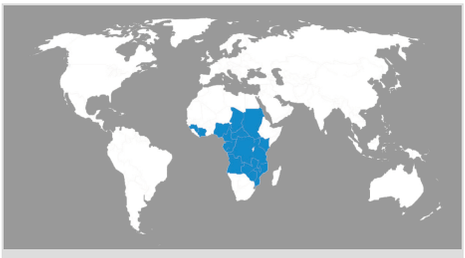
Background

Global Burden | Causative Agents & Transmission | Pathogenesis | Current Control Strategy | Existing Products | Get Involved

What is HAT Disease?

Human African Trypanosomiasis (HAT), also called African sleeping sickness, is a parasitic disease that is transmitted by infected tsetse flies. HAT can occur as a chronic or acute infection depending on the sub-species of parasite responsible for the infection. In either case, the disease progresses through two distinct stages. Stage 1 is the initial stage of infection and presents with non-specific symptoms including fever, rash, and fatigue. Untreated stage 1 HAT results in stage 2 disease where parasites invade the central nervous system causing severe neurological symptoms and eventually death. The symptoms resulting from central nervous system invasion include personality changes, mental deterioration, increased sleep, and eventually coma. The term “sleeping sickness” arose from the observation that patients with this disease become progressively sleepy until they eventually fail to wake up.

Global Burden



Countries reporting new cases of HAT infection
(Simarro et al. PLoS Med 5:e55 [2008])

HAT is primarily concentrated in Central Africa; 70% of all infections occur in a single country, Democratic Republic of Congo (DRC). There are a total of 37 countries in sub-Saharan Africa with endemic HAT and an estimated at risk population of nearly 60 million people. A small amount of transmission also occurs in the Eastern Mediterranean Region (<10% of all cases).

According to the World Health Organization (WHO), in 2009 the incidence of new HAT infections dropped below 10,000 cases for the first time in more than 50 years.[1] Due to known underreporting, the actual prevalence of disease is estimated to be closer to 30,000 cases. Between 1999 and 2008, the incidence of chronic and acute disease declined by 62% and 58%, respectively. The severe debilitating effects of HAT, combined with the high mortality rate, result in an estimated 1.7 million DALYs lost per year.

The economic impact of HAT, in combination with zoonotic forms of the disease that affect livestock, has severely impaired agricultural development in Central Africa. It is estimated that Africa loses US$1.5 billion in revenues from agriculture annually due to the combined human and zoonotics forms of sleeping sickness.[2]

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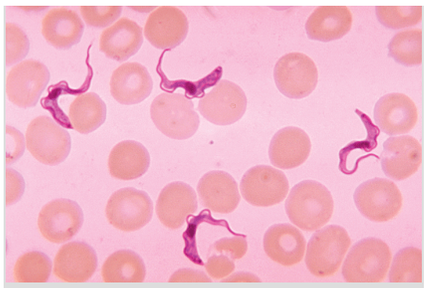
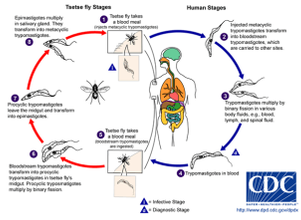
Causative Agent and Transmission

HAT is caused by the protozoan parasite *Trypanosoma brucei*. Humans become infected when parasites are injected into the human by the bite of a tsetse fly. The injected parasites can replicate asexually in the blood and invade the lymphatic and central nervous systems. Tsetse flies pick up parasites from the blood of an infected person while taking a blood



Blood smear containing *T. brucei* parasites
(photo: CDC/Myron Schultz)

meal, thus continuing the lifecycle. Unlike the closely related American trypanosome parasite, *T. cruzi*, *T. brucei* does not appear to invade cells and convert to the intracellular form known as the amastigote form. Although there is some evidence that this transition can occur in *T. brucei*, it appears to be rare and less significant for disease pathology than in its American cousin.



