Report of the second WHO stakeholders meeting on rhodesiense human African trypanosomiasis

Geneva, 26–28 April 2017
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Abbreviations

CDC United States Centers for Disease Control and Prevention
Ceva Ceva Animal Health (pharmaceutical company)
COCTU Coordinating Office for Control of Trypanosomiasis in Uganda
COVAB College of Veterinary Medicine, Animal Resources & Biosecurity
CTC capillary tube centrifugation (see also HCT)
DFID Department for International Development (United Kingdom)
DNDi Drugs for Neglected Diseases initiative
DVS Directorate of Veterinary Services
FAO Food and Agriculture Organization of the United Nations
FIND Foundation for Innovative New Diagnostics
HAT human African trypanosomiasis
HAT-e-TAG HAT elimination Technical Advisory Group
HCT haematocrit centrifugation technique (see also CTC)
g-HAT gambiense human African trypanosomiasis
IAEA International Atomic Energy Agency
ICIPE International Centre of Insect Physiology and Ecology
IEC Information, education and communication
IKARE IK Aid and Relief Enterprise
IRD Institut de Recherche pour le Développement
KALRO Kenya Agricultural and Livestock Research Organization
KENTTEC Kenya Tsetse and Trypanosomiasis Eradication Council
KWS Kenya Wildlife Services
LAMP loop-mediated isothermal amplification
LSTM Liverpool School of Tropical Medicine
mAECT Mini Anion Exchange Column Test
mHCT micro-haematocrit centrifugation technique
MINAGRI Ministry of Agriculture and Animal Resources
MOHCDGEC Ministry of Health, Community Development, Gender, Elderly and Children
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>NaLIRRI</td>
<td>National Livestock Resources Research Institute</td>
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<td>NIH</td>
<td>National Institutes of Health</td>
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<tr>
<td>NIMR</td>
<td>National Institute for Medical Research</td>
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<td>NMAIST</td>
<td>Nelson Mandela African Institute for Science and Technology</td>
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<td>NOHU</td>
<td>National One Health Unit</td>
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<td>NSSCP</td>
<td>national sleeping sickness control programme</td>
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<td>NTD</td>
<td>neglected tropical disease</td>
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<td>OHCU</td>
<td>One Health Coordination Unit</td>
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<td>OIE</td>
<td>World Organisation for Animal Health</td>
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<tr>
<td>PATTEC</td>
<td>Pan African Tsetse and Trypanosomiasis Eradication Campaign</td>
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<tr>
<td>PCR</td>
<td>polymerase chain reaction</td>
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<tr>
<td>r-HAT</td>
<td>rhodesiense human African trypanosomiasis</td>
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<tr>
<td>RDB</td>
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<tr>
<td>RDT</td>
<td>rapid diagnostic test</td>
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<tr>
<td>RT-PCR</td>
<td>real time polymerase chain reaction</td>
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<td>SOS</td>
<td>Stamping Out Sleeping sickness</td>
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<tr>
<td>STPH</td>
<td>Swiss Tropical and Public Health Institute</td>
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<tr>
<td>TANAPA</td>
<td>Tanzanian National Parks Authority</td>
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<tr>
<td>TDR</td>
<td>Special Programme for Research and Training in Tropical Diseases</td>
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<tr>
<td>UTCC</td>
<td>Uganda Trypanosomiasis Control Council</td>
</tr>
<tr>
<td>USAID</td>
<td>United States Agency for International Development</td>
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<tr>
<td>VWB</td>
<td>Veterinarians Without Borders</td>
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<td>WHO</td>
<td>World Health Organization</td>
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<td>ZDU</td>
<td>Zoonosis Disease Unit</td>
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1. Introduction

The roadmap\(^1\) on neglected tropical diseases published by the World Health Organization (WHO) in 2012 placed human African trypanosomiasis (HAT) on the list of neglected tropical diseases targeted for eradication or elimination by 2020. The London Declaration on Neglected Tropical Diseases\(^2\) includes the same goal. Since 2000, joint efforts by WHO and partners have led to remarkable and continuous progress in reducing the number of HAT cases, achieving important milestones towards the goal of eliminating the disease as a public health problem by 2020. This goal has been recently redefined by WHO as a 90% reduction of the total area at risk reporting more than one case per 10,000 people annually from 2004 baseline levels and fewer than 2000 cases reported annually at a continental level.

Elimination efforts have focused on gambiense HAT (g-HAT), which is responsible for most reported cases. There is increasing neglect of rhodesiense HAT (r-HAT) due to its rarity and the complexity of its elimination in animal reservoirs, resulting in a lack of interested funders and partners. Progress has been made with extremely limited resources. As the epidemic potential of r-HAT is high, working towards elimination should remain a priority even with low numbers of reported cases and the added challenge of multiple zoonotic reservoirs of the disease. The One Health approach is an opportunity to bridge the two fields of veterinary science and human health, and is directly relevant in the case of r-HAT.

The first WHO stakeholders meeting on r-HAT elimination (Geneva, 20–22 October 2014)\(^3\) was an important boost to the multisectoral coordination mechanism between WHO and partners to eliminate r-HAT as a public health problem. Contributing partners included members of academia, public–private partnerships, nongovernmental organizations, international organizations, donors and national sleeping sickness control programmes (NSSCPs). This second stakeholders meeting aimed to review the progress made in the past 2 years in terms of diagnostic and treatment capacities and to examine the current epidemiological situation in each country. The discussions focused on key elements of future activities, such as the importance of sustained surveillance, multisectoral coordination and partnerships, innovative ways to expand the use of tools and improving capacity-building.

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\(^2\) The London declaration on neglected tropical diseases. Uniting to Combat NTDs; 2012 (http://unitingtocombatntds.org/resource/london-declaration).

2. **Opening remarks**

Dr Raman Velayudhan, WHO Vector Ecology and Management, welcomed the participants on behalf of the Director of the WHO Department of Control of Neglected Tropical Diseases. He emphasized the importance of the One Health approach, and specifically vector ecology and management in the control of HAT. Many control programmes are faced with the same issues as those seen in HAT control, including gaps in capacity-building and a need for improved surveillance, diagnostics and treatment. The Sixty-ninth World Health Assembly (Geneva, 23–28 May 2016) had acknowledged that vector control is a key area that needs progress. The Seventieth World Health Assembly (Geneva, 22–31 May 2017) would discuss the draft global vector control response 2017–2030\(^4\) and provide an opportunity for HAT vector control efforts to align with this larger programme.

Dr Abdoulaye Diarra, focal point for HAT in the WHO African Region, noted the importance of collaboration across sectors, citing the significant progress made to date in HAT elimination. He highlighted the role that each country has played in reducing the transmission of HAT and increasing capacity at country level, and welcomed the convening of this meeting as an opportunity to look ahead and improve collective efforts.

The meeting was chaired by Dr Anne Moore, United States Centers for Disease Control and Prevention, and co-chaired by Professor Eric Fèvre, University of Liverpool. The meeting agenda is attached as Annex 1 and the list of participants as Annex 2.

3. **Meeting objectives**

The objectives of the meeting were:

- to describe the current epidemiological situation of r-HAT, health system capacities and control activities in each endemic country;
- to assess the current situation of tools to control r-HAT;

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• to identify main gaps and challenges to achieving the elimination of r-HAT as a public health problem and possible solutions, both continentally and at country level; and
• to promote the development of concrete plans for (i) capacity-building at country level to ensure access to diagnosis and treatment for r-HAT, and (ii) an integrated surveillance system for control and elimination.

4. The global situation of rhodesiense HAT

WHO has prioritized elimination of HAT under the Innovative and Intensified Disease Management unit. The disease is caused by the protozoan parasites *Trypanosoma brucei gambiense* (which cause chronic infection) and *Trypanosoma brucei rhodesiense* (which cause acute infection). Infection is transmitted to humans through the bite of infected tsetse flies (*Glossina* genus). The goal of the HAT control and surveillance programme is to eliminate the disease (g-HAT and r-HAT) as a public health problem by 2020. Since 2001, this elimination priority has been supported by a public–private partnership with Sanofi and Bayer.

Elimination of HAT as a public health problem has been defined as fewer than 2000 cases reported per year at a continental level, and a 90% reduction of the total area reporting 1 or more cases per 10 000 people (including exported cases). The next goal is to interrupt transmission of g-HAT by 2030 to achieve zero reported cases. The pursuit of this goal is significantly more complex for r-HAT than for g-HAT due to its predominance in animal reservoirs. The latest (2013) technical report of the WHO Expert Committee on control and surveillance of HAT states that complete elimination is not a technically feasible goal for r-HAT with the current means, but it does not rule out its elimination as a public health problem.

It is possible to eliminate r-HAT as a public health problem. Its occurrence is rare, and the current landscape suggests that some areas may be within range of this goal. The incidence of the disease is well mapped, particularly through the Atlas of HAT, which is an essential resource for monitoring progress.

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but which may present an incomplete picture due to underreporting. Medicines are available free of charge for countries, partnerships are in place, and a certain level of political will and support exists.

Elimination as a public health problem is a relevant goal as it helps to raise awareness of the disease and encourages countries to invest in its control. Several key elements of the WHO control programme revolve around (i) supporting and providing technical guidance to disease endemic countries at the national level to ensure access to diagnostic tools and treatment for all people at risk; (ii) strengthening surveillance by gathering and analysing all the data considered relevant to plan and monitor interventions; and (iii) coordinating stakeholders involved in r-HAT elimination. Importantly, reducing the number of cases is not an end-point but rather the first step of an integrated and sustained surveillance programme. For this reason, the method of assessing this first step of elimination will be straightforward. Conversely, the process will be much more complex and stringent for assessing the interruption of transmission of the disease.

Figure 1. Number of cases of human African trypanosomiasis reported yearly from 2008, including both gambiense and rhodesiense forms of the disease
In 2015, of the 2804 HAT cases reported to WHO (Figure 1), 71 were r-HAT. The data for 2016 are being finalized but show already a decrease to around 2200 cases. Currently, the programmes are well placed to reach the goal of fewer than 2000 cases by 2020. While the proportional contribution of r-HAT is low in comparison to g-HAT (2% of cases), it must not be overlooked. Rhodesiense HAT is endemic in Uganda, United Republic of Tanzania, Malawi, Mozambique, Kenya, Rwanda, Zambia and Zimbabwe (Figure 2).

Figure 2. Distribution of rhodesiense HAT cases in the endemic countries, 2011–2015, including exported cases
From 2000 to 2016, Uganda reported more than half of all r-HAT cases globally (a total of 5083 cases). In the past 5 years (2012–2016), Uganda and Malawi have reported the majority of cases (51% and 34%, respectively), and the United Republic of Tanzania, Kenya, Zambia and Zimbabwe the remainder of cases. During this period there is a clear declining trend in the number of r-HAT cases, with 52 reported in 2016 (Table 1, Figure 3).

Table 1. Number of r-HAT cases reported by the endemic countries, 2010–2016

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<tr>
<td>Zimbabwe</td>
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<td>9</td>
<td>1</td>
<td>3</td>
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<td>1</td>
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<td>Total</td>
<td>156</td>
<td>113</td>
<td>110</td>
<td>86</td>
<td>118</td>
<td>71</td>
<td>53</td>
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Figure 3. Numbers of r-HAT cases reported annually since 2001
Currently, there are no areas at high or very high risk of r-HAT, but some remain at moderate risk (Figure 4). The overall situation has shown improvement in the past 5 years from previous years, but there remain 102 800 km² including 6.1 million people where the disease remains a public health problem. The coverage of the population at risk of infection has also been improving, with 88% at moderate risk living less than 3 hours away from a health facility capable of diagnosing r-HAT, and 94% within 5 hours of a facility that provides treatment.

