kenya. *BMC Pediatrics* 2012;**12:**186.

[10] Shimada M, Ichinose Y, Kaneko S, Minakawa N. Profile of the Nagasaki University Kenya Research Station and Activities. *Trop Med Int Health* 2007;**35:**29–31.

解説
国立感染症研究所におけるHIV関連曝露事故対策

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はじめに

HIV汚染体液による職業的曝露に関するガイドラインについては、米国疾病予防制御センター（CDC）から発表されたものがある（1）。日本の医療機関においてはこのガイドラインを基本にした対策が行われている（2）。しかしながらこのガイドラインは「医療現場」での「HIV汚染体液」による曝露を想定している。「実験室現場」での「ウイルス培養原液等」による曝露を想定したものではない。実験室では高濃度のウイルス培養原液あるいはそれをさらに濃縮したウイルス原液を取り扱う。そのウイルス濃度は医療現場で取り扱うHIV感染者血液の濃度をはるかにしのぐ。曝露後の感染リスクも当然高くなる。もちろん実験室は、病原体曝露を防ぐべく高度の安全設計・安全運用がされており、医療現場に比べると曝露自体のリスクははるかに軽減されている。しかしながら、この曝露リスク軽減が、曝露後の感染リスクを下げることはない。高度安全実験室であれ、ひとたび曝露事故が起きてしまえば、ウイルス濃度や力価に依存して感染リスクが高くなるのは当然である。さらに、「実験室現場」で取り扱うウイルスはHIV-1だけではない。HIV-2、SIVさらにはSHIVが広く使われている。以上より、CDCのガイドラインは「実験室現場」では不十分である。本稿では、国立感染症研究所（感染研）における「実験室現場」でのHIV関連曝露事故対策について紹介する。

なお本稿は、感染症の危機管理国際フォーラム（国際予防医学リスクマネージメント連盟主催、2007年、東京）と第12回日本バイオセーフティ学会（2012年、東京）での発表内容をまとめたものである。

海外でのHIV関連曝露事故

対策を練るにあたっては、まず過去の事例に学ばねばならない。米国では、HIVの職業的曝露により、過去30年間（1981～2010年）で57例のHIV感染確定例と143例のHIV感染疑い例が報告されている（図1）（3）。このうち「実験室現場」での曝露事故によるものは確定例で3例、疑い例は0とされている。感染リスクは、経皮的曝露（主に針刺し）で0.3%、針刺しで0.10～0.36%、粘膜曝露で0.00～0.63%とされている（4-6）。しかし、これらは「医療現場」での数字であり「実験室現場」のものではない。いずれの現場であれ、感染リスクは病

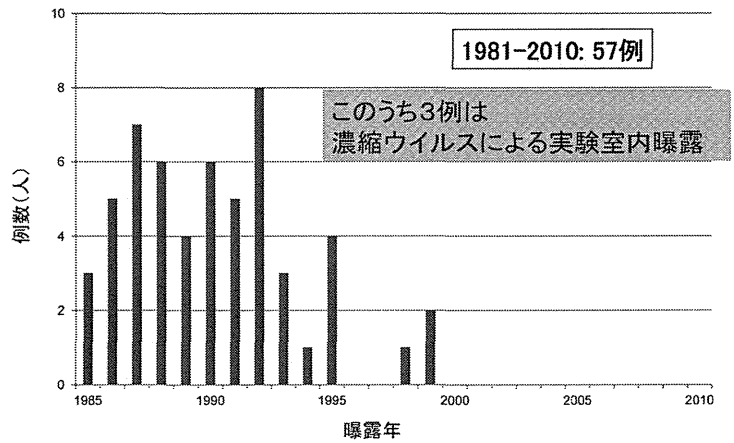

図1. 米国における職業的HIV感染例の年次推移
（参考文献3より改変）

原体の感染力価と量（7）、そして被曝者の感受性に依存することを念頭において、前記の数字を参照しつつ対策を講じるべきである。

既述通り、「実験室現場」で取り扱うウイルスはHIV-1だけではない。HIV-2、SIVさらにはSHIVが広く使われている。HIV-2とSHIVに関する職業的曝露に関する報告は見当たらない。SIVについては2例が報告されている（8-10）。いずれも「実験室現場」での曝露による可能性が高い。1例はSIV感染が成立し、もう1例は幸いにも一過性感染に留まった。後者はサル実験中の針刺し事故である。「実験室現場」での曝露事故では、病原体の感染力価や濃度が明らかであることから、感染リスクの定量的解析が容易である。リスク評価の項で推定する。なお、これらとは別に、SIV研究者472人中3名のHIV-2/SIV抗体陽性者が報告されているが、前記2例が含まれている可能性が指摘されている（11）。また、論文にはなっていないが、SIVの一過性感染がもう1例（1990年）あったことが関連研究者間で情報共有されている。

日本でのHIV関連曝露事故

筆者の調べた範囲では、我が国での職業的曝露によるHIV感染報告例はない。1990年代に、HIV取扱い歴のある若い研究者がHIV抗体陽性であったことが新聞報道（入手できず未確認）されたことがあるが、その職業的曝露については不明のままであったと記憶している。「医療現場」での職業的曝露に近い例として、血液製剤自己注射の際の針刺し事故による痛ましいHIV感染例（児→母）が報告されている（12）。