T. brucei life cycle.
Click to view

T. brucei parasites are transmitted through the bite of tsetse flies of the genus *Glossina*. *T. brucei* can also be transmitted from mother to child during pregnancy and be mechanically transmitted through blood products. However, the majority of transmission is attributed to the tsetse fly.

Parasite Sub-species	Tsetse vector	Area of Transmission	Animal Reservoir
T. b. gambiense	*Glossina palpalis* *Glossina tachinoides*	Banks of shaded streams	None
T. b. rhodesiense	*Glossina pallidipes* *Glossina* spp. (game biting)	Lightly covered bush	Domestic and wild ungulates

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Pathogenesis

Two forms of disease exist depending on the parasite sub-species: (1) Gambian or West African sleeping sickness is caused by *Trypanosoma brucei gambiense*, and (2) Rhodesian, Central, or East African sleeping sickness is caused by *Trypanosoma brucei rhodesiense*.

Gambian or West African sleeping sickness is the most common form of HAT, accounting for greater than 95% of cases. This form of disease is a chronic infection that begins asymptomatically and may present with non-specific symptoms such as fever and fatigue as parasites invade the lymphatic system (stage 1 disease). If left untreated, parasites can invade the central nervous system resulting in stage 2 disease and death. There is no animal reservoir for *T. b. gambiense*.

Rhodesian, Central, or East African sleeping sickness is less common, accounting for fewer than 5% of all cases. *T. b. rhodesiense* infection of humans results in acute infection and rapid progression to stage 2 disease. Rhodesian sleeping sickness is primarily a zoonotic infection with a large animal reservoir. It is likely that humans are only accidental hosts for this parasite.

Control Strategy

The current control strategy consists of two parts:

1. Active case detection and treatment

2. Vector control

Early detection of disease is essential for the treatment of HAT. Although treatment for stage 1 disease can be administered at the village level, treatment for stage 2 disease requires hospital administration and supportive care for toxic side effects. However, the non-specific symptoms of stage 1 disease make clinical diagnosis difficult. In areas of known transmission, WHO supports active screening and surveillance methods by providing free reagents, medicines, and support through mobile screening teams. Both serological (*T. b. gambiense* only) and parasitological diagnostic methods are used to screen patients. By detecting and treating stage 1 disease, patients can avoid taking the toxic drugs used to treat stage 2 disease and the human reservoir of parasites harbored in asymptomatic patients is reduced.

Vector control is the second key component of HAT control programs. Several strategies are used including tsetse fly traps, introduction of sterile male flies into the environment, and avoidance of known tsetse fly habitats.

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Existing Products

Drugs

Treatment of HAT depends on the species of parasite causing the infection and the stage of the disease as summarized below. NECT, a co-administration of nifurtimox and eflornithine, is the first new drug for HAT in over 25 years. Although NECT has not yet been approved by any country's regulatory agency, it has been added to the WHO essential medicines list and is recommended by the WHO over more toxic melarsoprol for the treatment of stage 2 *T. b. gambiense* disease.

Parasite Sub-species	Stage 1 drugs	Stage 2 Drugs
T. b. gambiense	Pentamidine (IM, minimal side effects)	Nifurtimox-Eflornithine Co-Administration (NECT, IV, expensive but currently supplied by WHO) Melarsoprol (IV, drug causes death in 5-10% of treated patients)
T. b. rhodesiense	Suramin (IV, severe side effects)	Melarsoprol (IV, results in death in 5-10% of treated patients)

Vaccines

There are currently no vaccines in use for HAT.

Diagnostics

Diagnosis of HAT is done primarily by microscopy. Both *T. b. rhodesiense* and *T. b. gambiense* can be seen in blood smears. A card indirect agglutination test (CATT) is also available for *T. b. gambiense*. To diagnose stage 2 disease, microscopy is performed on cerebral spinal fluid obtained by lumbar puncture.

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References

1. WHO African Trypanosomiasis Fact Sheet.
2. WHO (2010) First WHO report on neglected tropical diseases 2010: working to overcome the global impact of neglected tropical diseases.