Figure 4. Population at risk (top panel) and area at risk (lower panel) of r-HAT since 2000

One important caveat about the data on r-HAT is that they may be incomplete because a certain number of cases may be missed. The disease progresses rapidly, which can make it more difficult to
detect because death can occur before patients reach a health-care facility competent in diagnosis of HAT, especially if they live in a sparsely populated area.

Exported cases (diagnosed in a non-endemic country) are infected mostly in touristic areas (e.g. national parks, wildlife reserves). Indeed, very few cases are reported from the local population in these same areas. All exported cases are reported to WHO, because only WHO enables access to treatment. WHO can use the reported number of exported cases as an indicator of the presence of r-HAT transmission in geographical areas, signaling the disease’s spread.

The question of uncertainty and how to incorporate underreporting has been posed to mathematical modelers from various groups (the London School of Tropical Medicine, the Oxford University Spatial Ecology and Epidemiology Group, and the NTD Modelling Consortium). By definition, there are no data from which to build a model in areas that lack data. However, it is possible to model uncertainty around recorded cases, even if for r-HAT this is only through passive case detection. Models can also use data on the distribution of animal disease and on distribution of vectors to estimate areas at risk of r-HAT.

There are no appropriate serological screening tools for r-HAT, and therefore detection of cases relies on clinical suspicion and parasitological diagnosis. It would likely be difficult to find a sponsor to develop a new serological screening tool. The current serological knowledge for *T. b. rhodesiense* is not sufficient to develop a tool for screening or diagnosis. For example, it is unknown which surface antigens would be adequate targets. The likely positive predictive value would be very low, as there are generally low levels of prevalence (especially in areas approaching elimination), requiring an extremely specific test. A high number of false-positive cases would also require a huge amount of samples to track progress and assess elimination (< 1 case/10 000 samples). The low awareness of r-HAT and the lack of preparedness of health systems could also lead to the misdiagnosis of the disease. Even in epidemic situations such as Uganda in 1988–1990, models predicted that 39% of cases went undetected, and 92% of deaths were unreported. Furthermore, the increased use of rapid diagnostic tests (RDTs) for malaria, replacing the microscopy exams, has resulted in reduced numbers of incidental r-HAT diagnosis through microscopy. Nonetheless, it was noted that great progress has been made towards the elimination goal, even with deficient tools.

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The capacity of health systems to detect r-HAT in the affected countries is improving overall. In the six countries reporting cases, 111 facilities in the endemic area offer diagnosis (49 offer parasitological diagnosis and 34 offer also disease staging), and 32 facilities offer treatment.

5. Principles and concepts of HAT elimination

In 1988, the International Task Force for Disease Eradication set criteria to assess eradication or elimination of diseases. These criteria included the following:

- epidemiological vulnerability (absence of non-human reservoir, ease of spread, natural immunity, ease of diagnosis, duration of relapse potential);
- availability of effective, practical intervention (vaccine, curative treatment, means of vector control);
- demonstrated feasibility of elimination (documented elimination from a geographical unit);
- perceived disease burden;
- estimated cost; and
- opportunities for synergy with other programmes.

The first criterion is impossible to achieve for r-HAT because the disease is present in several animal reservoirs and its epidemiology is not yet fully understood. While some effective tools are available to prevent and manage r-HAT infections, significant improvements are needed (notably for treatment). Medicines for treatment are currently donated and made available free of charge at all times in the designated health facilities. The distribution of the disease is known (through the HAT Atlas). It is known also that control is feasible and that elimination may have been achieved in some areas (e.g. Botswana and Rwanda). There is political will to achieve this goal within national health authorities.

The next steps will require preparation of country specific strategies for elimination, with timelines and goals, focused on capacity-building at each level. Strategies must include mapping of the disease, a plan for implementation that is flexible across areas of high and low risk and in different environments, methods for monitoring and evaluation (including indicators, milestones and procedures for validation), and decision points on moving from control to surveillance. Post-control surveillance in both humans

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and animals will be a critical part of any long-term strategy. These next steps will require a multipronged approach with innovative thinking and good coordination to implement successfully.


In 2016, the HAT elimination Technical Advisory Group (HAT e-TAG) was convened to provide guidance on the validation by WHO of the elimination of HAT as a public health problem by 2020. The group has focused on devising both global and national indicators of elimination, and developing the template of dossiers that countries should submit to claim the elimination of HAT at national level. Deciding on the metrics of the indicators of elimination has been contentious, but has now been formally defined.

The target for elimination of HAT as a public health problem by 2020 was originally defined as:

- < 1 new reported case per 10 000 inhabitants per year in at least 90% of foci, with < 2000 reported cases/year at continental level. This milestone must be validated by WHO, the status must be maintained and is not an end-point; it requires continued surveillance.

The second step, the full elimination (zero cases) by 2030, was defined as:

- Sustainable disease elimination, defined as the interruption of the transmission of g-HAT. This milestone must be verified by WHO, the status must be maintained and is not an end-point; it requires continued surveillance.

Therefore, the previous indicators in the WHO roadmap were:

- Primary indicators (updated annually)
  - Number of cases reported
  - Number of foci reporting < 1 case/10 000 people per year

- Secondary indicators (updated biennially)
  - Geographical distribution of the disease
  - Population at risk, by levels
  - Coverage of the exposed population by control and surveillance activities

The concept of focus was originally defined by WHO in 1986 as a useful tool for describing the areas affected by HAT. It was defined as “a zone of transmission to which a geographical name is given
(locality, region, or river). However, foci are not objectively measurable, as they can change size or shift geographically over time, making it difficult to quantify them and define the borders of each focus. Depending on the geographical scale or time period being examined, and by whom it is examined, the grouping of foci can change drastically. Many foci extend across country borders, and many countries have different definitions of focus.

Thanks to the HAT Atlas, long-term detailed geographical data are now available and it is possible to more accurately describe the area at risk based on reported cases and on population estimates from geographical information systems (GIS), and to delineate the geographical area that shows the risk. A stratification in several levels of risk permits delineation and measurement of the areas presenting different risk levels. Subsequently, the population at risk can also be quantified by risk level. This makes the indicator quantifiable, repeatable and objective to measure. Its standardized methodology makes it an effective way of tracking progress much more robustly, and at any geographic level.

For these reasons, the HAT-e-TAG refined the indicator and target as follows:

- The target for 2020 is a 90% reduction of the area at risk reporting \( \geq 1 \) case/10 000 people per year.
- The primary indicators are thus the number of cases, and the area at risk reporting > 1 case/10 000 people per year.

This milestone must also be formally validated by WHO, and is not an end-point; it requires continued surveillance after the target is achieved. This new indicator was endorsed by the WHO Strategic and Technical Advisory Group for Neglected Tropical Diseases at its tenth meeting (29–30 March 2017) and is now the official metric. The 90% reduction refers to a baseline of the area at risk calculated over the 2000–2004 time-period. Importantly, the indicator is entirely dependent on the accuracy and completeness of the reported data.

The new definition of the indicator and target works well at the global level, but in practice it has been difficult to adapt new indicators to programmes that are already in place. The HAT-e-TAG advised that this particular indicator should not be established at a national level because it requires advanced expertise in geographical information systems and software that national programmes often lack. Therefore the national-level indicators need to be simpler and practicable at national programme level. The HAT-e-TAG has initiated discussions and work towards identifying these indicators.
7. Rhodesiense-HAT elimination strategies and role of WHO

7.1 Overview of elimination efforts

The greater part of the life-cycle of r-HAT is zoonotic, involving both domestic and wild animals as the main reservoirs of the parasite, and the vector *Glossina* spp., commonly known as the tsetse fly. Occasionally, the disease spills over into humans. Although a relatively rare event, when this occurs it provokes severe illness and patients deteriorate and die unless diagnosed and treated promptly. As the life-cycle of r-HAT can involve many hosts, there are multiple intervention strategies targeting different parts of the parasite life-cycle (Figure 5).

![Figure 5. Life-cycle of r-HAT and methods of intervention targeting different elements of the disease transmission](https://example.com/figure5)

Numerous sectors are involved in r-HAT control beyond human health services, such as veterinary services, vector control initiatives, the tourism industry, and services for management of protected areas as well as wildlife. Each sector leads particular activities, which differ by country, but all sectors can and should play a role in their respective fields, collaborating in surveillance and IEC (information, education, communication) activities. Involvement from local authorities is also needed.
Control strategies for the vector include tsetse screens and traps, sterilized insect technique (release of sterile tsetse males), insecticide impregnated net fencing, large-scale insecticide spraying (ground or aerial) and other methods. Personal protection methods such as use of insect repellents and minimizing skin exposure are also promoted for populations that may be at risk.

Approaches for r-HAT control may vary based on the presence of wildlife reservoirs versus cattle reservoirs, and they require different monitoring and control methods. Active screening is rarely applicable for areas in which wild animals are the main reservoir, but passive screening can be effective. Protected areas and parks are a very important source of income for countries, and should be recognized as high priorities for surveillance by policy-makers. Incorporating this One Health approach is important both ecologically and for local workers, who are constantly exposed.

For areas in which cattle are the main reservoir, active and passive screening is used. Cattle treatment as a preventive or curative measure is seen as a significant contributor to HAT elimination and additionally protects cattle against other infections. Treatment includes spraying the legs and stomachs of cattle with insecticide (restricted application protocol).

Interventions on humans are the sector covered by WHO, and include diagnosis of human cases (case finding) and treatment. If a surveillance system is in place, WHO can produce very useful information on disease distribution that helps to target interventions more effectively in all sectors. After the data are collected by the country and submitted to WHO, they are verified and entered into the Atlas of HAT, which is made available to countries on request. It was noted that country-level risk assessments should take into consideration all components of epidemiological information, which could help towards achieving the goal of elimination and sustained surveillance. For example, countries should ensure that healthcare facilities record the location of likely transmission as this is more informative than the patient’s hometown; they should also ensure that exported cases are included in the country reports. This is especially important now that the transmission intensity is reduced.

WHO offers training on diagnostics for clinical and laboratory staff, provides to national programmes equipment and materials (including treatment), and supports the supervision of health facilities offering HAT services (e.g. refreshing awareness periodically, providing advice when requested). The medicines are donated free of charge thanks to the partnership established with Sanofi and Bayer for the past 16 years. WHO is responsible for forecasting the amount of medicines needed and where they need to be allocated, and provides guidance on how the supply should be used effectively and before expiry.
Another responsibility of WHO is to enhance advocacy for continued support from national authorities, international actors and the scientific community, especially as the disease is declining and thus has limited appeal and awareness to many. Raising the profile of the disease also applies to exposed populations and healthcare workers.

Promoting the elimination of r-HAT is certainly within WHO’s remit, but WHO’s field of action is limited to the human health sector. WHO’s strength lies in its convening power and ability to coordinate national and international actors, develop common strategies and plan activities. To eliminate the disease it will be necessary to stimulate interaction between national health workers and veterinary scientists, as they will be eliminating the disease from the animal reservoir. At the international level, WHO is collaborating with relevant organizations, namely the Food and Agriculture Organization of the United Nations (FAO) and the World Organisation for Animal Health (OIE). Reinforcing and developing this interaction will be a critical part of achieving the elimination goal.