一方、「医療現場」における曝露事例についてはいくつか報告がある。稲垣らによると、1982～1992年の10年間で276施設においてHIV関連曝露事故は針刺しが87件、その他が31件あった（13）。木村らによると1996～2000年の5年間で全国のエイズ拠点病院（延べ921施設）において針刺しが4,167件の2%（実数記載なし）と報告されている（14）。木村らは同時に、日本全体で年間45万～60万件の針刺し・切創事故発生という驚くべき数字を推計している。「実験室現場」での職業的曝露については、ウイルス一般に関する下条らの古い報告（15）があるだけでHIV関連曝露事故に関するものは見当たらない。1施設のみではあるが感染研における事例を報告する（図2）。当研究所は常勤研究者300-350人規模で、このうちエイズ研究センター研究員を中心に20人前後がHIV関連病原体を取扱っている。1989～2012年の24年間で6件の曝露事故が報告されている。内訳は針刺し4件、メスによる切創1件、挫創1件で、挫創の1例以外は全て動物実験中の事故であった。後述のPEP（post-exposure prophylaxis）については5例で対応されている。転帰については全例、感染を免れている。

病原体曝露事故対策の三原則

1. 敵をしるべし。
2. 己の身は己で守るべし。
3. 周りに及ぼすなかれ。

参考までに災害時の三助（自助・共助・公助）も挙げておく。

リスク評価

上記三原則の第一として、SIVとSHIVのサルに対する感染リスク評価を表1にまとめる。ホスト（サル）の感受性には個体差があるが、抵抗性のある個体を除いた一般的なサルに対する感染リスク評価と

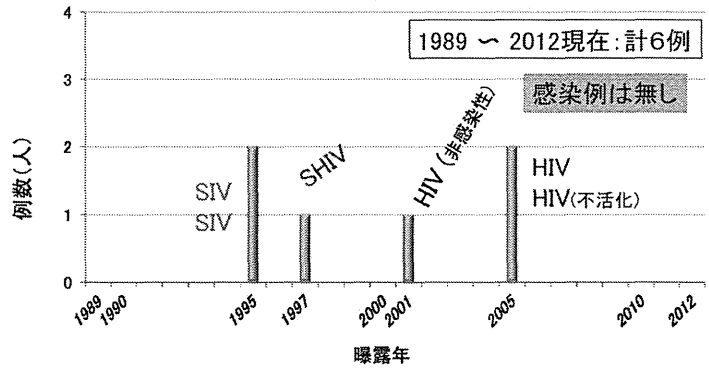

図2. 国立感染症研究所におけるHIV関連曝露事故例の年次推移

考えていただきたい。サルを用いた実験は頭数が少なくならざるを得ない。示した数字は少ない例数に基づくものであり、実際には幅があることをご了解頂きたい。また、これらの数字はサルに対する感染力価であり、ヒトに対するものではない。前述のSIV感染ヒト症例が報告されるまで、SIVはヒトに感染しないとされていた。

乱暴だが、この表の感染力価をヒトにあてはめ、前記SIV感染事故の定量的評価を試みたい。まず一過性感染例は針刺しによる曝露で、感染源であるサルはSIV感染6ヶ月後の慢性期であったことが記載されている。血中ウイルス量の記載はないが慢性期は通常10^3～10^4 copies/mlで、最大でも10^6 copies/ml程度と仮定する。針刺し直前の針は肉眼的に確認できるレベルのサル血液に汚染されていたことから、曝露量をサル血液換算で最大0.001 mlと推定する。最終的に、遊離ウイルス量換算では最大でも1,000コピーと算出される。曝露元のウイルスはSIVsm ΔB670であり、表1のウイルスと単純比較はできないが、50%のサルが感染する量には達していないことが想定される。本例では抗ウイルス剤の投与歴に関する記載はないが、事故発生の1990年にはSIV曝露事故におけるPEPは確立されていないことから、恐らくPEPはなされていない。このシナリオ通りであれば一過性感染で矛盾しない。もうひとつのSIV感染確定例ではどうだろう？一過性感染例よりも大量のウイルスに曝露していたのであろうか。残念ながら本例ではデータ不足で推計ができない。まずSIV曝露の明確な記憶や証拠がない。次にSIVの血清学的検査の際にグローブ着用を怠っていたこと、両手～前腕の皮膚炎のためにステロイド服用歴（2ヶ月）があったという記載がある。曝露量の推計が困難で、なおかつホスト側の免疫因子が定量困難な交絡因子として存在している。

それでは感染研の例ではどうだろう。詳細が判明している1997年のSHIV曝露事故で、前記同様の乱暴な評価を試みる。先のSIV一過性感染同様に、本例も針刺しで、感染源のサルはやはり慢性期であった。しかし、慢性期であっても本例では血中ウイルス量が検出感度以下～10^3 copies/mlであった。さらにはSHIVであること、麻酔用の針で細かったこと、針刺し前の針には血液が肉眼的に確認されていなかったことが大きな違いである。すなわち感染力価と感染量が大きく異なる。本例では遊離ウイルス量換算では最大でも1コピーと推計される。SHIVがサル50%に感染する量（表1）にははるかに及ばない。本例ではPEP対応がなされたが、PEP無しでも感染不成立であった可能性が高いと容易に推測できる。

以上のように「実験室現場」のHIV関連曝露事故では、少なくとも曝露量の定量的評価がある程度可能である。これらの症例の積み重ねは非常に重要と考える。

曝露事故防止対策（事前対策）

曝露事故防止対策の基本は何と言っても曝露自体の防止である。「医療現場」ではスタンダード・プリコーションが代表的であり、「実験室現場」ではバイオセーフティである。いずれも適切なリスク評

表1. SIVとSHIVの感染経路と感染力価

感染経路:	経粘膜、経血液 （空気感染は否定されている）
感染力価:	対サル*のone AID50 (50% animal infectious dose)
遊離ウィルス/経静脈投与の場合	* SIVは赤毛サル、SHIVはカニクイサルが対象
SIVmac239: 2,000 copies	
SIVmac251: 4,000 copies	
SHIV KS661c: $1.5x10^5$ copies	
遊離ウィルス/経直腸投与の場合	
SIVmac239: $3x10^6$ copies	
SIVmac251: $6x10^6$ copies	
SHIV KS661c: $1.5x10^7$ copies	
ウィルス感染細胞/経静脈投与の場合	
不明	
ウィルス感染細胞/経粘膜投与の場合	
SIVmac239感染サルPBMC/経膣: $5x10^4$ 細胞	
SHIV KS661c感染CEM細胞/経直腸: $4x10^4$ 細胞	