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Pipeline & Analysis

Drugs | Vaccines | Diagnostics | Get Involved

Drugs

PIPELINE

Product/Research Program	Developers	Discovery	Pre-clinical	Phase I	Phase II	Phase III
NECT	Doctors Without Borders Drugs for Neglected Diseases Initiative Programme National de Lutte contre la Trypanosomiase Humaine Africaine, DRC Swiss Tropical and Public Health Institute					
Fexinidazole	Drugs for Neglected Diseases Initiative HAT Platform Partners Sanofi-Aventis Swiss Tropical and Public Health Institute					
SCYX-7158	Anacor Pharmaceuticals, Inc. Drugs for Neglected Diseases Initiative SCYNEXIS, Inc.					
CPD-0801	Consortium for Parasitic Drug Development Georgia State University The University of North Carolina at Chapel Hill					
Nitroimidazole backup program	Drugs for Neglected Diseases Initiative Global Alliance for TB Drug Development Swiss Tropical and Public Health Institute					
ARA-01 lead compound program	aRigen Pharmaceuticals, Inc. University of Tokyo					
CPD-0905	Consortium for Parasitic Drug Development Georgia State University The University of North Carolina at Chapel Hill					
	Consortium for Parasitic Drug Development					

Tipfarnab analogs	Georgia State University The University of North Carolina at Chapel Hill					
HAT Lead Optimisation Consortium	Drugs for Neglected Diseases Initiative Pace University SCYNEXIS, Inc.					
Cell-based screening hits (GNF/CPDD)	Consortium for Parasitic Drug Development Genomics Institute of the Novartis Research Foundation					
Pafuramidine maleate	Consortium for Parasitic Drug Development Georgia State University Immtech Pharmaceuticals Inc. The University of North Carolina at Chapel Hill					On Hold

ANALYSIS

There is a great need for new treatments for HAT to replace the complicated and often toxic current drugs. The most advanced product is a combination therapy of nifurtimox-eflornithine (NECT) that, while not yet formally approved, has been recommended for use by the WHO since May 2009. Eflornithine is administered every 12 hours for 7 days in conjunction with nifurtimox given orally every 8 hours for 10 days. A single NECT kit to treat one patient weighs approximate 9 kg and costs around $360. While NECT represents a significant improvement over the often deadly arsenic-based melarsoprol, additional medications with simplified treatment regiments, improved safety, and reduced cost are needed.

The only other clinical stage product is fexinidazole, a nitroimidazole-based compound related in chemical structure to the compound benzinidazole that is currently used for the treatment of American trypanosomiasis (Chagas disease).

The majority of HAT drug discovery is currently in the pre-clinical and discovery phases. These projects are focusing on backup programs for clinical stage products (i.e., nitrimidazole backup program for fexinidazole and diamidine backup program for DB289, a product that was halted in phase III development), and identification of new chemical entities by means of high throughput screening, and characterization of novel compound scaffolds. As there are very few products in clinical development for HAT, a greater number and diversity of projects are needed to ensure success.

Interestingly, two of the products in development for HAT are related to products in use for American trypanosomiasis (Chagas disease). Nifurtimox (part of the NECT product) is in use for Chagas disease and fexinidazole is structurally related to benznidazole, which is also currently in use for Chagas disease. Drug development for HAT will undoubtedly benefit from active collaborative drug discovery projects with Chagas disease programs.

	Strengths	Weaknesses	Opportunities	Risks
NECT				
Most advanced program: Phase III	Already in use through WHO	Long and complicated dosing regimen requiring hospitalization Several toxic side effects	Rapidly replacing the more toxic drug melarsoprol	Cost, storage, and shipment of kit may impede sustainability of this treatment strategy
Fexinidazole (DNA damage)				
Most advanced program: Phase I	Orally available Crosses blood brain barrier (can work for	Preclinical data demonstrates cross-resistance between fexinidazole and nifurtimox	Possible combination with other existing medications	As HAT infection becomes more rare, access to patients for clinical trials may be

	stage 1 or stage 2 disease) Potentially improved safety profile	high-lighting potential danger of fexinidazole as monotherapy		limited

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Vaccines

A preventative vaccine for HAT is considered unlikely and is not being pursued. As the total number of HAT cases and deaths is declining drastically, better case identification and management as well as improved treatments are priorities over exploratory vaccination projects.