7.2 Strategies for elimination: case-finding

The most important decision for successful case-finding is the choice of surveillance sites. Site selection is the responsibility of the national programme coordinator. Surveillance sites need to be near transmission areas, have a good attendance rate, enough staff resources (always consider already functioning facilities first), laboratory facilities present, experienced staff and accessibility/communication with the central level. Countries have sent WHO an exhaustive list of the health facilities that can carry out clinical diagnosis, parasitological diagnosis and disease staging for r-HAT (Figure 6). This list will be updated regularly to track changes, as it is useful for management as well as for mapping the health coverage of endemic areas.

The distribution of healthcare facilities layered over the distribution of r-HAT risk can inform countries about how to improve the positioning of facilities to cover a larger number of susceptible people. Areas with reported infections but no healthcare facilities can indicate neglected areas, as distance from healthcare facilities is a main contributing factor for health seeking behavior from patients. An extreme example can be seen in Zimbabwe, where the only HAT-competent diagnostic facility is located in Harare, hundreds of kilometres away from transmission areas. It was noted that collaboration with existing private healthcare facilities could improve coverage in some areas.
Other ways of improving case-finding include training clinical staff to better recognize the signs and symptoms of r-HAT, with the use of support tools such as posters or information sheets. A checklist of frequent symptoms can aid clinical staff in diagnosing r-HAT and help to highlight its presence in endemic areas. Cascade training for peripheral health facilities is a way of building capacity and cost-effectively spreading knowledge of the disease outwards from sentinel sites. It is important to examine how health systems work in each country, as each country has its own needs. Decisions about diagnostic testing are referred back to the clinician, so awareness efforts and guidance should target clinicians. Improving awareness of r-HAT for traditional healers could also be beneficial for supporting early referral to health facilities.

Training laboratory staff can also improve case-finding. For example, each local network could be given a customized decision tree of available diagnostic methods ranging from simple to complex, in addition to posters and information sheets on r-HAT. Often, diagnostics are unavailable due to a lack of equipment, which should be reviewed and reinforced by the national programme where needed. Microscopy slides of laboratory examinations should be saved for quality control and competency assessment, together
with samples/images/videos of trypanosomes that can be used to refresh staff knowledge and be passed on to new staff. Regular supervision is needed for quality control and motivation of staff. It was noted that a supervisor checklist could be useful (already developed for g-HAT).

Active screening for r-HAT is usually reactive rather than prospective. It targets the family and village of the infected person, and should be done without delay. Currently, it is based on parasitology screening of a selected population. Data collection on the number of suspected, tested and confirmed cases could help in monitoring trends in the incidence of the disease. A questionnaire has been introduced in some countries targeted at referring doctors, relating to the details of suspected cases (patient history, travel, activities).

7.3 Strategies for elimination: treatment

Treatment for r-HAT must be rapid and readily available. The medicines available free of charge must be ordered in time and the supplies must be appropriately managed by the national programmes. WHO provides guidance and technical support on managing the supply of medicines, and has also mapped healthcare facilities which provide treatment, based on data submitted by countries. This information is all fed back to national focal points and summary data are available online.

7.4 Strategies for elimination: epidemiological surveillance

Surveillance of rhodesiense HAT starts with collection, validation and consolidation of data by the national coordinator, who prepares the reports for partners including WHO. These data are included in the global HAT Atlas by WHO in a process that involves checks for coherence and consistency; any verification queries are sent to country coordinators in order to maximize data validity.

Emphasis is given to establishing and reporting the most probable place of infection of all HAT cases, as this information has key epidemiological value. All cases diagnosed in non-endemic countries (exported cases) are included and mapped at their most probable place of infection, and the national focal points are informed accordingly.

Surveillance data are key for planning control and elimination of HAT. For example, the mapping of transmission areas by stratified levels of risk allows the precise location of sentinel sites or HAT-competent health facilities to be checked and identification of areas that are not well covered.
Countries have contributed significantly to the development and updating of the HAT Atlas, and expressed their interest in using the tool at a country level. Thus far, Francophone countries have undergone training and been provided with equipment and software to use the Atlas for their benefit. The training material is being translated into English, and there are plans for training in Anglophone countries during the first half of 2018.

7.5 Strategies for elimination: IEC (information, education, communication)

This strategy aims to increase awareness of r-HAT among: (i) exposed populations (i.e. on where to seek healthcare and what protective measures to use); (ii) health care workers around sentinel sites, to remain aware of r-HAT as a possible diagnosis and provide information to patients being referred; (iii) traditional healers, as they are often the first people patients seeks help from and must therefore be included in a positive way to encourage prompt referral of patients presenting HAT-compatible symptoms.

There is a potential role for the private sector in this strategy. Hotels and parks have a large stake in protecting their animals, their staff and their visitors, and have the resources to promote better awareness of r-HAT. If transmission areas include national parks, messaging should be retargeted to those areas that tourists may visit and hotel staff may frequent. As technology advances, anthropological surveys have demonstrated that the communication channels that people use currently are very different from past methods, e.g. mobile devices. Suggestions included a social media campaign on the dangers of r-HAT and protective measures, or training programmes on protective measures for hotel staff.

There is also a need to delineate between messaging regarding protection of livestock and cattle (which was a very successful campaign) and messaging regarding wildlife reservoirs because the populations at risk have very different demographics (local residents versus tourists, respectively). Tourists are more likely to travel to larger health-care facilities such as hospitals for early diagnosis. However, local residents may have limited access to health care, so messaging should focus on them.

7.6 Strategies for elimination: coordination

The HAT elimination network coordinates the efforts of a wide range of stakeholders against HAT (Figure 7). Its role is to convene partners in order to identify gaps in control efforts and to develop
common strategies for elimination. National coordination bodies are very important members of the network who evaluate progress and plan activities within the endemic countries.

Figure 7. The HAT elimination network

Across all efforts, it was noted that renewed momentum and coordination is needed. For example, the Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC) was created with the objective of enhancing advocacy and high-level political communication across the endemic countries. As many leaders have changed since the campaign was launched, this energy needs to be renewed across the African Union.
8. Country status reports

8.1 Kenya

Epidemics of r-HAT in Kenya have been interspersed with long periods of low endemicity (Figure 8) across three main foci: the Lambwe Valley, western Kenya and the Maasai Mara National Reserve. The cluster of cases detected in the early 2000s in western Kenya was drastically reduced in subsequent years thanks to the concerted efforts between the governments of Kenya and Uganda in mobilizing local authorities and acting collaboratively (screening, vector control, and treatment). These actions demonstrate that cross-border collaboration is a key element of success.

Since 2012, only two cases have been reported from the Maasai Mara National Reserve, and no cases have occurred in the Lambwe Valley since 2009 (Figure 9). Both cases (diagnosed in Belgium and Germany) were in Stage 1 of the disease. They provoked a massive response from multiple groups, which led to training in six health centres in 2012, including 14 laboratory workers and 71 other medical personnel. No cases have been detected in local people or tourists since then. Historically, reported cases from western Kenya have been in local people while in Maasai Mara the disease has been exclusively reported in tourists.

Figure 8. Number of r-HAT cases in Kenya, 1990–2015
Figure 9. Distribution of r-HAT cases in Kenya, 2010–2014
Health facilities are concentrated in western Kenya, where historically most cases occurred. Although no diagnostic facilities have been officially recorded in southern Kenya, local health workers have been trained in how to recognize the disease. No cases have been treated in Kenya’s public health-care system for at least 8 years, resulting in a lack of medical and laboratory personnel experienced in r-HAT. Furthermore, there is a shortage of diagnostic equipment, specifically centrifuges. The focal point of Kenya noted the need to develop cheap, effective, and reliable RDTs for r-HAT.

The Government of Kenya has taken a leading role in control activities, with the support of WHO, the National Institutes of Health (NIH), the International Atomic Energy Agency (IAEA), the United States Centers for Disease Control and Prevention (CDC), the Swiss Tropical and Public Health Institute (STPH) and others. Control activities are coordinated by the Department of Vector-borne Diseases in the Ministry of Health, which is drafting a strategic national plan to strengthen control and surveillance of r-HAT by building capacity. The plan aims to integrate HAT into national health policies in order to obtain national support and funding. Ultimately, decentralized health services will select their own priorities based on their local situation.

Other active sectors include the Kenya Tsetse and Trypanosomiasis Eradication Council (KENTTEC, involved in vector eradication efforts), the Kenya Agricultural and Livestock Research Organization (KALRO, focused on support for diagnostics and surveillance of trypanosomiasis, and able to provide rapid response if cases appear), the Directorate of Veterinary Services (DVS), Kenya Wildlife Services (KWS, dealing with national parks and reserves), and the International Centre of Insect Physiology and Ecology (ICIPE). The Zoonosis Disease Unit (ZDU) has been active since 2011, and includes epidemiologists from the Ministries of Health and Agriculture, CDC, KWS and others. Lack of sustained funding and overlapping mandates between programmes can be challenging, but continued collaboration between the different programmes is the key to progress towards elimination.

The next steps for Kenyan control of r-HAT are to finalize the national elimination strategy and continue to strengthen the diagnostic capacity of medical staff, with a focus on non-traditional foci (specifically Maasai Mara). Coordination between different actors will continue to be a priority, within the framework of the One Health approach.
8.2 Malawi

Malawi has three foci of r-HAT transmission in the central, western and northwestern regions (Figure 10). The area at risk of r-HAT infection has reduced over the past 15 years, but there are more reported cases in the north and western foci. There has been no significant decline in reported cases over the past 4 years, and those that were reported were diagnosed at Stage 2 (Figure 11). A total of 35 cases were reported in 2016, mostly from the Rumphi focus.

Figure 11. Distribution of r-HAT cases in Malawi, 2010–2014
Among the challenges facing the r-HAT response is the failure of early case detection resulting in high case fatality rates, poor access to hematocrit centrifugation technique (HCT) diagnostics, a lack of cross-border joint interventions, attrition of HAT trained staff, and a lack of research and regular funding for equipment such as utility vehicles for the programme. As the end of a collaborative diagnostic effort with the Foundation for Innovative New Diagnostics (FIND) approaches (October 2017), there is uncertainty over the future sustainability of some control efforts.

Control activities include improving access to laboratory diagnostic services (mainly HCT capacity) and increasing community awareness via radio messaging, involving traditional healers and collaborating with community leaders. Other facets of control activities are mentoring health workers on diagnosis and case management, and facilitating strong linkages with wildlife, veterinary and academic institutions to enhance operational research. Cross-border interventions with Zambia remain a key component of r-HAT control.

There is a national multisectoral r-HAT task force but it is inactive. Other significant partners in the control effort are WHO and FIND (see “Progress in r-HAT diagnostic tools”). The Ministry of Tourism and Wildlife is responsible for deploying tsetse fly traps and targets, providing protective gear for workers,
conducting operational research and increasing community awareness. It remains difficult to control the disease in the park itself due to limited road access.

There is a certain level of underdiagnosing, which is difficult to estimate. However, in the northern part of the country, health facilities are close enough for people to access. Of the 20 health-care facilities, 5 are capable of diagnosis in the northern focus. Future plans include expanding HCT diagnostics in the remaining 15 health facilities. Expanding and intensifying vector control will also play a large role. There is a plan to lobby for inclusion of r-HAT prevention, control and case management tools in the curriculum of health training. Sustained community participation in r-HAT prevention and control will be important.