価に基づいて構築される。一般的なバイオセーフティについては成書を参考されたい。HIV 関連病原体について、これまでに三原則の第一：敵を知るべし（リスク評価）を行ってきた。すなわち、「実験室現場」のどのような状況で、どれくらいの病原体による曝露が起こった場合に感染する可能性があるのか、をあぶり出した。重要なキーワードは「動物実験」「針刺し」「ウイルス量」「感染力価」である。研究者自身は、実際の実験の前に、これらのキーワードを含めて、リスク評価の詳細あるいは少なくとも概要を理解して実験に臨むべきである（三原則の第二：己の身は己で守るべし）。前述の感染研の針刺し4件のうち少なくとも2件は、リキャップ禁止で事故そのものを容易に防止できていたはずである。また、「ウイルス量」と「感染力価」が事前に判明している点は、不明なことが多い「医療現場」と比較すると「実験室現場」の大きなアドバンテージである。自身の安全は自身の知識と行動でまず確保して頂きたい。

曝露後の感染防止に関する事前対策のツールは3つある。ワクチンと中和抗体、そして抗ウイルス剤である。残念ながら HIV 関連病原体に対する効果的なワクチンはない。中和抗体は存在するが、ウイルスの多様性に対応できていない。唯一、抗ウイルス剤は存在し、常備可能である。近年、抗ウイルス剤の予防内服（PrEP: pre-exposure prophylaxis）の効果が実証されている（16,17）。PrEP の適応は臨床現場でも議論が多いが、少なくとも低リスク集団は対象外とされている。PrEP の「実験室現場」への適応について、感染研では以下の理由から現時点では推奨しない。実験数に比較して曝露事故の頻度が少ないため、毎回の実験で PrEP を導入した場合、benefit/cost（b/c 比）は極めて小さくなる。一方、後述の PEP での b/c 比は、PrEP の b/c 比に比較してはるかに大きい。現時点ではかなり特殊な実験以外は PEP 対応で充分である。

他に事前対策として重要な点は、後述の曝露事故事後対策について事前に理解しておくことである。事故後に慌てて事後対策を探し回るようでは、自身が助かるチャンス（自助）を放棄しているに等しい。後述の PEP のための informed consent（説明と同意）についても担当医師と研究者の間で事前に取り交わしておくことが望ましい。また PEP のための薬剤を常備しておくこと、さらに PEP に習熟した連携医療機関の確保も重要である。これらの準備を含めて、一連の曝露事故対策システムの構築・整備・アップデートは公の役目（公助）であり、労働安全衛生法第 22 条で定められている事業者の義務である。

曝露事故事後対策

不幸にして曝露防止に失敗しても感染防止のチャンスは残っている。そのためのツールもやはり3つある。感染リスクの量的低減化（洗浄）と質的低減化（消毒薬と抗ウイルス剤）である。HIV 関連病原体に限らず曝露面の流水洗浄と消毒は感染リスクの低減に有効である。Miller らは SIV のサル健常膣粘膜曝露後 15 分以内での酢酸洗浄で 100%（2/2）、60 分以内の洗浄で 83%（5/6）の感染防止効果を報告している（18）。刺創や切創では曝露された可能性の高い血液の絞り出し除去も有効と考える。しかしながら炎症反応は細胞の HIV 感受性を高める。物理的刺激による炎症増強につながらないよう軽く絞り出すに留めたい。同様の理由で刺激性の強い消毒剤の使用は感染研では積極的には勧めていない。刺激性の少ない石鹸の使用を勧めている。

3つめのツールである抗ウイルス剤は、HIV 関連曝露事故対策の最大の特徴である。CDC のガイドライン（1）の基本部分である。曝露の状況に応じて抗ウイルス剤による多剤併用療法が勧められている。いわゆる PEP である。Cochrane review 2010（19）により AZT 単剤での PEP の有用性は確認されている。理論的に多剤併用療法はさらに有用と考えられるが、データ不足のせいか、同 review では確認されていない。しかしながら図1にあるように米国では 1999 年以降、曝露事故による HIV 感染確定例は確認されていない（3）。多剤併用療法を用いた PEP の効果による可能性が示唆されている。感染研でも積極的に多剤併用療法による PEP を勧めている。

PEP の適応については、「曝露の状況に応じて」とある。実際の現場ではこの判断は難しい。三原則の第二：己の身は己で守るべし、を実践し、取扱っている「ウイルスの量」や「感染力価」を事前に承知しており、曝露後も冷静さを失わない研究者は判断できるであろう。一方で頭が真っ白になる研究者もいるであろう。感染研では、よっぽど安全と確信できる場合を除き、曝露の状況判断は後回しでも良い、曝露後は直ちに最初の薬剤を服用するよう勧めている。なお、感染研では HIV-1 曝露の際は AZT/3TC + LPV/RTV を、SIV/SHIV/HIV-2 曝露の際は FTC/TDF + LPV/RTV を、それぞれ勧めていた。ところが直近のガイドラインで、HIV-1 に対する第一選択薬群から AZT/3TC がはずれた。

現在ではHIV-1曝露の際もFTC/TDF + LPV/RTVを勧めている。第一選択薬の選定は今後も適時アップデートされる。

これらの3つのツールを被曝者が単独で同時並行的に利用するのは実は難しい。三原則の第二・自助には限界がある。共助が必要である。感染研ではBSL3実験は複数名での作業が原則である。特に単独でのBSL3「動物実験」は無謀と言って良い。被曝者となった場合は、傍らにいるはずの研究者に協力を仰ぐよう勧めている。たまたま席をはずしていても、とにかく人を呼ぶよう勧めている。自身は洗浄・消毒に専念し、その人に薬剤アクセスを依頼すれば良い。