Diagnostics

Diagnostics that can detect stage 2 disease without lumbar puncture, as well as a test that can detect *T. b. rhodesiense* are the greatest diagnostic needs. There are numerous new diagnostics in development, primarily through the Foundation for Innovative New Diagnostics (FIND). Thus far these projects are in discovery and preclinical stages focusing on new nucleic acid detection assays, antibody/antigen detection assays, and disease staging assays using blood rather than cerebrospinal fluid. Highlighting the difficulty of that goal, a FIND collaboration attempting to find blood markers for HAT staging did not achieve promising results, and was put indefinitely on hold.

FIND is also working to improve the sensitivity of existing diagnostics by working on ways to concentrate blood samples to detect lower levels of parasitemia. The most promising candidate in that project is the lysing of red blood cells, which may increase diagnostic sensitivity by up to twenty times.

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Tools

The following series of tables describe the availability of tools for research, discovery, and development of novel drugs, vaccines, and diagnostics for HAT. The tools listed in the following tables are not intended to be an all-inclusive list but rather capture the most common tools used for drug, vaccine, and diagnostic development. The tools for HAT are generally well developed. Patients with HAT are primarily located in extremely rural areas in countries with low infrastructure and high instability making clinical evaluation of new products extremely challenging.

Drug Development Tools

Basic Research: Target Identification	Target Validation	Screening: Hit/Lead Identification Optimization	Pre-clinical Validation	Clinical Validation
Genome: Sequenced & annotated **Key databases:** TriTrypDB ***In vitro* culture*:*** Yes	**Gene knock-outs:** Yes **Conditional gene knock-outs:** Yes **Transposon mutagenesis:** Possible **RNAi:** Yes **Other antisense technology:** Yes **Parasite viability assays:** Yes, but limited usefulness due to polycistronic transcription **Proteomics:** Yes **Crystal structures:** Not extensive	**Whole-cell screening assays:** Yes, multiple assays **Enzymatic screening assays:** Yes	**Animal models:** Yes Mouse models available for both stage 1 and stage 2 disease infection	**Monitoring treatment efficacy:** Yes, microscopy **Availability of endpoints:** Yes, clearance of parasitemia **Availability of surrogate endpoints:** No **Access to clinical trial patients/sites:** Yes, but most disease occurs in areas with minimal infrastructure and high levels of violence and instability

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Vaccine Development Tools

Basic Research: Antigen Identification	Immune Response Characterization	Clinical Validation
See drug development tools	**Predictive animal models:** Mouse	**Surrogate markers of**

above	**Detection of endogenous antigen specific response in clinical samples:** Not well characterized **Natural immunity well characterized:** No	**protection:** No **Challenge studies possible:** No

Diagnostic Development Tools

Basic Research: Biomarker Identification	Biomarker Validation	Clinical Validation
See drug development tools above	**Biomarkers known:** More needed for both strains of parasite **Access to clinical samples:** Limited **Possible sample types:** Blood or CSF (stage 2)	**Access to clinical trial patients/sites:** Yes, but most disease occurs in areas with minimal infrastructure and high levels of violence and instability **Treatment available if diagnosed:** Yes

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Product Details

Antibody probes

Synonyms:

Disease:
Human African Trypanosomiasis (HAT)

Technology:
Immunoassay

Specific Indication:
Antigen detection

Sample of Type:
Blood

Portability:
Unknown

Training Required:
Unknown

Notes:

Clinical Trials:

Publications:

ARA-01 lead compound program

Synonyms:
ARA-01 lead compound program

Disease:
Human African Trypanosomiasis (HAT)

Target/Technology:
Unknown

Specific Indication:

Mechanism of Action:

Product Type:
Drug

Molecule Class:
ascofuranone derivative

PRV Elegible?
Yes

Administration Route:

Notes:

Clinical Trials:

Publications:

Cell-based screening hits (GNF/CPDD)

Synonyms:
Cell-based screening hits (GNF/CPDD)

Disease:
Human African Trypanosomiasis (HAT)

Target/Technology:
Unknown

Specific Indication:

Mechanism of Action:

Product Type:
Drug

Molecule Class:

PRV Elegible?
Yes

Administration Route:

Notes:

Clinical Trials:

Publications:

CPD-0801

Synonyms:
CPD-0801

Disease:
Human African Trypanosomiasis (HAT)

Target/Technology:
Unknown

Specific Indication:

Mechanism of Action:

Product Type:
Drug

Molecule Class:
Diamidines

PRV Elegible?
Yes

Administration Route:

Notes:

Clinical Trials:

Publications:

CPD-0905

Synonyms:
CPD-0905

Disease:
Human African Trypanosomiasis (HAT)

Target/Technology:
Unknown

Specific Indication:

Mechanism of Action:

Product Type:
Drug

Molecule Class:
Diamidines

PRV Elegible?
Yes

Administration Route:

Notes:

Clinical Trials:

Publications:

Fexinidazole

Synonyms:
Fexinidazole

Disease:
Human African Trypanosomiasis (HAT)

Target/Technology:
DNA damage

Specific Indication:
Stage 2

Mechanism of Action:

Molecule Class:
Nitroimidazole

Product Type:
Drug

Administration Route:
Oral

PRV Elegible?
Yes

Notes:

More information on this product is available from DNDi.

Clinical Trials:

NCT00982904
NCT01340157

Publications:

HAT Lateral-flow RDT

Synonyms:

Disease:
Human African Trypanosomiasis (HAT)

Technology:
Rapid Diagnostic Test (RDT)

Specific Indication:

Sample of Type:

Antibody detection of T.b. gambiense

Portability:
Handheld

Blood

Training Required:
Minimal

Notes:

Clinical Trials:

Publications:

HAT lateral-flow RDT (2nd generation)

Synonyms:

Disease:
Human African Trypanosomiasis (HAT)

Specific Indication:
Antibody detection, all subspecies of African trypanosomiasis

Portability:
Handheld

Technology:
Immunoassay

Sample of Type:
Blood

Training Required:
Minimal

Notes:

FIND and Standard Diagnostics are working to develop a generalized follow-up product to their T.b. gambiense-specific RDT.

Clinical Trials:

Publications:

HAT Lead Optimisation Consortium

Synonyms:
HAT Lead Optimisation Consortium

Disease:
Human African Trypanosomiasis (HAT)

Specific Indication:

Product Type:
Drug

PRV Elegible?
Yes

Target/Technology:
Unknown

Mechanism of Action:

Molecule Class:

Administration Route:

Notes:

Clinical Trials:

Publications:

HAT-PCR-Oligochromatographic dipstick

Synonyms:

Disease:
Human African Trypanosomiasis (HAT)

Specific Indication:
Low-level parasitemia detection

Portability:
Peripheral laboratory

Technology:
Rapid Diagnostic Test (RDT)

Sample of Type:
Blood

Training Required:
Moderate

Notes:

Clinical Trials:

Publications:

Identifying markers for HAT staging (FIND/Aberdeen)

Synonyms:

Disease:
Human African Trypanosomiasis (HAT)

Technology:
Unknown

Specific Indication:
staging Human African Trypanosomiasis (HAT)

Sample of Type:
Blood

Portability:
Unknown

Training Required:
Unknown

Notes:

Clinical Trials:

Publications:

Identifying markers for HAT staging (FIND/Makerere/ITM)

Synonyms:

Disease:
Human African Trypanosomiasis (HAT)

Technology:
Unknown

Specific Indication:
Human African Trypanosomiasis (HAT) staging

Sample of Type:
Blood

Portability:
Unknown

Training Required:
Unknown

Notes:

Clinical Trials:

Publications:

Loop-mediated isothermal amplification (LAMP) of DNA (HAT)

Synonyms:

Disease:
Human African Trypanosomiasis (HAT)

Technology:
Nucleic acid based

Specific Indication:
cure confirmation, antigen DNA detection

Sample of Type:
Blood

Portability:
Peripheral laboratory

Training Required:
Moderate

Notes:

Clinical Trials:

Publications:

Nanobodies antigen detection test

Synonyms:

Disease:
Human African Trypanosomiasis (HAT)

Technology:
Immunoassay

Specific Indication:
antigen detection

Sample of Type:
Blood

Portability:
Unknown

Training Required:
Unknown

Notes:

Clinical Trials:

Publications:

NECT

Synonyms:
Nifurtimox-Eflornithine
NECT
NECT – Nifurtimox-Eflornithine Co-Administration (HAT)

Disease:
Human African Trypanosomiasis (HAT)

Specific Indication:
Stage 2

Product Type:
Drug

PRV Elegible?
Yes

Target/Technology:
Unknown

Mechanism of Action:

Molecule Class:

Administration Route:
IV

Notes:

NECT was added to the WHO essential medicines list in May 2009 and has been in use since November 2009 in Democratic Republic of Congo. More information on this product is available from DNDi.

Clinical Trials:

NCT00146627

Publications:

19559476

Nitroimidazole backup program

Synonyms:
Nitroimidazole backup program

Disease:
Human African Trypanosomiasis (HAT)

Specific Indication:

Product Type:
Drug

PRV Elegible?
Yes

Target/Technology:
DNA damage

Mechanism of Action:

Molecule Class:
Nitroimidazole

Administration Route:

Notes:

More information on this product is available from DNDi.

Clinical Trials:

Publications:

Pafuramidine maleate

Synonyms:
Pafuramidine maleate
DB289
Oral furamidine pro-drug

Disease:
Human African Trypanosomiasis (HAT)

Specific Indication:
Stage 1

Product Type:
Drug

Target/Technology:
Unknown

Mechanism of Action:

Molecule Class:
Diamidines

PRV Eligible?
Yes

Administration Route:
Oral

Notes:

Clinical Trials:

NCT00619346
NCT00803933
NCT00802594

Publications:

Primo Star iLED fluorescence microscope

Synonyms:

Disease:
Human African Trypanosomiasis (HAT)

Technology:
Cell-based

Specific Indication:
Detection of trypanosomes

Sample of Type:
Blood

Portability:
Table-top

Training Required:
Moderate

Notes:

Clinical Trials:

Publications:

RBC lysis

Synonyms:

Disease:
Human African Trypanosomiasis (HAT)

Technology:
Cell-based

Specific Indication:
Detection of low-concentration parasites

Sample of Type:
Blood

Portability:
Peripheral laboratory

Training Required:
Moderate

Notes:

For more information, see a Makerere report on the technology.

Clinical Trials:

Publications:

SCYX-7158

Synonyms:
SCYX-7158
Oxaboroles

Disease:
Human African Trypanosomiasis (HAT)

Target/Technology:
Boron Chemistry

Specific Indication:

Mechanism of Action:

Product Type:
Drug

Molecule Class:
Oxaboroles

PRV Eligible?
Yes

Administration Route:

Notes:

Clinical Trials:

Publications:

More information on this product is available from DNDi.

Single format IgM quantification test using 'dri dot' cards

Synonyms:

Disease:
Human African Trypanosomiasis (HAT)

Specific Indication:
T.b. gambiense staging

Portability:
Peripheral laboratory

Technology:
Rapid Diagnostic Test (RDT)

Sample of Type:
Other

Training Required:
Advanced

Notes:

This latex agglutination test using a CSF sample to stage T.b. gambiense uses a 'dri dot' method to eliminate the need for temperature control of the sample.