8.3 Mozambique

The first case of r-HAT in Mozambique was reported in 1909, with four epidemic periods in the country since then; no cases have been reported since 2004 (Figure 12). There is a very low population density in the foci, as they include game reserves and scattered, nomadic populations. This can be a challenge for case detection and reporting. In previous decades, cases have been reported only in the foci of Tete (2004) and Niassa (2002) (Figure 13). After gaining independence in 1975, responsibilities for r-HAT control were split between the Ministry of Agriculture and the Ministry of Health within the NTD department, but there are no specific public health activities related to it. Previously listed in the weekly epidemiological bulletin of the Ministry of Health, HAT is now only for exceptional notification.

In general, health-care facilities are not able to diagnose HAT and the last training on clinical and laboratory diagnosis and case management was held in the early 1990s in Tete. Since then, laboratory diagnosis has been sporadic in Tete and Niassa. In one remarkable case, a patient was undiagnosed with r-HAT for 4 years. There remains a lack of experience in case management, and medicines are not readily available due to lack of communication with the WHO office. A training course for laboratory technicians in at-risk areas was conducted aimed at creating a surveillance system, but no case was ever notified through it. The focal point requested specific guidelines from WHO on how to better implement this system.
Figure 12. Distribution of r-HAT cases in Mozambique, 2010–2014
Figure 13. Number of rhodesiense sleeping sickness cases in Mozambique, 1990–2015

Around 75% of Mozambique is infested with tsetse flies. The Ministry of Agriculture conducts intermittent surveys to ascertain the need for control, but no other specific control measures have been implemented. Until the early 1990s there was a large European Union project supporting proactive activities for animal health and vector control, but this was not maintained.

The ministries of Health and Agriculture have recently been working together to promote coordination of activities in the broader context of zoonotic diseases. This is potentially the best platform to make a case for improved HAT surveillance in high-risk areas. They have recently appointed a Medical Officer to address zoonotic diseases, and will link with the National Institutes of Health (NIH) to pursue the development of a robust surveillance system. Although there have been no detected cases of r-HAT for over 15 years, it is still possible that the disease is still present. The country focal point noted that the control programme would like to initiate surveys to collect blood samples and screen for areas of potential risk, to know where to be vigilant. The development of a serological test for r-HAT would help with this.

Future steps also include increasing awareness of zoonotic diseases, and the focal point highlighted their willingness to work across borders, using their experiences and lessons to improve responses. WHO is very willing to help with the situational analysis of HAT in Mozambique, and to support efforts for
surveillance and training for health facilities in areas perceived to be at risk. A country visit by WHO would be very beneficial.

### 8.4 United Republic of Tanzania

The first recorded case of r-HAT in the United Republic of Tanzania was in 1922 in Maswa, Shinyango. Rhodesiense is the only form of HAT reported in the country, and it is one of seven priority diseases for control and elimination under the One Health Coordination Unit (OHCU). Large outbreaks have occurred in the north western part of the country across 10 endemic regions, with over 90% of reported cases from this area (Figure 15).

![Figure 15. Number of rhodesiense sleeping sickness cases in the United Republic of Tanzania, 1990–2015](image)

During the last five year period (2012–2016) the numbers of reported cases have significantly declined (2 cases in 2016), with additional cases reported in tourists (Figure 16).
Figure 16. Distribution of r-HAT cases in the United Republic of Tanzania, 2010–2014
The HAT control epidemiology unit of the Ministry of Health, Community Development, Gender, Elderly and Children (MOHCDGEC) is responsible for the coordination of control activities, and has a designated HAT focal person. The MOHCDGEC also includes a member of the OHCU and representation in the Prime Minister’s Office. The interventions are integrated into an NTD master plan and a national One Health strategy, and have been drafted into Guidelines for Surveillance of Zoonotic Diseases. These plans include a national disease surveillance and control system, reporting on a weekly basis.

The United Republic of Tanzania has 15 health facilities with a wide range of human resource capacity and capability (ranging from 9000 to 500 000 people covered). Laboratory diagnosis and quality control are done for all suspected cases. Treatment efforts are coordinated by the National Institute for Medical Research (NIMR) in Tabora, using the medicines supplied by WHO.

Research efforts are undertaken by the WHO Special Programme for Research and Training in Tropical Diseases (TDR) and the Nelson Mandela African Institute for Science and Technology (NMAIST). The research is specifically examining the effects of climate change and, importantly, the resistance to trypanosomiasis among the Maasai Steppe, through sensitization, laboratory tests and vector research.

Tanzania National Parks Authority (TANAPA) is responsible for vector control, primarily through insecticide impregnated targets and spraying of vehicles entering parks. The Ministry of Livestock and Fisheries has also initiated a project on vector control using the One Health approach in collaboration with TANAPA, and a campaign for IEC. The methods used are mainly traps and targets in the western part of the country and national parks. Some areas have proven hard to access but efforts have continued there as these locations are extremely important for tourism. Park authorities and the tourism sector have had a significant positive impact on r-HAT control in both Kenya and the United Republic of Tanzania.

The United Republic of Tanzania has a strong record of multisectoral coordination. The National One Health Unit (NOHU) resides in the Disaster Management Department of the Prime Minister’s Office. It includes a steering committee, a secretariat with members from key ministries, multiple technical working groups on training, advocacy and communication, research and development, surveillance, and preparedness and response. This unit also works with partners such as MOHCDGEC, TANAPA, NIMR, OIE, the United States Agency for International Development (USAID), WHO, FAO, PATTEC and academic institutions.
Challenges to control of r-HAT in the United Republic of Tanzania include the increased use of malaria RDTs, reducing the likelihood of diagnosing HAT via microscopy. Most trained staff have now retired, and new staff are generally inexperienced with HAT. Furthermore, there is inadequate infrastructure and funding for surveillance, diagnostics and vector control. Remote areas are often hard to access, especially during the heavy rain season.

There are reported cases of r-HAT in tourists but not in local people, and this remains unexplained. Recent screening in park staff found no r-HAT infection. There are several hypotheses for this, but intensive research is needed to test them. One possibility is that tourists are usually very mobile during the active time of flies, which could increase their exposure. Tourists also outnumber the local people in some places such as the Serengeti, where 50,000 tourists visit annually compared to a few hundred park staff, increasing the chances of a tourist being infected rather than the local population. Park staff and locals could be very aware of the dangers of tsetse, and thus practice personal protection measures. Alternatively, people could be infected and dying but going undiagnosed as r-HAT. It is possible that cases are being missed, and this highlights the need for permanent surveillance and capable health facilities closer to these areas.

Future work includes improving HAT control under the One Health approach and securing sustained funding. The draft HAT plan and guidelines on surveillance of zoonoses will be finalized, as will an action plan on vector-borne diseases control for 2017–2020. Capacity-building through training and provision of equipment to all HAT endemic foci is necessary, as is strengthening their IEC campaign to encourage people to seek health care earlier rather than later.

8.5 Rwanda

There have been no reported r-HAT cases in Rwanda since 2000. However, it is important to continue monitoring the disease in the country. Historical data demonstrate that the disease was present in the population, the vector is still present in the country and neighbouring countries still report r-HAT cases.

The Ministry of Health has prepared a strategic plan for 2013–2018 and drafted an NTD master plan for 2017–2020 that encompasses integrated strategic and operational plans for control and elimination of

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targeted NTDs, and surveillance for r-HAT. The NTD & OPD (Outpatients Department) unit, in collaboration with the national reference laboratory, has been mandated to implement sentinel surveillance activities as well as monitoring and evaluation activities specifically for r-HAT. Some funds have been made available for essential items and sensitization, and further collaboration with WHO will be welcome.

Rwanda held an r-HAT training course in 2016 involving 12 health centres surrounding the Akagera National Park, and these centres act as sentinel sites for r-HAT. Control activities focus on vector control, case management and research (Figure 17).

![Distribution of centres of HAT surveillance in Rwanda, 2017](image)

**Figure 17. Distribution of centres of HAT surveillance in Rwanda, 2017**

For animal health, the Ministry of Agriculture and Animal Resources (MINAGRI), through the Rwanda Agricultural Board, is responsible for setting vector traps, providing sensitization to farmers for bush clearing activities, and providing veterinary staff and equipment for laboratory diagnosis of animal trypanosomiasis. The Rwanda Development Board (RDB), through the Akagera National Park, has also
procured traps for tsetse fly control. The involvement of local leaders in r-HAT surveillance and awareness campaigns will be invaluable for detecting any reoccurrence of the disease.

Logistically, transporting staff and having sufficiently trained staff has been a problem. Awareness materials are not yet in place at sentinel sites, and sensitization of the population has not been well established due to funding gaps. Monitoring and evaluation activities must be developed, including laboratory quality control. Future activities include preparing surveillance tools (such as a working protocol and case report forms), improving awareness in both health-care workers and the community, advocating for further collaboration across sectors and borders, and providing supervision to health-care facilities and laboratories.

8.6 Uganda

There are 33 r-HAT endemic districts in Uganda in five major foci (Ssese, Busoga, Bukedi, Teso, Lango) in addition to protected areas. The numbers of reported cases have significantly decreased over time (Figure 18), but transmission still involves both domestic and wild animals, and there are still some locations with populations at moderate risk.

![Figure 18. Number of rhodesiense sleeping sickness cases in Uganda, 1990–2015](image-url)
Cases have been reported over the past five years, with 28 in 2015 and 10 in 2016. The most active focus was historically Lango, which reported 48 cases in 2012 and 2 in 2016 (Figure 19). The case fatality rate has declined from 7% in 2015 to 0% in 2016, although many of the reported cases are detected in the second stage of disease. The opposite trend has been observed in protected areas, where 4 out of 5 cases in the past 3 years were detected at stage 1. The location of the country’s HAT-competent health facilities follows the distribution of the historical foci, creating a well-covered area.

Figure 19. Distribution of r-HAT cases in Uganda, 2010–2014
NTDs are included in the national health policy, the health sector strategic and development plan, and there is also an NTD master plan. Structurally, HAT control is the responsibility of the Department of Community Health and the Division of Vector Borne Diseases Control. The NSSCP has a programme manager at the national level, and there are regional coordination offices and district level focal persons.

Control activities carried out by other sectors include surveillance and control of the animal reservoir (by the College of Veterinary Medicine, Animal Resources & Biosecurity [COVAB]), FIND, the University of Edinburgh, Social Finance, the Department for International Development (DFID) and the European Union); provision of laboratory facilities and vector control (Gulu University); reduction of the animal reservoir (IK Aid and Relief Enterprise (IKARE)/Ceva Animal Health); surveillance (National Livestock Resources Research Institute (NaLIRRI)); drug trials (STPH); and vector eradication (PATTEC, IAEA).

One critical challenge is the lack of human resource capacity to diagnose and initiate treatment in some facilities. There is insufficient support for supervision and mentoring of health-care workers, and limited funding and diagnostic equipment (e.g. hematocrit centrifuges). Late case presentation due to low community awareness and drug toxicity generating up to 7% case fatality rates are also major problems. Suboptimal multisectoral coordination due to varying priorities and implementation timeframes has led to some delays in the implementation of control activities.

The re-emergence of the disease in formerly controlled areas and its emergence in new areas are always a cause of concern. The evidence suggests that where there has been mass spraying of animals, the incidence of the disease decreases rapidly, although additional factors leading to this reduction in the numbers of cases have not been fully explored. This method has been successful as it protects cattle for different vector-borne disease and therefore very often owners spray their own cattle at their own expense.