以上の初動後は、曝露の状況判断に移行する。のちに定量的評価が可能となるよう「感染力価」や曝露量、時間等の情報をメモしておいて頂きたい。これは後の公助のためにも必要な作業である。病原体による環境汚染のチェックも重要である。汚染箇所は速やかに除染・消毒する。すなわち三原則の第三:周りに及ぼすなかれ、である。

その後は健康管理担当者に連絡し、その指示に従う。通常は附属の病院か、事前に協力を依頼してあるPEPに習熟した連携医療機関を受診することになる。感染研では以上の流れを簡潔にまとめたものを各実験室内に掲示している（図3)。以後の流れはCDCのガイドラインに準ずるが、二次感染の可能性が完全に否定されるまで危険行動（無防備な性行動や、出血を伴う受傷後の不適切な処理等）を控えることも重要である（三原則の第三)。ガイドラインにはないが、曝露の定量的評価も重要である。これによりPEPの効果が定量的に判定できる。PEPの定量的効果判定を積み重ねていけば信頼性の高い根拠となる。根拠に基づいた対策の確立は公助そのものである。

1. 真っ先に大量の水で洗浄する。
（針刺しなどの場合は、刺入部から血液をできるだけ絞り出す）
（石鹸の併用:○　次亜塩素酸・ヨード剤の併用:効果は不明）

2. 同時に人を呼ぶ。
＃誰でも良い。以下の連絡・処置などを手伝ってもらう。

3. 速やかにコンビビル1錠またはツルバダ1錠(HIV-1の場合)
あるいはツルバダ1錠(SIV, SHIV, HIV-2の場合)を服用する。
＃薬剤は所定の位置にある。
＃場所を知らない人は、仲宗根(内線2737)へ
＃カレトラの服用に関しては仲宗根の指示に従う。

4. 汚染物の状況(病原体の種類、付着の状態など)をメモ

5. 曝露時間、状況をメモ

6. 以後の処置は仲宗根(内線2737)の指示に従う。

図3. HIV関連曝露事故に対する緊急対処法
（実験室掲示用）

その他（課題等）

・自己責任：「医療現場」と異なり「実験室現場」でのPEP（特に初回の服薬）は処方せん発行前にならざるを得ない。処方せん発行前のPEPについては、あくまでも自己判断・自己責任であることを了解しておくことが前提である。

・事前のinformed consent：前述の自己判断・自己責任も含めて、PEPについては担当医師と研究者の間で事前にinformed consentを取り交わしておくことが望ましい。

・薬剤耐性ウイルス：経済的理由からPEPのための常備薬剤の種類は限定される。「実験室現場」で取扱う病原体は薬剤耐性/感受性が事前に判明していることが多い。予算が許すのであれば、主に扱う薬剤耐性ウイルスに効果のある薬剤の常備が望ましい。連携医療機関受診の際に、曝露ウイルスの薬剤耐性/感受性プロファイルを申告することは当然である。

・保障：感染研のSHIV曝露事故（1997年）では労災補償が適応された。厚労省の通知等（労災保険におけるHIV感染症の取扱いについて：平成22年9月9日付基発0909第1号、同健疾発0909第1号）には「実験室従事者」の記載はないが、「実験室現場」におけるHIV関連曝露事故についても労災が補償される。但し「実験室従事者」の身分によっては労災対象外の場合も充分にあり得る。学生等は学校保険でカバーされると思われるが、対象外の可能性が高い「実験室従事者」については事前の確認が個々に必要である。

・妊娠：妊婦あるいは妊娠の可能性のある女性は、危険な病原体を取扱うリスクを充分に考慮して、まず実験への参加自体の可否を判断し、可と判断した場合は、さらに薬剤の影響を考慮した上でPEPの採否を事前に判断するべきと考える。

さいごに

1987年に三重大医学部附属病院で医師2名と看護師1名がB型劇症肝炎をあいついで発症し、医師2名が亡くなった（20)。感染経路は不明で針刺しの可能性は低いとされている。その記憶も新しい

翌1988年に筆者は針刺しによるB型肝炎を発症した（念のため、三重大ではない）。幸い劇症化に至らず今日に至っている。全国ではこの前後で73人の医療関係者がB型肝炎を発症し、このうち8人が亡くなっている。現在では当たり前だが、当時、医療従事者のB型肝炎ワクチン接種義務への認識は極めて低かった。接種勧告をという私の退院後の第一声は届かなかったが、幸い、2回目の要請により聞き入れてもらえた。この事故では大学院生であった自身の職業的身分の軽さも思い知らされた。曝露後の免疫グロブリン輸注をためらった（自助ができていなかった）我が身を恥じた。

「医療現場」に限らず「実験室現場」においても曝露事故により多くの研究者が亡くなっている(21)。最近でも、液体窒素に起因する酸欠でHIV/STD研究者（2011年、ロンドン）(22)が、髄膜炎菌性髄膜炎でワクチン研究者（2012年、サンフランシスコ）(23)が亡くなっている。前者は病原体によるものではないが、1992年の北海道大学での同様事故（2名死亡）を思い出させる。「実験室現場」は多くのハザードを抱えているのである。ごく最近、多くの研究者（80%強）は自身の実験室を安全と考えているが、一方でその半数近くが実験中になんらかの事故を経験している実態がNatureにより報告された(24)。我が国ではHIV関連曝露による死亡事故が、幸いにもこれまでに1例も発生していない。我が国の実験室における高度の安全設計・安全運用の成果と評価する。一方で安全への過信はリスク低減に反するという意見もNature報告で紹介されている。過信することなく、このHIV関連曝露事故対策は常にアップデートされる。安全運用の一助となることを祈ってやまない。

