Development of an App. for the identification of schistosomiasis intermediate host snails

Dr Amadou Garba Djirmay
Scientist / Global NTD Programme

World Health Organization
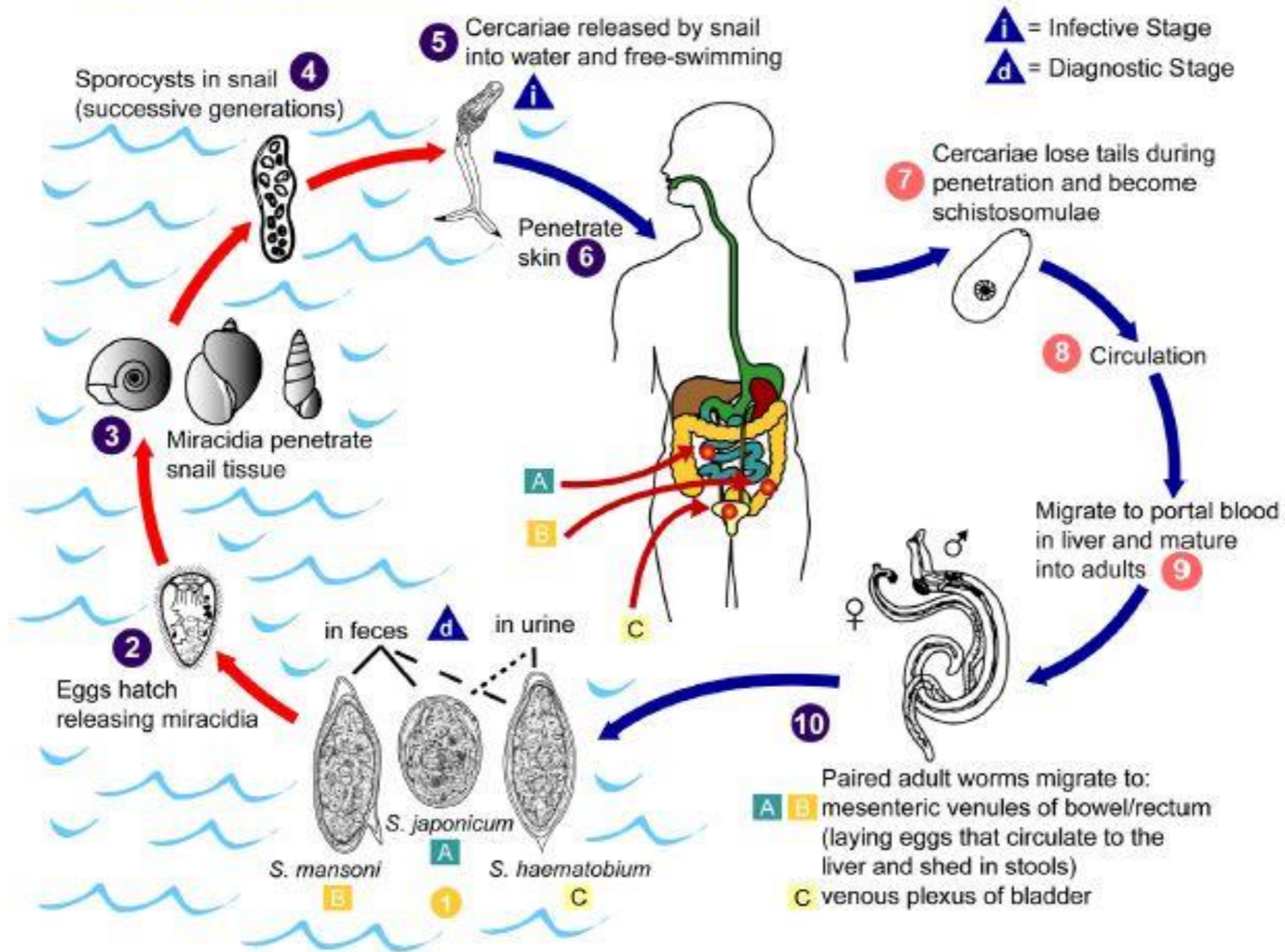
Schistosomiasis

Figure 6. Life cycle of schistosomes infecting humans (CDC Image library).

Schistosome species and their intermediate snail hosts

Schistosome species infecting humans	Snail genus responsible for transmission
S. mansoni	*Biomphalaria*
S. haematobium, S. intercalatum, S. guineensis	*Bulinus*
S. japonicum	*Oncomelania*
S. Mekongi	*Neotricula*

World Health Organization

Rationale for the App. development

- WHA 65.21 called for interruption of transmission of schistosomiasis where possible

- Operational components (the provision of potable water, adequate and reliable sanitation, hygiene interventions, and snail control) are required to have a greater impact towards the interruption of transmission.

- Implementation of snail control activities require competences in malacology.

- Limited capacity in snail control exist in endemic countries, considering the priority given to preventive chemotherapy and the abandon of snail control

- Existing WHO guidance on snail identification is outdated (1984)

- New technologies /AI allows the development of a phone application that is based on a photograph of individual field-collected snails to assist in building capacity for the surveillance and evaluation of the snail control activities

World Health Organization

Main characteristics of the App.