An urgent research question concerns the effects of land use change and population pressure on the incidence of the disease, as these are likely important factors for the persistence of r-HAT. The movement of animals between parks could be an additional factor in its spread. Plans for addressing cases in protected areas need to be developed and implemented further, as the presence of exported cases suggests there could be local cases going undiagnosed.

Future work aims to address gaps in capacity-building across the health system, from providing training, supervision, equipment and field-based surveillance tools, to increasing awareness and strengthening the referral system from the community level to the health system. The existing surveillance mechanism
needs improvement, through strengthening partner coordination and expanding the surveillance network. Cross-border collaboration would be beneficial in this respect.

### 8.7 Zambia

Zambia has reported cases of r-HAT since the 1920s. There have been three main foci of the disease, usually in buffer zones close to game parks and protected areas (Figure 20). In 2015 and 2016, eight cases were reported (6 and 2, respectively) (Figure 21).

![Figure 20. Number of rhodesiense sleeping sickness cases in Zambia, 1990–2015](image)

There are 12 health centres with some capacity for diagnosing and treating r-HAT; 11 have laboratory diagnostic facilities and the 12th can carry out clinical diagnosis and refer cases to other facilities if needed. For treatment, there are 8 health-care facilities in addition to mobile hospitals that can diagnose r-HAT and refer cases to the nearest hospital.
The NSSCP focuses mainly on diagnosis and treatment, and has strong communication with the structures in all three foci. Two training workshops led by WHO were held for the three provinces in 2015. Participants included medical officers, nurses, clinical officers, health planners and environmental health technicians. In March 2017, a follow-up visit by the NSSCP examined the state of laboratory diagnostics, the availability of medicines and the availability of trained staff. Diagnostic tests included Woo’s method, Giemsa thick blood films, or a combination of the two methods (see “Control tools”). Out of 12 trained staff, 11 were still in place 2 years later.

Vector control activities carried out by the veterinary department include spraying of vehicles departing national parks, installing insecticide impregnated targets in national parks, and aerial spraying in the south western area by PATTEC.

Challenges have included structural changes at the Ministry of Health, overwhelmed district medical officers and attrition of trained staff. For diagnostics, the methods used do not include the most sensitive ones for r-HAT diagnosis, and laboratory diagnostic services at rural health centres in transmission areas are insufficient.
Future work for the Zambian NSSCP includes promoting the use of Woo’s method in all hospitals, and opening more laboratory diagnostic and treatment centres in endemic areas. There will be more efforts dedicated to documenting fevers not responsive to antimalarial treatment, and deaths with history of fever and reports of r-HAT symptoms. Improved IEC campaigns for communities will play an important role for this step. The supply of r-HAT medicines to district hospitals will continue and support will be requested from WHO for additional training sessions for staff, including for pharmacists. The focal point indicated that they would be open to a trial of serological diagnostic tests for r-HAT and highlighted their willingness for cross-border collaboration.

8.8 Zimbabwe

In Zimbabwe, r-HAT is limited to one area in the Zambezi Valley (Figure 22). There have been at least 2 cases per year except in 2012, when 9 cases were reported for unknown reasons (Figure 23). Possible hypotheses included wildlife declines or temperature changes in the area. In 2016, Zimbabwe reported one case.

![Figure 22. Distribution of r-HAT cases reported in Zimbabwe, 2010–2014](image-url)
Figure 23. Number of rhodesiense sleeping sickness cases in Zimbabwe, 1990–2015

Historically, cases have been associated with proximity to the Zambezi river and wildlife, making the interface between wildlife and humans a major concern for r-HAT risk. This is especially important as the area is used for safari hunting groups and national parks visitors. Tsetse flies are present in an area of 20 000 km² in the northern part of the country, and studies of their distribution through transects have been made showing that the pattern of tsetse fly distribution closely matched the distribution of cases.

Generally, there is still poor diagnostic capacity in health-care facilities, especially in the affected area. Health-care workers are not trained in r-HAT specifically, which may be leading to misdiagnosis. Furthermore, there is no treatment facility for r-HAT in the focus area, and cases are treated in Zambia or in hospitals in the capital. However, there are plans to develop capacity in two hospitals close to the endemic area. While training staff in smaller health facilities nearer to endemic areas could improve the power of detection, hospitals are practically a better place to start. Currently, medicines are only dispensed in one pharmacy in Harare (which is over 200 km from the endemic areas).

There is a well-established tsetse control division involved in eradicating the vector through various methods. The Ministry of Health is responsible for the diagnosis and treatment of r-HAT, usually based on passive surveillance. In one active screening of 120 park staff, they found no cases. The National NTD master plan has designated HAT as one of eight priorities. Vector control is a key element of future
activities, as the highest risk of infection occurs at the interface of protected areas and settled areas. The introduction of tsetse barriers at strategic locations may help prevent the dispersion of the vector into settled areas. A One Health approach supported by veterinary services has led to case management guidelines for rabies and anthrax, with plans to do the same for r-HAT, focusing on surveillance, rapid response, and improved case detection and reporting.

9. Diagnostic tools

There have been no major advances in r-HAT diagnostic tools in recent years.

The process of diagnosing r-HAT involves different steps, from suspicion of cases to staging the infection (Table 2). Clinical suspicion of r-HAT is based on characteristic symptoms for each stage of the disease, although many signs and symptoms are commonly seen in both stages. Early symptoms include fever, malaise, joint pains, headache, fatigue, weight loss, chancre (infrequently seen in local patients), oedema, swollen lymph nodes and rash. Late stage symptoms include psychiatric disturbances, motor abnormalities, sleep disturbance and other signs of brain involvement. Reference laboratories often use indirect fluorescent antibody tests to assess the suspicion of HAT. Antigen detection is unreliable and has been abandoned as a diagnostic technique for r-HAT. It was noted that RDTs for detecting antibodies have a low sensitivity for r-HAT diagnosis in health-care settings.

Parasitological diagnosis can use samples from chancre, lymph and blood. Diagnosis can be done through a chancre aspirate within days of infection, but patients do not present always with a chancre.

Blood examination (thin blood film or a fresh preparation) is a useful diagnostic technique as there are usually high numbers of trypanosomes in blood, and this can identify the majority of cases. It also has the advantage that blood concentration methods (usually unavailable) are not needed. To make a conclusive diagnosis based on blood examination, the technician must be able to see at least 4 out of 5 characteristic stained parts of the trypanosome, and compare sizes to the surrounding blood cells (trypanosomes should be four times the size of red blood cells). This is more difficult to do on thick blood films than thin blood films, but the same criteria apply. Storing of slides is recommended because it is a useful practice for reference standards and quality control. Thick blood films are advantageous not only because of their simplicity and ability to detect trypanosomes but also because they can detect malaria, filariae and other parasites.
Table 2. Steps involved in the diagnosis of r-HAT and techniques that can be used; tests shown in black text are used for control, and those in grey are restricted to research laboratories or specific projects

<table>
<thead>
<tr>
<th>Step</th>
<th>Techniques</th>
</tr>
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<tbody>
<tr>
<td>Suscicion HAT</td>
<td>Clinical suspicion, IFAT</td>
</tr>
<tr>
<td>Parasitology</td>
<td>Chancr, lymph Blood: wet blood film, thin &amp; thick blood film, iLED, capillary centrifugation, QBC, mAECT, PCR, LAMP</td>
</tr>
<tr>
<td>Staging</td>
<td>CSF: white blood cell count, trypanosomes</td>
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The capillary centrifugation technique (also called CTC, mHCT, Woo’s test) is a blood concentration test that could play an important role in the diagnosis of r-HAT. Trypanosomes can be searched for between plasma and white blood cells, seen on the top of the layer of red blood cells, in a capillary tube after centrifugation. This test depends on the availability of micro hematocrit centrifuges and reading the results needs some experience. Uganda has adopted this technique as a standard and it appears to be functioning well, especially if staff are experienced. Currently, the best diagnostic technique is the minianion exchange centrifugation technique, although it is used more widely for g-HAT. Other techniques include acridine orange staining of blood films followed by iLED microscopy and a quantitative buffy coat, which is hardly used for diagnosing r-HAT currently. Its main disadvantage is requiring special capillaries and centrifuges, and a system to make ultraviolet light.

Molecular techniques include real time polymerase chain reaction (RT-PCR) and loop-mediated isothermal amplification (LAMP). However, there is only one primer specific to r-HAT on the serum resistance associated gene. LAMP can be done through sodium dodecyl sulfate lysed blood on filter paper, or fresh blood. Nonetheless, the presence of false positives in PCR or LAMP tests makes them insufficient to decide on treatment. Staging is an important part of diagnosis, as it informs the prescribed treatment. Staging the disease requires a lumbar puncture to obtain a white blood cell count and to search for trypanosomes under the microscope.

Often, patients are given antimalarial medicines which provide no relief, leading to patients repeatedly returning to a facility as they are not improving. This is one issue that needs to be better highlighted, and health-care workers should be advised that if patients are non-responsive to antimalarials, HAT is a possible diagnosis.
10. Treatment tools

The chairperson of the “Integration of new tools into national and global policies working group” presented the perspectives for a trial on fexinidazole as an oral treatment for r-HAT. The objectives of this group are to facilitate regulatory processes at national and international levels for the introduction of new tools, coordinate actions taken in this aspect, enable the integration of new tools into HAT policies and strategies within countries, and harmonize and standardize procedures.

The first meeting of this working group (Geneva, December 2014) noted the need for the development of new medicines to combat r-HAT. The sixth meeting (Geneva, December 2016) discussed the concerns over the poor safety of melarsoprol\textsuperscript{10} and the possibilities for improving the treatment of r-HAT by carrying out clinical studies on fexinidazole.

The poor outcome with the current melarsoprol regimen demonstrates the ethical need to obtain a replacement to treat second stage r-HAT, as its toxicity is related to most deaths. The recommended treatment specified in a recent (2013) report by WHO\textsuperscript{11} is suramin in the first stage of the disease (there is a smaller evidence base, which suggests that pentamidine is also effective). For the second stage of r-HAT, a 10 day course of melarsoprol is the recommended treatment. The occurrence of encephalopathic syndrome as an adverse reaction greatly limits the effectiveness of melarsoprol.

Oxaborole SCY7158 demonstrated early evidence in mice that it could be a suitable lead for a treatment for both forms of HAT. A Phase II/III trial in g-HAT was initiated in seven study sites in the Democratic Republic of the Congo at the end of 2016.

The rareness of r-HAT frames any attempts to assess new treatments, as it is effectively an “orphan” disease with very few cases annually to recruit into any clinical trial. A target product profile for r-HAT treatment, which describes the ideal and acceptable characteristics that a new product should have, was discussed by this WHO subgroup. The main features retained were: efficacy in both stages of infection; applicable with any comorbidities and for all special populations (e.g. pregnant women); no serious complications; no need for sophisticated equipment; oral administration for no more than 10 consecutive days; and affordable.


Pre-clinical data for fexinidazole suggest promising results for r-HAT both in vitro and in vivo. A 4-days 100 mg daily dose was required for efficacy in an acute murine HAT model, and a 5-days 200 mg daily dose was required for 87.5% efficacy in a central nervous system murine HAT model. The pre-clinical data suggest that a regimen of 4 days on a stronger dose followed by 6 days of a lower “maintenance” dose could be effective. Concomitant food consumption is needed to get the required plasma concentration (minimum 2.2 ng/mL) within 24 hours of ingestion.