参考文献

1. Antiretroviral Postexposure Prophylaxis After Sexual, Injection-Drug Use, or Other Nonoccupational Exposure to HIV in the United States. MMWR 2005; 54 (No. RR-2).
2. 抗HIV治療ガイドライン：医療従事者におけるHIVの曝露対策，pp.140-147，平成23年度厚生労働省研究費補助金エイズ対策研究事業・HIV感染症及びその合併症の課題を克服する研究班，2012年
3. Surveillance of Occupationally Acquired HIV/AIDS in Healthcare Personnel, as of December 2010. Updated: May, 2011. (http://www.cdc.gov/HAI/organisms/hiv/Surveillance-Occupationally-Acquired-HIV-AIDS.html)
4. Bell DM. Occupational risk of human immunodeficiency virus infection in healthcare workers: an overview. Am J Med. 1997, 102 (5B) : 9-15.
5. Ippolito G, et al. The risk of occupational human immunodeficiency virus infection in health care workers. Italian Multicenter Study. The Italian Study Group on Occupational Risk of HIV infection. Arch Intern Med. 1993,153: 1451-8.
6. Tokars JI, et al. Surveillance of HIV infection and zidovudine use among health care workers after occupational exposure to HIV-infected blood. The CDC Cooperative Needlestick Surveillance Group. Ann Intern Med. 1993, 118: 913-9.
7. Cardo DM, et al. A case-control study of HIV seroconversion in health care workers after percutaneous exposure. Centers for Disease Control and Prevention Needlestick Surveillance Group. N Engl J Med. 1997, 337: 1485-90.
8. Seroconversion to simian immunodeficiency virus in two laboratory workers. MMWR. 1992, 41: 678-81.
9. Palca J. Human SIV infections suspected. Science. 1992. 257: 606.
10. Khabbaz RF, et al. Infection of a laboratory worker with simian immunodeficiency virus. N Engl J Med. 1994, 330: 172-7.
11. Anonymous survey for simian immunodeficiency virus (SIV) seropositivity in SIV-laboratory researchers -- United States, 1992. MMWR. 1992, 41: 814-5.
12. 富樫武弘，他．注射針刺傷によると推定したHIV-1,HCV同時感染の1例．日本小児科学会雑誌．1991, 95: 780-4.
13. 稲垣　稔，他．針刺し事故小委員会報告：HIV関連汚染事故の実態調査．厚生省平成4年度HIV感染症発症予防・治療に関する研究班研究報告書．1993, pp.57-62.
14. 木村　哲，他．医療従事者における針刺し・切創の実態とその対策に関する調査．厚生労働科学特別研究事業・平成14年度研究報告書．2003.
15. 下条寛人，他．わが国の実験室におけるウイルス感染．ウイルス．1973, 23: 123-4.
16. Nakasone T, et al. Double oral administrations of emtricitabine/tenofovir prior to virus exposure protects against highly pathogenic SHIV infection in macaques. Jpn J Infect Dis. 2012, 65: 345-9.
17. Cohen MS, et al. Prevention of HIV-1 infection with early antiretroviral therapy. N Engl J Med. 2011, 365: 493-505.
18. Hu J, Gardner MB, Miller CJ. Simian immunodeficiency virus rapidly penetrates the cervicovaginal mucosa after intravaginal inoculation and infects intraepithelial dendritic cells. J Virol. 2000, 74: 6087-95.
19. Cochrane review 2010: Antiretroviral post-exposure prophylaxis (PEP) for occupational HIV exposure

(Review). The Cochrane Library 2010, Issue 3.
20. 高瀬幸次郎, 他. 医療従事者にみられたB型劇症肝炎の2例. 肝臓. 1988, 29: 1303.
21. Biosafety in microbiological and biomedical laboratories. US-DHHS, CDC and NIH. 5th edition, 2007.
22. de Paiva A. Safety survey reveals lab risks. Proceedings of the ABSA 55th Annual Biological Safety Conference. 2012, p.124.
23. Officials investigate San Francisco lab worker death. Nature News Blog, 03 May 2012. (http://blogs.nature.com/news/2012/05/officials-investigate-san-francisco-lab-worker-death.html)
24. Safety survey reveals lab risks. Nature. 2013, 493: 9-10.

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BRIEF REPORT

False Beliefs About ART Effectiveness, Side Effects and the Consequences of Non-retention and Non-adherence Among ART Patients in Livingstone, Zambia

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Abstract Beliefs about antiretroviral treatment (ART) are crucial for treatment success but not well documented in sub-Sahara African countries. We studied the frequency of false beliefs about ART in 389 ART patients in Livingstone, Zambia. Despite intensive pre-ART counseling, we find that more than half of the patients hold at least one false belief about ART effectiveness, side effects, or the consequences of ART non-retention or non-adherence. Commonly held false beliefs—e.g., pastors can cure HIV infection through prayer and ART can be stopped without harmful effects while taking immune-boosting herbs—are likely to decrease ART adherence and retention.

Keywords Sub-Sahara Africa · Antiretroviral treatment · Knowledge · Beliefs

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Introduction

With an adult HIV prevalence of 14 % [1], Zambia is one of the countries in sub-Saharan Africa highly affected by the HIV epidemic. Antiretroviral treatment (ART) became available in the public sector in Zambia in 2002; the pace of ART scale-up accelerated rapidly in 2004 and 2005. By December 2009, more than a quarter of a million people were receiving ART in the country [2]. It is well documented that the success of ART depends crucially on patient retention in care and high levels of treatment adherence [3–6]. ART patients' behavior, in turn, is likely to depend in part on beliefs about treatment effectiveness, side effects, and the consequences of non-retention and non-adherence [7, 8]. It is thus important that ART patients do not hold wrong beliefs about the treatment they receive. For this reason, ART initiation in many treatment programs in sub-Saharan Africa is preceded by several teaching sessions about ART [9, 10]. Only two previous studies in sub-Saharan Africa have reported beliefs about ART in ART patients [10, 11]. These studies took place in the early phases of ART scale-up in the respective countries (South Africa in 2002 [10] and Togo in 2005 [11]). Several years into the large-scale ART provision in sub-Saharan Africa, our understanding of the beliefs ART patients hold about their treatment is still limited.