Clinical Trials:

Publications:

Tipfarnab analogs

Synonyms:
Tipfarnab analogs

Disease:
Human African Trypanosomiasis (HAT)

Specific Indication:

Product Type:
Drug

PRV Elegible?
Yes

Target/Technology:
Unknown

Mechanism of Action:
Farnesyltransferase inhibitor

Molecule Class:

Administration Route:

Notes:

Clinical Trials:

Publications:

trypanosome vaccine antibodies

Synonyms:
trypanosome vaccine antibodies

Disease:
Human African Trypanosomiasis (HAT)

Specific Indication:

Product Type:
Vaccine

PRV Elegible?
Yes

Target/Technology:
Recombinant/purified protein vaccines

Mechanism of Action:

Molecule Class:

Administration Route:

Notes:

Clinical Trials:

Publications:

Developer Details

Doctors Without Borders (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	NECT	Phase III

Programme National de Lutte contre la Trypanosomiase Humaine Africaine, DRC (Congo (DRC))

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	NECT	Phase III

Swiss Tropical and Public Health Institute (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	NECT	Phase III

Swiss Tropical and Public Health Institute (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Fexinidazole	Phase I

Swiss Tropical and Public Health Institute (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Nitroimidazole backup program	Pre-clinical

Drugs for Neglected Diseases Initiative (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	NECT	Phase III

Drugs for Neglected Diseases Initiative (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Fexinidazole	Phase I

Drugs for Neglected Diseases Initiative (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	SCYX-7158	Pre-clinical

Drugs for Neglected Diseases Initiative (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	HAT Lead Optimisation Consortium	Discovery

Drugs for Neglected Diseases Initiative (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Nitroimidazole backup program	Pre-clinical

HAT Platform Partners (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Fexinidazole	Phase I

Sanofi-Aventis (France)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Fexinidazole	Phase I

Sanofi-Aventis (France)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Melarsoprol	Approved

SCYNEXIS, Inc. (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	SCYX-7158	Pre-clinical

SCYNEXIS, Inc. (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	HAT Lead Optimisation Consortium	Discovery

Anacor Pharmaceuticals, Inc. (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	SCYX-7158	Pre-clinical

Consortium for Parasitic Drug Development (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Pafuramidine maleate	Phase III

Consortium for Parasitic Drug Development (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	CPD-0801	Pre-clinical

Consortium for Parasitic Drug Development (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	CPD-0905	Discovery

Consortium for Parasitic Drug Development (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Tipfarnab analogs	Discovery

Consortium for Parasitic Drug Development (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Cell-based screening hits (GNF/CPDD)	Discovery

Georgia State University (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Pafuramidine maleate	Phase III

Georgia State University (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	CPD-0801	Pre-clinical

Georgia State University (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	CPD-0905	Discovery

Georgia State University (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Tipfarnab analogs	Discovery

Immtech Pharmaceuticals Inc. (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Pafuramidine maleate	Phase III

The University of North Carolina at Chapel Hill (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Pafuramidine maleate	Phase III

The University of North Carolina at Chapel Hill (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	CPD-0801	Pre-clinical

The University of North Carolina at Chapel Hill (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	CPD-0905	Discovery

The University of North Carolina at Chapel Hill (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Tipfarnab analogs	Discovery

Pace University (United States)

Type	Disease	Product/Research Program	Current Phase

Drug	Human African Trypanosomiasis (HAT)	HAT Lead Optimisation Consortium	Discovery

Global Alliance for TB Drug Development (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Nitroimidazole backup program	Pre-clinical

Foundation for Innovative New Diagnostics (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	Antibody probes	Pre-clinical

Foundation for Innovative New Diagnostics (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	Identifying markers for HAT staging (FIND/Aberdeen)	Pre-clinical