If the fexinidazole clinical trials can be carried out successfully, it is possible that efficacy is shown in both stages of the disease, eliminating the need for lumbar punctures for staging. One obstacle has been that it cannot be a randomized controlled trial due to the very low number of cases.

A multicountry (Malawi and Uganda), multicentre, prospective, one arm trial has been proposed to assess the efficacy of fexinidazole, but funding for this trial continues to be a challenge. The objective of the proposed study is to provide minimal evidence that fexinidazole offers an alternative to melarsoprol for the treatment of r-HAT. The study design has been bridged from trials for g-HAT (noting that the diseases have very different clinical manifestations and timelines) and defined for a minimum sample size of 32 patients who could be recruited over 18 months, as r-HAT is becoming rare.

Treating stage 2 patients is currently the priority, but inclusion of stage 1 is envisaged after a futility analysis on the first 10 patients in stage 2. The trial would include one cohort (in both disease stages) in statistical analyses. A committee will assess both patient outcomes and trial outcomes. Based on the evidence from melarsoprol treatments, the threshold of unacceptable failure (i.e. mortality) has been fixed at 9% at a primary end-point at 6 months after treatment and at 12% at a one year follow up end-point. A healthy patient with no trypanosomes at 12 months would be seen as a success. The importance of following up patients after the end of treatment was highlighted, as relapses occur and traditionally there has been no follow up for r-HAT. The proposed design includes follow up visits every 3 months for one year, although some concerns were raised about the feasibility of this.

It was proposed that after the one year follow up, further recruitment could be done as part of a Phase IIIB or IV trial, or expansion to other countries, pending positive results. The low numbers of patients would not provide enough definitive information to sustain recommendations, but it would give an indication of the level of effectiveness and support further investigations.

Currently, funds are being sought from multiple sources to test fexinidazole in the proposed trial. The priority for a better treatment for r-HAT is evident. The consensus of experts reiterated the ethical
imperative of developing this treatment. It is needed as soon as possible and must be tested appropriately. The support of the stakeholders would be helpful in encouraging funders to invest in the treatment. The countries agreed that this is an important tool that should be advanced for the sake of patients.

11. Vector control

There are several competent vector species of HAT (Table 3), which have variable distributions across the endemic area. The vector control landscape has not drastically changed in terms of available tools. Techniques that have proven effective for eliminating HAT foci in the past should not be forgotten but may need adapting for the current situation. In the past, successes were achieved through large-scale operations with the help of external contractors. The process was generally expensive and required strong national vector control departments.

Table 3. Competent *Glossina* genus vectors of HAT

<table>
<thead>
<tr>
<th>Country</th>
<th>HAT cases</th>
<th>Primary vectors</th>
<th>Other vectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uganda</td>
<td>406</td>
<td><em>G. f. fuscipes</em></td>
<td>Morsitans group</td>
</tr>
<tr>
<td>Malawi</td>
<td>167</td>
<td><em>G. morsitans</em></td>
<td></td>
</tr>
<tr>
<td>Zambia</td>
<td>43</td>
<td><em>G. morsitans</em>; <em>G. pallidipes</em></td>
<td></td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>22</td>
<td><em>G. morsitans</em>; <em>G. pallidipes</em></td>
<td></td>
</tr>
<tr>
<td>Tanzania</td>
<td>14</td>
<td><em>G. swynnertoni</em>; <em>G. pallidipes</em></td>
<td>Palpalis group</td>
</tr>
<tr>
<td>Kenya</td>
<td>2</td>
<td><em>G. swynnertoni</em>; <em>G. pallidipes</em></td>
<td>Palpalis group</td>
</tr>
</tbody>
</table>

Odour baited targets have been used successfully to control *G. pallidipes* (savannah flies) in Botswana and Zimbabwe, but are less effective on riverine species (Morsitans group). This led to the development of “tiny targets” based on analyses of the responses of riverine tsetse to visual and olfactory cues. Compared to traditional traps, they are twice as effective, 10 times cheaper, last for 6 months and are much easier to deploy. Field trials in Kenya demonstrated that 10 targets/km² can eliminate over 99% of isolated *G. fuscipes* populations. Tiny targets are more expensive than cattle spraying (US$ 220–290/km²), although they are getting progressively cheaper. The manufacturer Vestergaard Frandsen
Group has pledged to provide tiny targets at progressively reduced prices and finally free of charge after 2020 to help eliminate HAT.

In some areas there are multiple species of fly that may vary in their susceptibility to tiny targets. In those areas, cattle spraying (if relevant) would indiscriminately control the vector populations, and is recommended where possible. Cattle are the most effective targets for vector control, and the cheapest (US$ 50–120/km²). One small monthly dose applied to cattle legs and stomach (where most flies feed) can lead to good control. There has been no detected long lasting environmental health impact on non-target species from spraying, as it uses a low dose and has a short exposure time. The Stamping Out Sleeping sickness (SOS) initiative has demonstrated that 20% coverage can interrupt transmission of r-HAT. In Uganda, cattle are being treated with the restricted application protocol. However, in many other foci with wildlife reservoir, this cannot be done.

On the edge of wildlife areas, tsetse flies are an acute problem and parks act as a source of infection for people. If flies gain access to homes, they begin to bite humans. Fly numbers decline quickly with distance from wilderness areas, indicating that this is where vector control efforts should be concentrated. Several mathematical models have been developed to predict tsetse fly distribution, and how it may be affected by climate change and habitat availability. A decrease in the number of flies caught has been observed in areas with a temperature increase (e.g. the Zambezi Valley), but these populations will likely relocate to new habitats that are more suitable.

There is a need to develop a target product profile for fly targets, specifying ideal measurements, colours, materials and deployment methods in different environments to make them fit for purpose. This will be extremely helpful in improving the implementation and efficacy of these targets, for example by adapting to use in the savannah, as tiny targets are less effective in that environment. Slight changes in target design can lead to reductions in cost without loss of performance.

It was noted that techniques for protecting against malaria might also be effective against r-HAT, such as screens, indoor residual spraying and other practices. Indeed, this could be a cheaper pathway of protecting people, by adapting already existing tools.

There was some discussion around the plausibility of indirect surveillance of HAT prevalence through monitoring the presence of T. b. rhodesiense in the vector. Catching enough tsetse flies to determine T. b. rhodesiense prevalence requires a lot of effort and is costly, although it is may be possible for some species.
12. **Progress in r-HAT diagnostic tools**

Since 2014, FIND has sponsored a project in Malawi focused on improving diagnostic capacity for r-HAT and facilitating access to existing tools. There are three conservation areas where *T. b. rhodesiense* is endemic and present in multiple animal reservoirs, and over 90% of r-HAT cases are attributed to Vwaza Marsh Wildlife Reserve (Rumphi focus). Of reported cases, over 90% are diagnosed in stage 2, and around 20% of patients die during treatment.

Until 2013, diagnostic capacity was only available at Rumphi Hospital. FIND identified four potential sites closer to game reserves where the disease has been reported, trained staff in those locations, and provided diagnostic laboratory equipment in order to upgrade their diagnostic capabilities. Specifically, they provided LED fluorescence capacity at all five sites, and LAMP at one site.

LED fluorescence microscopy has been aided by new technology with the development of affordable software capable of taking pictures of trypanosomes on smartphones. Negative suspected cases can be referred for further LAMP and parasitological confirmation. There has not been much data on diagnosis of r-HAT using LAMP; limited data from Uganda (n=50 patients and 42 controls) suggest good sensitivity and specificity to r-HAT. Results from a larger trial on g-HAT showed a specificity of 98.8% on fresh blood and 94.3% on dried blood. It is a useful diagnostic tool to increase suspicion, but cannot confirm infection.

Over 2.5 years, 1735 people have been screened, and 72 cases have been confirmed across old and new sites included in the project. The proportion of cases diagnosed at new sites has increased to 55% in 2016 from 21% in 2014, as people become more aware of these facilities. The project has had no impact on whether the disease is diagnosed in stage 1 or 2, with most diagnoses happening at stage 2. Nonetheless, there is objective evidence of lower case fatality rates since the project began. Historical data of 122 cases over 4 years from the national programme were studied and the exercise suggested that the severity of the disease has declined since the project started, supporting the hypothesis that the new facilities and training are leading to earlier diagnosis. This will be explored further using data on the white blood cell records of patients, if they are available. It is difficult to test whether this success is related to the diagnostic methods used or simply because there is better access to diagnostic facilities.
The project has not been without challenges. Much of the community is still not fully aware of the new sites around Vwaza Marsh, and some are still going to Rumphi. Campaigns to increase awareness of the new sites are needed, as is regular training of clinical staff to recognize HAT symptoms.

Concerns were raised about the project being phased out, as FIND usually only supports short-term projects with the aim of building local capacity. They will continue to provide technical support and reagents, but are planning discussions with WHO and others to see how the project can be sustained. Currently, there are no plans to develop further diagnostic tools for r-HAT, such as an RDT. This is due to limited funding.

13. Capacity-building for HAT: lessons learnt

Training of laboratory staff by the Institut de Recherche pour le Développement (IRD) has taken place since 2007, in or around risk areas in multiple countries, and organized by health ministries and WHO. More than 200 people have been trained, although that number is likely higher through cascade training. The general objectives of the training sessions are to create awareness, strengthen diagnostic capacity, management of samples and tests, and to set up a surveillance system in endemic zones. Often, representatives from surrounding zones are invited to participate. The format of the training sessions includes presentations, discussions and a laboratory session.

The training is designed to be a flexible 4 day programme, tailored to the needs of the area and covering the general epidemiology of HAT, clinical manifestations, and highlighting the problem of delayed diagnosis and the importance of surveillance. Importantly, this is followed by a practical laboratory session where the participants have access to samples or slides of trypanosomes, some for the first time. The target audience is health-care workers where the disease is present, laboratory technicians, nurses, doctors, clinical officers, a representative from the NSSCP and a representative of a reference laboratory. The class size is ideally fewer than 25 people, and the course is not aimed at researchers or administrative staff and programme managers. However, the audience noted that the presence of administrators or managers for some parts of the training may be beneficial as a way of advocacy for the programme, and to help trained staff progress with their knowledge as the decision makers become aware of their skills.
To carry out the training, a laboratory is required for the practical session (either in a hospital or a veterinary laboratory), at least 2–3 microscopes, centrifuges and other standard laboratory materials (coats, gloves, bins, etc.). Reagents, parasite samples and laboratory mice are needed to examine live trypanosomes (*T. b. brucei* is usually used as it is not infectious). These samples should come from the country if possible, as importing them requires additional efforts.

Notably, it is very important to monitor the staff once the training is complete, to make sure the information is applied regularly and not forgotten. Staff are highly mobile in most countries and some facilities lose their trained staff. There are few human resources to carry out the training, and countries that have the capacity to do so should integrate them into an existing programme. The feedback from the countries that had training was extremely positive, with encouraging outcomes.

It was noted that there is also an international course on human African trypanosomiasis aimed at coordinators and national sleeping sickness programs specifically.

### 14. Multisectoral approaches to r-HAT elimination

#### 14.1 Coordinating Office for Control of Trypanosomiasis in Uganda (COCTU)

Almost 25 years ago in Uganda, trypanosomiasis was considered the most advantaged disease because it was given an institution to combat it: the Coordinating Office for Control of Trypanosomiasis in Uganda (COCTU), including various partners and sectors.