Here, we report for the first time findings on the frequency of false beliefs about ART among ART patients several years after the start of the public-sector ART scale up in a sub-Saharan African country. Our study took place in primary healthcare centers around Livingstone, Zambia.

Methods

This study was conducted in 2009 in the Livingstone District of Zambia, which is located at the border to Zimbabwe. The district consists of Livingstone City and surrounding peri-urban areas. The district has one general tertiary hospital and 13 primary healthcare centers the city. Of the 13 healthcare centers, 11 provide ART. The interviewer team for this study visited each of the 11 healthcare centers once on a randomly selected day over a 2-week period.

All ART patients aged 18 and above who came to receive ART at one of the 11 health centers during the day of the visit by the study interviewer team were asked to participate in face-to-face interviews. ART enrolment, the minimum age of 18, and ability to give informed consent were the only study inclusion criteria; we did not apply any exclusion criteria. Of 421 ART patients who visited a health center during one of the interview days, 403 patients consented to study participation (i.e., non-participation was less than 5 %). We excluded 14 (or 3 %) of the 403 study participants from our final sample, because they had at least one missing value for one of the variables used in the analysis. Our final sample thus included 389 of the total of 1,578 active ART patients in the 11 healthcare centers in the district. All patients in this sample provided informed, written consent to participate in the study. The interview included questions on socio-demographic variables and 10 true-or-false questions to evaluate different dimensions of ART knowledge (on ART effectiveness and side effects, ART retention, and ART adherence). We tested the questions used in this study by asking 25 patients and three health workers to tell us how they understood the question and what they would consider in answering it. We revised the initial questionnaire based on the results of this pilot study, replacing phrases and words that could be misunderstood with alternatives that the pilot study participants indicated did not carry the risk of misunderstanding.

Data were processed and analyzed in SPSS 17.0 for Macintosh. A multivariable logistic regression model was used to examine conditional associations of the socio-demographic variables (age, sex, education, electricity at home, family support for ART treatment, and duration of ART) with perfect knowledge (i.e., answering all ART knowledge questions correctly).

Results

The median age of the respondents was 40 years (interquartile range (IQR) 32–46), and the median months on treatment was 23 (IQR 12–41). Of the 389 respondents, 5 % were male; 50 % had attained secondary-school level of education or higher; 70 % were currently not working; 27 % were living in a house with electricity; and 88 % received family support for ART treatment.

Overall, 56 % of respondents held at least one false belief about ART (Table 1). Of all respondents, 41 % held at least one false belief about ART effectiveness and side effects; 17 % held at least one false belief about ART retention; and 17 % held at least one false belief about ART adherence. Table 2 shows the results of regressing an indicator variable of perfect ART knowledge on age, sex, education, electricity at home, family support of ART taking, and duration of ART.

Discussion

While 95 % of respondents correctly replied that they were aware that they would have to take medicine every day for life once they began ART, 17 % of participants falsely believed that HIV could be cured by ART. These two beliefs seem incompatible but were jointly held by 16 % of all respondents, suggesting fundamental misunderstandings of the functioning of ART even after the comprehensive ART counseling and education HIV patients receive preceding ART initiation. Another particularly worrisome false belief is that pastors can cure HIV infection through prayer (held by 17 % of participants), which suggests that these patients may at some point decide to discontinue medical treatment and seek cure through prayer. This hypothesis is supported by anecdotes that ART health workers and patients shared informally with members of the interview team recounting that some patients had stopped ART after attending prayer services promising to cure their HIV infection.

The percentage of participants who described at least one false belief relating to ART adherence was 17 %, a figure that seems high given that all of the respondents had previously participated in adherence counseling sessions and were asked about adherence during the routine ART clinic visits. Almost one in six respondents believed that ART could not cause side effects. Such a false belief is likely to lead to unnecessary health losses among ART patients, as patients who do not realize that their treatment may be the source of symptoms, may not report certain symptoms to health workers, thus limiting the workers' ability to intervene early and appropriately [12].

Table 1 Art beliefs

Statement	% (95 % CI) of patients who agreed with the false statement shown in the first column
Effectiveness and side effects	
Pastors can cure HIV by prayer	17 % (13–21 %)
HIV can be cured by ART*	17 % (13–21 %)
If you start ART you will die soon	3 % (2–5 %)
ARVs cannot cause side-effects such as vomiting, rash, pain in legs*	14 % (11–18 %)
Patients with at least on false belief about ART effectiveness and side effects	41 % (36–46 %)
Retention	
You do not have to take ARVs for the rest of your life	6 % (4–9 %)
You can stop taking ARVs while you are taking immune-boosting herbs	10 % (7–13 %)
You can stop ART after you regain health	4 % (2–7 %)
You can stop ART without consulting health workers if you have side effect	2 % (0–4 %)
Patients with at least one false belief about ART retention	17 % (13–21 %)
Adherence	
Missing doses of ARVs does not lead to disease progression*	8 % (5–11 %)
There is no risk of ARVs becoming ineffective in future if you stop taking ARVs	14 % (11–18 %)
Patients with at least one false belief about ART adherence	17 % (13–21 %)
At least one false belief	56 % (51–61 %)

N = 389, *ARV* antiretroviral drugs, *ART* antiretroviral treatment, *CI* confidence interval