Foundation for Innovative New Diagnostics (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	Loop-mediated isothermal amplification (LAMP) of DNA (HAT)	Clinical

Foundation for Innovative New Diagnostics (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	Mini Anion Exchange Centrifugation Technique (mAECT)	Approved

Foundation for Innovative New Diagnostics (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	Nanobodies antigen detection test	Pre-clinical

Foundation for Innovative New Diagnostics (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	Primo Star iLED fluorescence microscope	Clinical

Foundation for Innovative New Diagnostics (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	RBC lysis	Pre-clinical

Foundation for Innovative New Diagnostics (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	Single format IgM quantification test using 'dri dot' cards	Pre-clinical

Foundation for Innovative New Diagnostics (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	Identifying markers for HAT staging (FIND/Makerere/ITM)	Pre-clinical

Foundation for Innovative New Diagnostics (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	HAT Lateral-flow RDT	Clinical

Foundation for Innovative New Diagnostics (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	HAT lateral-flow RDT (2nd generation)	Pre-clinical

Carl Zeiss (Germany)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	Primo Star iLED fluorescence microscope	Clinical

Institute of Tropical Medicine (Belgium)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	HAT-PCR-Oligochromatographic dipstick	Pre-clinical

Institute of Tropical Medicine (Belgium)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	Mini Anion Exchange Centrifugation Technique (mAECT)	Approved

Institute of Tropical Medicine (Belgium)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	Single format IgM quantification test using 'dri dot' cards	Pre-clinical

Institute of Tropical Medicine (Belgium)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	Identifying markers for HAT staging (FIND/Makerere/ITM)	Pre-clinical

Institut National de Recherche Biomedicale (Congo, Democratic Republic)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	Mini Anion Exchange Centrifugation Technique (mAECT)	Approved

Makerere University

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	RBC lysis	Pre-clinical

Makerere University

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	Identifying markers for HAT staging (FIND/Makerere/ITM)	Pre-clinical

Standard Diagnostics (India)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	HAT Lateral-flow RDT	Clinical

Standard Diagnostics (India)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	HAT lateral-flow RDT (2nd generation)	Pre-clinical

University of Brussels

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	Nanobodies antigen detection test	Pre-clinical

Seattle Biomedical Research Institute (United States)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	Antibody probes	Pre-clinical

Murdoch University (Australia)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	Loop-mediated isothermal amplification (LAMP) of DNA (HAT)	Clinical

Obihiro University

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	Loop-mediated isothermal amplification (LAMP) of DNA (HAT)	Clinical

Coris BioConcept (Belgium)

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	HAT-PCR-Oligochromatographic dipstick	Pre-clinical

Rega Institute for Medicinal Research

Type	Disease	Product/Research Program	Current Phase
Diagnostic	Human African Trypanosomiasis (HAT)	HAT-PCR-Oligochromatographic dipstick	Pre-clinical

University of Aberdeen

Type	Disease	Product/Research Program	Current Phase

Diagnostic	Human African Trypanosomiasis (HAT)	Identifying markers for HAT staging (FIND/Aberdeen)	Pre-clinical

Genomics Institute of the Novartis Research Foundation (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Cell-based screening hits (GNF/CPDD)	Discovery

University of Tokyo (Japan)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	ARA-01 lead compound program	Pre-clinical

aRigen Pharmaceuticals, Inc. (Japan)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	ARA-01 lead compound program	Pre-clinical

iBIO (United States)

Type	Disease	Product/Research Program	Current Phase
Vaccine	Human African Trypanosomiasis (HAT)	trypanosome vaccine antibodies	Pre-clinical

Special Programme for Research and Training in Tropical Diseases (Switzerland)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Pentamidine	Approved

Armour Pharma (United Kingdom)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Pentamidine	Approved

APP Pharmaceuticals (United States)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Pentamidine	Approved

Bayer AG (Germany)

Type	Disease	Product/Research Program	Current Phase
Drug	Human African Trypanosomiasis (HAT)	Suramin	Approved