In the past years, they have developed a five-year strategic plan (2015–2020) with six focus areas: (i) policy and planning, (ii) diagnosis and case detection, (iii) treatment and post-treatment care, (iv) reduction in tsetse contacts with humans and animals, (v) ecohealth approaches, and (vi) other crosscutting issues. COCTU is operational in areas at risk covering almost half the country, and willing to work with other partners and share information. They are in contact with 112 local governments, and obtain reports of animal trypanosomiasis cases from 50 districts (including data from livestock owners and district veterinarians). COCTU also maintains the national surveillance database of tsetse flies, sleeping sickness and Nagana cases.

In 2016, COCTU, Makerere University and the University of Edinburgh began setting up a surveillance unit at COVAB. Over 600 samples from animals have been tested, with an aim for a minimum of 1200
animals to be screened annually. Most active districts submitting samples get the opportunity to have
them all screened. Veterinarians Without Borders (VWB) have collected data from other areas of
Uganda and are reporting the data back to COCTU.

If infected animals are found, there should be capacity to provide treatment through practical and low-
cost, community-based interventions. A COCTU, 3V Vet Franchise and IKARE partnership trains key
animal resource partners in high-risk areas, using the slogan “Using cattle to kill tsetse.” This activity
links the veterinary services and the animals at risk, and provides trypanocidal drugs and insecticides to
the cattle, which are largely paid for by the owners. Cattle treatment is expanding to other areas of the
country, with the support of the government. In 2016, hundreds of thousands of cattle were treated,
and people across the country were trained. Additionally, this strategy created jobs for people who
carried out the treatment. A significant reduction in animal trypanosomiasis has been seen in Uganda
due to cattle spraying, and livestock owners appear happy with the progress to date. It would be helpful
to estimate the impact of cattle spraying on achieving the HAT elimination target, as advocacy for this
method and to increase support from political figures.

All the work is done through key partnerships, including Social Finance, DFID, Gulu University, FIND and
NaLIRRI. Improved coordination is needed within country programmes, as each may request funding for
similar activities separately and the permanent secretary rejects these proposals as redundant. A
stronger mechanism for information sharing between partners is necessary to improve efficiency.

Although WHO has repeatedly stated the importance of the animal reservoir for r-HAT elimination,
there is a need for stronger supporting statements from WHO, FAO, OIE on the importance of
eliminating the animal reservoir and suppressing the tsetse vector. The country focal points requested a
short letter from WHO addressed to the Ministry of Health that would clearly reiterate this point. It will
be the responsibility of all partners to disseminate this information.

A meeting to commemorate the 25th anniversary of COCTU will be held on 8 October 2017. This will
showcase the achievements of the programme and discuss what can be improved based on lessons
learnt. COCTU has committed to further promote community-based approaches, and to place more
emphasis on gender equality in their efforts.
14.2 Stamping out Sleeping sickness (SOS)

The fight against r-HAT has seen many periods where the disease was not a threat, interspersed with periods of social changes and civil unrest. The movement of animals and people and the interruption of tsetse control are factors that can combine to create spillovers and potential epidemics. Some areas are disproportionately reporting most of the cases, but the reasons are not fully known.

Although progress has been made in reducing numbers of cases, most gains have been in areas where livestock are the primary host of the parasite, not where it is wildlife. Treating domestic reservoirs of r-HAT can significantly reduce the transmission of the disease to humans, saving lives and health system costs. A survey of the prevalence of different *T. brucei* parasites in cattle showed that over 50% of the detected trypanosomes are human infective, indicating an urgent need for treatment. Pigs were also checked for human infective parasites, but it is harder to intervene for pig infections.

Cattle spraying reduces the probability of transmission of the disease and in general reduces other illnesses such as tick-borne diseases. Treating 85% of cattle with trypanocidal drugs was sufficient to eliminate human-infective parasites, which can rarely be transmitted back from humans to animals. Lower trypanosome prevalence in cattle can also lead to improved productivity, so overall this is a beneficial strategy for elimination, and cost effective.

Trypanosomes can be found in many mammalian wildlife species, including wildebeest, zebra, impala, lion, buffalo, elephant, giraffe and hippopotamus. In one study examining trypanosome species in lions over 15 years, the evidence showed that as the animals get older parasite competition within hosts effectively removes human infective *T. brucei* by the time the lion is 6 years old. This study suggests that interventions in wildlife should target younger animals. Regular surveillance of lions or hyenas for *T. brucei* could be integrated into existing surveillance programmes.

There is evidence that r-HAT is moving away from older sites and expanding north into new sites. This phenomenon is concerning although there are fewer cattle in these new areas. It was noted that treatment of cattle at the point of sale in markets would be important to ensure that the disease does not spread further. In practice, this rule is adhered to where the disease is reported but not necessarily in other areas. This will require cooperation with local authorities to implement.
14.3 Experiences in Zimbabwe

Zimbabwe is implementing an integrated approach to r-HAT control that combines programmes for vector control, habitat modification, animal health, protected areas, other NTDs and zoonoses. Disease control methods have evolved as knowledge of ecosystem changes improves, and collaboration with the national park services has been very important, especially for vector control activities.

The links between the wildlife tourism sector and tsetse control have been a critical component of the control efforts, as many cases are recorded from national park staff and tourists, rather than the local population (0 positive after screening). Additionally, many staff in wildlife areas may not be from there originally and will likely travel across the country for leave. This brings a new risk element of disease expansion. Local people may be infected but not seeking medical care, preferring to seek out traditional healers. There is a need to better understand if there are really no cases, or if cases are being missed. Humans are likely exposed to r-HAT when they are searching for ecosystem services, and understanding this behaviour may help to prevent and detect unreported cases. The park areas were visited with sociologists to examine behaviours and collaborate with traditional healers.

The management of r-HAT in these protected areas has been taken on by both park services and the Ministry of Health, along with other partners. It was noted that safari companies also have an important role to inform tourists and staff about risks. Activities include active surveillance, placement of health facilities close to protected areas to provide health coverage to staff and vector control. Guidelines for vector control have been developed in collaboration with the Ministry of Health, and it was noted that vector control efforts would have to be regional, as some foci are shared between countries.

While collaboration across such a wide range of ministries and groups is highly encouraging and effective, there are some challenges in aligning priorities. However, establishing these partnerships has led to significant progress in controlling r-HAT.
15. **Proposals for national roadmaps**

Each country’s focal point elaborated and presented a draft national action plan to eliminate r-HAT as a public health problem by 2020, which they will develop further with WHO and their respective Ministry of Health. Most plans include a collaborative element which links human health activities with vector management and animal health. For countries that have not reported cases for several years, the main focus is on developing an integrated system of sustained surveillance. To this end, there were requests that WHO develop guidance on how to assess elimination as a public health problem, and how to progress from there. The focal points of the endemic countries noted that surveillance targets for specified areas would be helpful as performance indicators.

It was noted that some foci include national boundaries, where cross-border collaboration will be an essential component of any strategic plan. While elimination as a public health problem will be assessed on a country basis, any declaration of elimination will imply continued surveillance, enhancing surveillance along borders where cases are still being reported. For this long-term goal, it was reiterated that r-HAT control must be fully integrated into the countries’ health systems in order to ensure funding and adequate training over time.

While it is important to focus on case detection capacity, the surveillance phase of elimination provides an opportunity to support the One Health approach by monitoring animal reservoirs. Furthermore, it is easier to take samples from animals to test for human infective *T. brucei*. While elimination of the disease in animals would be unfeasible to include as a requirement in the assessment of human r-HAT elimination, WHO noted the significance of monitoring animal health, and that efforts to sustain surveillance in animals and vectors could help identify places where possible re-emergence of human cases may occur.

WHO requested that the focal point of each country summarize the main points of their plan in a short document, in order to have a working document and also to review progress at the next stakeholders meeting in 2 years.
Through the discussions among participants at different moments of the meeting, a number of opportunities for innovation were identified:

1. Community engagement events to promote health-seeking behaviour. At the same time, it would be possible to screen for r-HAT in local people predicted to be exposed to the disease.

2. A screening and surveillance programme adapted to refugee camps.

3. Obtaining the mobile numbers of influential people in communities in order to keep lines of communication open.

4. Some hospitals have been upgraded in recent years with modern laboratory equipment, resulting in unused equipment such as older hematocrit centrifuges. These centrifuges could be located and re-distributed to health facilities situated in r-HAT areas and which do not have this equipment.

16. Challenges to the elimination of r-HAT as a public health problem

16.1 Structural challenges

- There is inadequate funding and resources of national programmes for implementation of surveillance, diagnosis and vector control activities.

- There is inadequate support from the Ministry of Health in disease endemic countries. R-HAT is a low priority for health decision makers.

- Strategic national plans for r-HAT interventions are not yet fully functional.

- In order to achieve and maintain the goal of eliminating r-HAT as a public health problem, integration of r-HAT control activities and management of patients within the health system is needed. Existing structures should be used to train health-care workers to diagnose and treat r-HAT, perhaps with guidance from WHO.

- One point of discussion focused on the importance of differentiating areas with patterns of transmission related to livestock versus protected areas, where transmission will continue for years. It may not be an either/or scenario as some places are the interface of wildlife and cattle.
16.2 Challenges linked to control tools

16.2.1 Diagnostics

- Current screening tools for r-HAT are limited, and there are no serological tests available.
- More sensitive confirmation diagnostic techniques (e.g. Woo’s test, mAECT) are not always available in health facilities.

16.2.2 Treatment

- The current treatment for r-HAT is highly toxic, and not easy to use.
- Staging the disease requires a lumbar puncture, which is not available in all health-care facilities.
- There are significant difficulties in running clinical trials for r-HAT drugs, because it is an orphan disease (low number of cases) and has no funding.

16.2.3 Vector control

- The vector control tools currently in use are of variable quality and not used systematically.
- There is a need for guidance on what tools to use, how to use them, where to deploy them and when to carry out vector control. A target product profile for vector control tools in different environments would help with this challenge and to promote the appropriate use of vector control. For example, tiny targets are not appropriate for all areas, but need to be tailored to the environment.

16.2.4 Surveillance

- Currently, the methods for monitoring elimination are deficient. There is thus an urgent need for criteria and procedures to assess the elimination of r-HAT as a public health problem.
- R-HAT can be misdiagnosed as malaria. One possibility to combat this is to take random but systematic blood smears of negative malaria RDTs, to check for r-HAT. However, this can add significant effort to already stressed health systems. Another possibility is to train health-care workers to test patients who are not responding to antimalarials (and thus repeatedly returning to the health-care facility) for r-HAT. Collaboration with malaria teams could help in this aspect.
16.3 Challenges linked to the health system

- Poor access to health services, especially in remote, hard-to-reach areas remains a significant challenge in combating r-HAT.
- In general, health facilities have difficulties in diagnosing and managing HAT cases due to poor diagnostic and case management capacity. There is a low level of knowledge of r-HAT among health-care workers, leading to misdiagnosis of cases and inappropriate treatment.
  - Key staff from health centres surrounding transmission areas are not trained, and it is difficult to maintain capacity due to the attrition of r-HAT trained staff. Most trained staff have retired, and new staff have never seen HAT cases. Furthermore, there is a high turnover in health-care facilities resulting in the transfer of trained staff. This could be a contributing factor to why there are reported cases in tourists, but no cases reported from local individuals.
  - R-HAT is a severe disease and requires intensive care capacities (including emergency care or management of complications), which are often lacking.
  - There are insufficient laboratory diagnostic services for r-HAT at rural health centres in transmission areas.
  - The increased use of malaria RDTs may reduce the likelihood of diagnosing HAT cases. There is a need to fine-tune the interpretation of results and actions taken after the RDT. Promoting the regular use of microscopy can improve the possibility of detecting r-HAT.
  - There is inadequate diagnostic equipment (e.g. haematocrit centrifuges) in some facilities. This results in the continued use of the least sensitive laboratory diagnostic methods for r-HAT in certain hospitals.