* Questions from a questionnaire used previously in South Africa [10]

Table 2 Multivariable logistic regression analysis of factors associated with perfect ART knowledge

	Odds Ratio (95 % CI)	*P* value
Age		
≥40 years	1.44 (0.94–2.20)	0.095
<40 years	1	
Sex		
Male	0.84 (0.52–1.37)	0.491
Female	1	
Educational attainment		
Secondary or higher	1.64 (1.06–2.52)	0.025
Primary or lower	1	
Electricity at Home		
Yes	0.58 (0.35–0.95)	0.030
No	1	
Family support		
Yes	2.38 (1.19–4.76)	0.014
No	1	
Duration of ART		
0–12 months	0.73 (0.44–1.21)	0.217
13–24 months	0.54 (0.32–0.91)	0.020
≥24 months	1	

ART antiretroviral treatment, *CI* confidence interval

While we cannot rule out that some participants misunderstood a particular question—for instance, because they interpreted the word "cure" as meaning "absence of symptoms" rather than "elimination of HIV"—it seems unlikely that misunderstandings of question meanings were common because, as described above, we carefully tested the study questionnaire in a pilot study and revised the initial questions based on the pilot results to minimize the risk that particular words and phrases could be misunderstood.

A prior study in South Africa [10] found that 50 % of respondents believed that HIV can be cured by ART and 36 % believed that ART cannot cause side effects. The participants in our study were substantially less likely to hold these false beliefs (17 and 14 %, respectively). There are several possible reasons for this difference. For one, all participants in our study were on ART at the time of the interview, while in the South African study only 30 % of participants received ART [10]. This difference in sample composition might explain the differential in false beliefs: People receiving ART have first-hand experience with the treatment, and it is likely that they have received more ART-specific education than those not on ART. Furthermore, our study took place several years after the South African study and it is likely that over calendar time ART knowledge in the Southern African region has increased.

Our findings that the likelihood of perfect ART knowledge improves with increasing education and the presence of family support conform with our expectations. People with higher levels of general education are likely to have better access to information on ART and may have had

more exposure to teaching about human biology and other areas of knowledge that are relevant to understanding the functioning of ART. People whose families support them in their ART treatment are likely to have more opportunities to examine and improve their understanding of the functioning of ART in discussions with others. Contrary to our expectation, the presence of electricity at home, a proxy for socioeconomic status, was negatively associated with perfect ART knowledge in multivariable regression. It is possible that this finding can be explained by a selection effect: people of lower socioeconomic status are likely to face higher hurdles to ART access, for instance, because they may find it difficult to pay for transport to the healthcare centers where ART is available. As a result, only those in this group who are particularly knowledgeable and motivated to receive ART may access the treatment. In contrast, people of higher socioeconomic status may access ART even if they are not very knowledgeable and motivated to receive ART, because they do not face substantial hurdles to access.

Our findings further suggest a u-shaped relationship between ART duration and knowledge. Such a relationship could be explained by interactions of several effects, such as health workers improving their skills in explaining the functioning of ART over time, patients increasingly seeking out alternative sources of information on treating HIV infection as they develop unpleasant side effects on ART, and increased drop-out of patients with imperfect ART knowledge. Future research needs to further elucidate the determinants of ART knowledge, in order to ensure that education and counseling of ART patients is effective and appropriate at different stages in the course of ART. It will also be important to understand in how far the quality and intensity of the current education and counseling in primary healthcare centers in Zambia can be increased.

Previous studies have found that beliefs about ART predict ART adherence [13, 14], but none of these studies examined the effect of beliefs on adherence within sub-Saharan Africa. Furthermore, no study has investigated the relationship between belief about ART and retention in HIV care. We find that a substantial proportion of patients believe that they do not have to take antiretroviral drugs (ARV) for the rest of their lives, and that they can stop taking ARV while taking immune-boosting herbs, when side effects occur, or after their health status has improved. Such beliefs are likely to increase the risk of treatment discontinuation. To inform decisions on how to optimally allocate limited budgets for ensuring the long-term success of ART in Zambia, future work should investigate how important ART knowledge is for retention and adherence relative to other factors, such as the transport and time costs of accessing ART, forgetfulness, and stigma.

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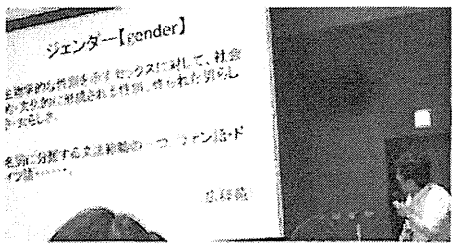
References

1. UNAIDS. Report on the global AIDS epidemic 2010, Geneva. 2010. http://www.unaids.org/globalreport/Global_report.htm. Accessed 6 Feb 2011.
2. WHO/UNAIDS/UNICEF. Towards universal access: scaling up priority HIV/AIDS interventions in the sector: progress report 2010. Geneva: WHO; 2010.
3. Bangsberg DR, Perry S, Charlebois ED, et al. Non-adherence to highly active antiretroviral therapy predicts progression to AIDS. AIDS. 2001;15(9):1181–3.
4. Weiss L, French T, Finkelstein R, Waters M, Mukherjee R, Agins B. HIV-related knowledge and adherence to HAART. AIDS Care. 2003;15(5):673–9.
5. Goujard C, Bernard N, Sohier N, et al. Impact of a patient education program on adherence to HIV medication: a randomized clinical trial. J Acquir Immune Defic Syndr. 2003;34(2):191–4.
6. Roberts KJ. Barriers to and facilitators of HIV-positive patients' adherence to antiretroviral treatment regimens. AIDS Patient Care STDS. 2000;14(3):155–68.
7. Bärnighausen T, Chaiyachati K, Chimbindi N, Peoples A, Haberer J, Newell ML. Interventions to increase antiretroviral adherence in sub-Saharan Africa: a systematic review of evaluation studies. Lancet Infect Dis. 2011;11(12):942–51.
8. Finocchario-Kessler S, Catley D, Thomson D, Bradley-Ewing A, Berkley-Patton J, Goggin K. Patient communication tools to enhance ART adherence counseling in low and high resource settings. Patient Educ Couns. 2012. doi: 10.1016/j.pec.2012.03.020.
9. Torpey KE, Kabaso ME, Mutale LN, et al. Adherence support workers: a way to address human resource constraints in antiretroviral treatment programs in the public health setting in Zambia. PLoS ONE. 2008;3(5):e2204.
10. Nachega JB, Lehman DA, Hlatshwayo D, et al. HIV/AIDS and antiretroviral treatment knowledge, attitudes, beliefs, and practices in HIV-infected adults in Soweto, South Africa. J Acquir Immune Defic Syndr. 2005;38(2):196–201.
11. Potchoo Y, Tchamdja K, Balogou A, Pitche VP, Guissou IP, Kassang EK. Knowledge and adherence to antiretroviral therapy among adult people living with HIV/AIDS treated in the health care centers of the association "Espoir Vie Togo" in Togo, West Africa. BMC Clin Pharmacol. 2010;10:11.
12. Sanjobo N, Frich JC, Fretheim A. Barriers and facilitators to patients' adherence to antiretroviral treatment in Zambia: a qualitative study. SAHARA J. 2008;5(3):136–43.

13. Chakrapani V, Newman PA, Shunmugam M, Kurian AK, Dubrow R. Barriers to free antiretroviral treatment access for female sex workers in Chennai. India AIDS Patient Care STDS. 2009;23(11):973–80.

14. Ramchandani SR, Mehta SH, Saple DG, et al. Knowledge, attitudes, and practices of antiretroviral therapy among HIV-infected adults attending private and public clinics in India. AIDS Patient Care STDS. 2007;21(2):129–42.

●jaih-s との共同企画フォーラムⅢ



「HIV/エイズとジェンダー」

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1986年奈良県立医科大学卒業。奈良県立医科大学 産婦人科学、JICAケニア感染症研究対策プロジェクト長期専門家(HIV/AIDS)、国立国際医療センター国際医療協力局、JICAカンボジア母子保健プロジェクトフェーズⅡ長期専門家(チーフアドバイザー)JICAインドネシア保健省計画予算局長期専門家(保健政策アドバイザー)などを経て、2010年より現職。

●今日のテーマは「HIVを取り巻く課題や考え方について理解する」ことである。

●HIVの基礎

HIVはウイルスの名前で、AIDSは疾患名で、正しく使いわけるべきである、また、HIVの感染ルートは性行為(男性から女性の方が約10倍感染しやすい)、血液(輸液、針の使い回し)、母子感染がある。

●ケニアでの研究活動時のデータ

西ケニアの6つのヘルスセンターでHIV陽性率を調査した。同じ地域であるにも関わらずヘルスセンターごとで陽性率がかなり異なっていたため、それぞれのヘルスセンターを調査したところ、部族によって陽性率が大きく異なることが分かった。陽性率が高い部族ではwife inheritance(寡婦相続)という習慣的規範があり、アフリカ内でのwife inheritanceの報告とHIV感染分布が一致しているようでもあり、このような習慣的規範がHIVの感染拡大に関連しているように思えた。

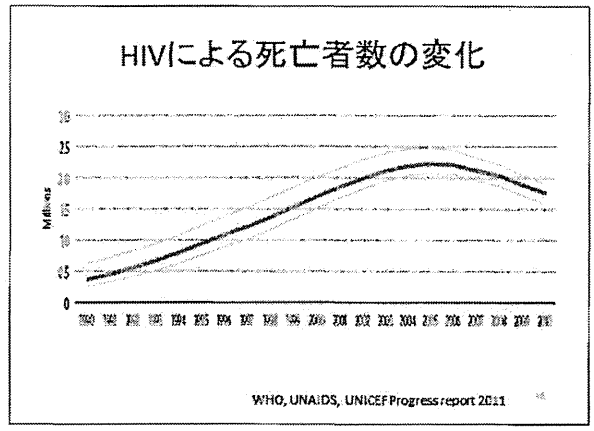
通常、感染拡大因子の一つに接触の頻度(人間の行動)があるが、HIV拡大の問題はウイルス学的な問題ではなく、人間の行動に目を向けた方がいいのではないかということを知った。

●AIDS 問題を取り巻く要因

世界のHIV陽性者は増加傾向だが、新規感染者は1997年をピークに減少してきている。日本では新規感染者は2007年頃まで増加しており、日本の予防対策は遅れている。一方で、世界的のHIVによる死亡者は2005年をピークに減少しつつある。途上国でも治療を必要とする人の半分以上はHIVの治療を受けることができるようになり、死亡者も減少していることから世界のHIV陽性者は増加傾向になっている。世界のエイズ対策はかつて予防中心の対策を行っていたが、近年では治療も拡大され、慢性疾患の扱いになってきており、世界的にHIVに対する偏見は徐々に少なくなってきている印象がある。

Wife InheritanceとBeliefs

- 単身の未亡人は呪いが解けていない・・拒否するとさらに呪われて子どもまでが死亡する
- Wife Inheritanceが終わるまで葬儀終了したことにならない
- 新しい夫に嫁ぐ前に未亡人となった妻は「cleansing」と称して第三者と性交渉を必ず持つこともある
- 部族のidentity・・神聖な文化
- 夫はAIDSによって死亡していることが多いが、家族などにはAIDSとの認識はない・・・(例えば、西ケニアでは「Chira」と言う信仰的疾患と考えられている)



男性のHIV治療へのアクセスは女性に比べてよく