- Surveillance protocols and reporting forms have not yet been developed. There is an urgent need to develop requirements for post-elimination as a public health problem. These protocols should also provide guidance on how to assess the continued functionality of surveillance systems.
- There is insufficient support in terms of supervision and mentoring in most health-care facilities. This includes insufficient monitoring and evaluation activities and quality control.
16.4 Challenges linked to the community

- Low community awareness of the disease and its treatment and lack of sensitization contribute to poor health-seeking behaviour and late presentation from patients. This arises from the unavailability of awareness materials, and the lack of funds to create and disseminate them.

- There is a lack of involvement from local leaders in HAT surveillance and control.

- No sensitization activities are carried out to improve awareness of r-HAT in traditional healers.

- There is a clear need for anthropological studies to better understand barriers to health-seeking behaviour and openness to participation in vector control activities.

- It is imperative to properly target populations at higher risk of transmission (e.g. park rangers).

16.5 Challenges linked to coordination

- Currently, there is inadequate awareness of the importance of a coordinated One Health approach for elimination of r-HAT as a public health problem.

- There is suboptimal multisectoral coordination (within the framework of One Health) due to varying priorities, implementation timeframes and overall impact evaluation of implemented activities. In some countries, there is a lack of a coordination body.

- There are insufficient interactions between countries and programmes to promote coordination of activities in the broad context of zoonotic diseases. A mechanism for information sharing is necessary. Meetings between groups and between country focal points would be beneficial.

- International organizations need to issue strong supporting statements on the important role of the animal reservoirs and tsetse vector for the control and elimination of r-HAT as a public health problem.

- Cross-border joint interventions are needed, as several foci lie along country borders. Communication between focal points led to several offers of collaboration and a productive and engaging discussion of how to best achieve the elimination goal.
17. Conclusions

- The number of reported cases of rhodesiense human African trypanosomiasis (r-HAT) continues to exhibit a downward trend, which is in line to meet the 2020 goal of eliminating HAT as a public health problem. Nevertheless, weaknesses in surveillance within transmission areas suggest there could be gaps in knowledge about the real status of transmission and the burden of the disease.

- In order to document the elimination of the disease as a public health problem, it is necessary to improve surveillance by expanding country capacity for case detection. Continuous capacity-building and increased community awareness are important elements to ensure the goal is achieved and sustained.

- WHO maintains the main responsibility to support disease endemic countries in ensuring access to diagnosis and treatment for r-HAT patients, and in monitoring the epidemiological progress of the disease.

- The development of better control tools is encouraged in support of eliminating the disease as a public health problem.
  - In order to improve surveillance of the disease, the use of existing tools should be optimized, and quality should be regularly monitored.
  - Development of serological screening tools is needed.
  - Considering the significant adverse events related to current therapeutic tools for r-HAT, there is strong demand from endemic countries and other stakeholders for extending the clinical trials of fexinidazole as a treatment for r-HAT. The rarity of the disease (i.e. low number of reported cases) severely hampers the design and funding of clinical trials.
  - The current vector control tools are highly variable in characteristics and quality. Target product profiles of these tools tailored to different environments are needed. This would improve the evidence-based knowledge for countries to make decisions on which tools to use in different settings, and how to use them most effectively.
• The increased use of rapid diagnostic tests (RDTs) for malaria has reduced the use of blood smear microscopy for this purpose, thus incidentally diminishing the possibility of diagnosing r-HAT via microscopy. The use of blood smear microscopy in r-HAT endemic areas should be encouraged.

• The focal points of r-HAT endemic countries request WHO to provide guidance on the requirements, procedures and criteria for assessing and validating the elimination of r-HAT as a public health problem.

• Taking into account the importance of the Atlas of HAT in mapping the disease and monitoring its elimination as a public health problem, the focal points of r-HAT endemic countries express their interest in gaining ownership of and promoting the use of this tool at national level. WHO is requested to provide appropriate training material in English for r-HAT endemic countries.

• Wildlife and domestic animals are the main reservoirs of r-HAT and play a central role in maintaining transmission to humans through the bite of infected tsetse flies. The zoonotic nature of the disease indicates that vector control and treatment of infected animals are key elements for controlling it. Therefore, a multisectoral approach within the One Health framework is essential. This requires collaboration and coordination of different sectors including animal health, agriculture, conservation of natural areas, tourism and human health. In endemic countries, the establishment and reinforcement of national coordination bodies is encouraged. At the international level OIE, FAO and WHO should jointly support these efforts.
Annex 1. Agenda

**Day 1: Description of the situation of HAT and progress**

*Aim:* To describe the current situation of r-HAT and an update of the tools for its control

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Presenter</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td>09:00–09:30</td>
<td><strong>Welcome</strong></td>
<td>ADG WHO HTM</td>
<td>General introduction and welcome addressed by WHO</td>
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<td>WHO/AFRO Rep.</td>
<td>Director WHO/HTM/NTD</td>
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<tr>
<td>09:30–09:45</td>
<td><strong>Introduction to the meeting</strong></td>
<td>Coordinator</td>
<td>To describe the meeting, contents, objectives and procedures</td>
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<tr>
<td>09:45</td>
<td><strong>Coffee break</strong></td>
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<tr>
<td>10:00–11:00</td>
<td><strong>Global situation of r-HAT</strong></td>
<td>J.R. Franco, WHO</td>
<td>To describe the epidemiological situation of r-HAT, the distribution and the trends</td>
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<td></td>
<td></td>
<td>G. Priotto, WHO</td>
<td>WHO role and limitations in r-HAT elimination</td>
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<td></td>
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<td>To define the role of WHO within the One-Health approach</td>
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<tr>
<td>11:00–13:00</td>
<td><strong>Country report on r-HAT</strong></td>
<td>Focal points of each country</td>
<td>To describe the epidemiological situation of r-HAT in each country, the country’s health system capacities to tackle r-HAT (diagnostic and treatment availability, including drug accessibility) and the control activities carried out for all sectors concerned</td>
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<td>To describe the epidemiological situation of r-HAT in each country, the country’s health system capacities to tackle r-HAT (diagnostic and treatment availability, including drug accessibility) and the control activities carried out for all sectors concerned</td>
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<td>13:00–14:00</td>
<td><strong>Lunch break</strong></td>
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<td>Time</td>
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<td>Presenter/Institution</td>
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<td>14:00–15:00</td>
<td><strong>Situation of r-HAT control tools</strong></td>
<td>V. Lejon, IRD</td>
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<td>o Current situation of diagnostics</td>
<td>C. Burri, STH</td>
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<td>o Current situation of r-HAT treatment tools</td>
<td>S. Torr, LSTM</td>
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<td>o Current situation of r-HAT vector control tools</td>
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<td>To describe the current status, advances and perspectives in the tools for</td>
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<td>control of r-HAT</td>
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<td>15:00</td>
<td><strong>Coffee break</strong></td>
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<tr>
<td>15:30–16:00</td>
<td><strong>Perspectives of r-HAT control tools</strong></td>
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<td>16:00–16:30</td>
<td><strong>Research and advances on r-HAT diagnostic tools</strong></td>
<td>S. Bieler, FIND</td>
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<td></td>
<td>To describe the progress and outlook in control tools for r-HAT</td>
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<td>16:00–16:30</td>
<td><strong>Report of the working group: “Integration of new tools into national and global policies”: oral treatment for rhodesiense HAT. Perspectives for a trial on fexinidazole</strong></td>
<td>J. Seixas, IMT Lisbonne / A. Tarral, DNDi</td>
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<td></td>
<td>To present the working group discussions on the perspectives for a safer oral treatment for r-HAT. Reflexions for a trial on fexinidazole</td>
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<tr>
<td><strong>Day 2: Control and elimination of r-HAT</strong></td>
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<td><strong>Aim:</strong> To define the WHO approach in r-HAT control for its elimination as public health problem</td>
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<tr>
<td>09:00–09:30</td>
<td><strong>Principles and concepts of HAT elimination: the case of r-HAT – feasibility and limitations</strong></td>
<td>A. Moore, CDC</td>
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<td>To clarify concepts of HAT elimination (as a public health problem, as interruption of transmission) in order to set a frame to define feasibility of r-HAT elimination</td>
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<td></td>
<td>To introduce the HAT-e-TAG. Summary of the meeting, advances and perspectives</td>
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<tr>
<td>10.00</td>
<td><strong>Coffee break</strong></td>
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<td>Time</td>
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<tr>
<td>10:30–12:00</td>
<td><strong>Strategies for elimination</strong></td>
<td>G. Priotto / JR Franco / A. Diarra, WHO</td>
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<td><em>To describe the approach used to ensure access to diagnosis and treatment for r-HAT and subsequent reporting to get the most accurate picture of r-HAT transmission</em></td>
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<td><strong>Integrated surveillance:</strong></td>
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<td>- Selection of sites</td>
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<td>- Capacity-building in diagnosis and treatment</td>
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<td>- Management of drugs</td>
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<td>- Monitoring and evaluation</td>
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<td>- Reporting</td>
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<td><em>To describe the surveillance system for r-HAT control and elimination, including the principles and the methodology</em></td>
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<tr>
<td>12:00–12:30</td>
<td><strong>Capacity-building for r-HAT: lessons learnt in previous experiences, needs.</strong></td>
<td>V. Lejon, IRD</td>
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<td>12:30</td>
<td><strong>Lunch break</strong></td>
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<tr>
<td>14:00–15:30</td>
<td><strong>Multisectoral approach to r-HAT elimination (One Health):</strong></td>
<td>C. Waiswa, COCTU</td>
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<td>- Experiences in Uganda: coordination of sectors, example of COCTU</td>
<td>S. Welburn, UoEdinb</td>
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<td>- Experiences in Uganda: Stamp Out Sleeping sickness</td>
<td>W. Shereni, MoA</td>
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<td>- Experiences in Zimbabwe</td>
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<td><em>How to link the elimination of r-HAT with other initiatives (Vector control; Animal Health; Management of protected areas; Control of NTDs; Control of zoonosis)</em></td>
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<td>15:30</td>
<td><strong>Coffee break</strong></td>
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<tr>
<td>16:00–17:00</td>
<td><strong>Gaps and challenges</strong></td>
<td>General discussion</td>
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<td><em>To identify main gaps and challenges in order to apply strategies and therefore to achieve r-HAT elimination as a public health problem and possible solutions</em></td>
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### Day 3: Next steps in r-HAT elimination

**Aim:** To define main interventions at country level to advance in the r-HAT elimination, identifying the main constraints

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Focal points of each country</th>
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<tbody>
<tr>
<td></td>
<td>To discuss plans to fight r-HAT identifying the main actions needed in each country according to the epidemiological situation and challenges</td>
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<td>10:30</td>
<td>Coffee break</td>
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<tr>
<td>12:30</td>
<td>Lunch break</td>
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<tr>
<td>14:00–15:00</td>
<td>Conclusions and outcomes</td>
<td>General discussion</td>
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<tr>
<td></td>
<td>Meeting wrap-up</td>
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</tbody>
</table>
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