Must, Should, Could	Topic	Description
Must	AI Model performance	AI Model recognition ratio must be 90%
Should	AI Model performance	AI Model recognition ratio should be 90%
Must	Taking pictures	The mobile application must allow the user to: •make one or several photos of a snail •visualize the photos taken •submit one or several photos together for recognition (depending on the AI model).
Must	Metadata	The mobile application must collect photo's metadata and background information like GPS coordinates, date, time and other data relevant to the AI model.
Must	Offline recognition	The mobile application must answer, in offline mode, to the user whether the snails is a vector or not.
Must	Sub-species recognition	The mobile application must tell which sub-species it recognized (if positive)
Must	Send data when online	Application must offer the user the possibility to submit pictures taken to the platform along with data related to the pictures and recognition (Answer provided by the recognition algorithm).
Should	Detect phone language	Application should detect the language of the phone and remember what the user selected on the same phone.
Must	Platform Vector validation. Entry form	To control the quality, a form will be created showing randomly the pictures received on the platform. This form will be accessible to WHO experts only. Experts will be able to enter following fields: official species and official sub-species (selected from a list), and a comment. The system will register the date of entry (or update). User will be able to save the entry, discard changes, skip current picture and either exit review process or see next picture.

World Health Organization

Methods

- Constitution of image datasets for the App. database and for the software evaluation

- Collection of snails images from various regions (Africa, Asia, Americas) from experts and research centre collection and from google searches

- Identification and classification of the snail images (1st quality control)

- Color information in photos not used as predictor of species, because field snails often have encrustment on the shell.

- Identification based on the snail morphology (shell)

Methods

- Creation of a machine learning model based on a dataset of snail shell photographs, organized by a malacologist

- Creation of a specific data set for the model challenge

- Experiments using raw dataset with cropped images of size
- Model biased towards background color and texture.

World Health Organization

Preliminary results

- Best accuracy on Training set - 92 %

- Best accuracy on Validation set - 80 %

- Some more experiments showed that model still had biais towards a few classes whose images vary a lot in sizes and colour.

- The scores are good, and the model is expected to perform well if certain conditions are met

World Health Organization

Imbalance class distribution of the dataset
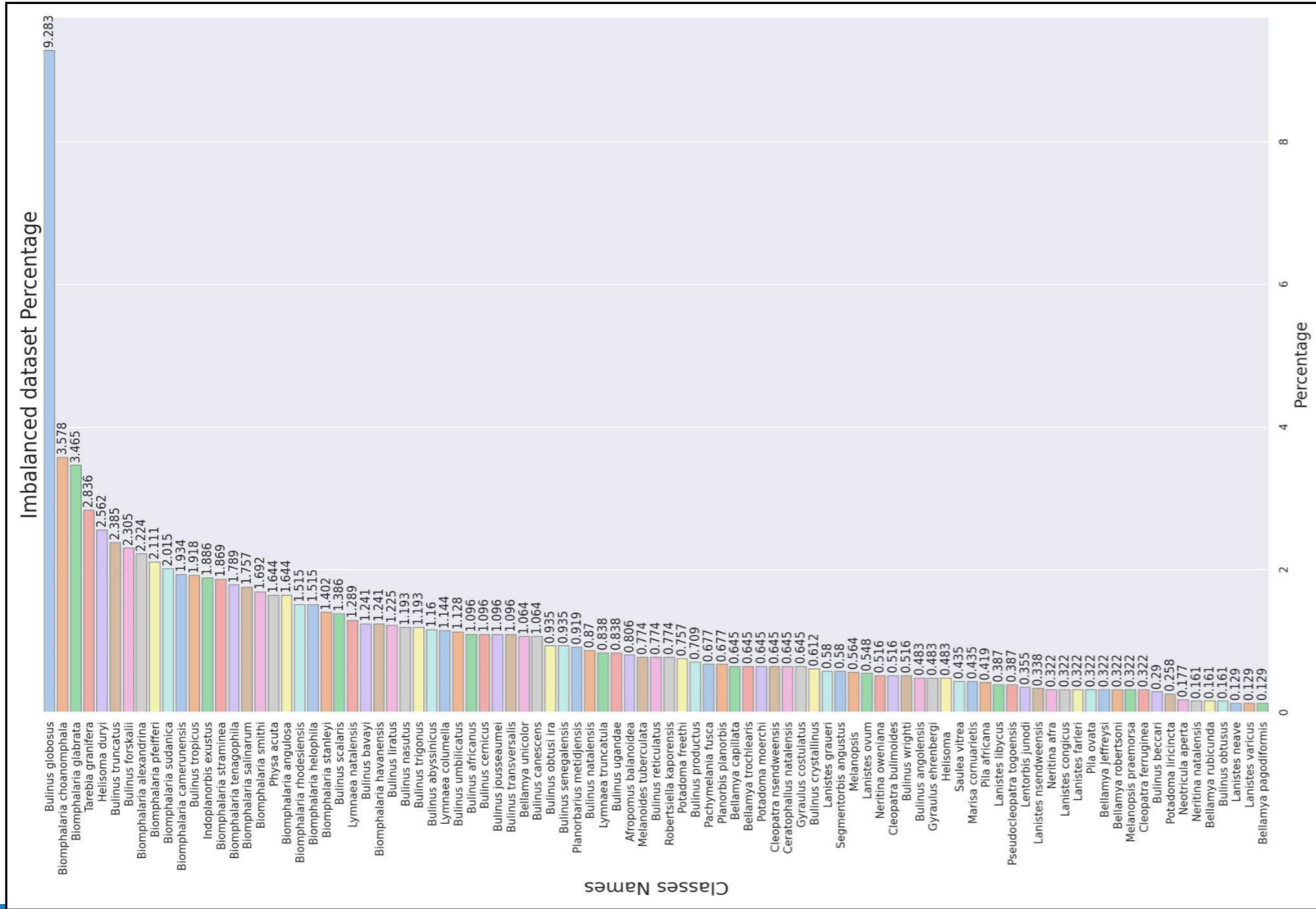
Snail images

Min : 129
Max: 9283

93 Snails classes

World Health Organization

Accuracy scores for each species in the validation dataset
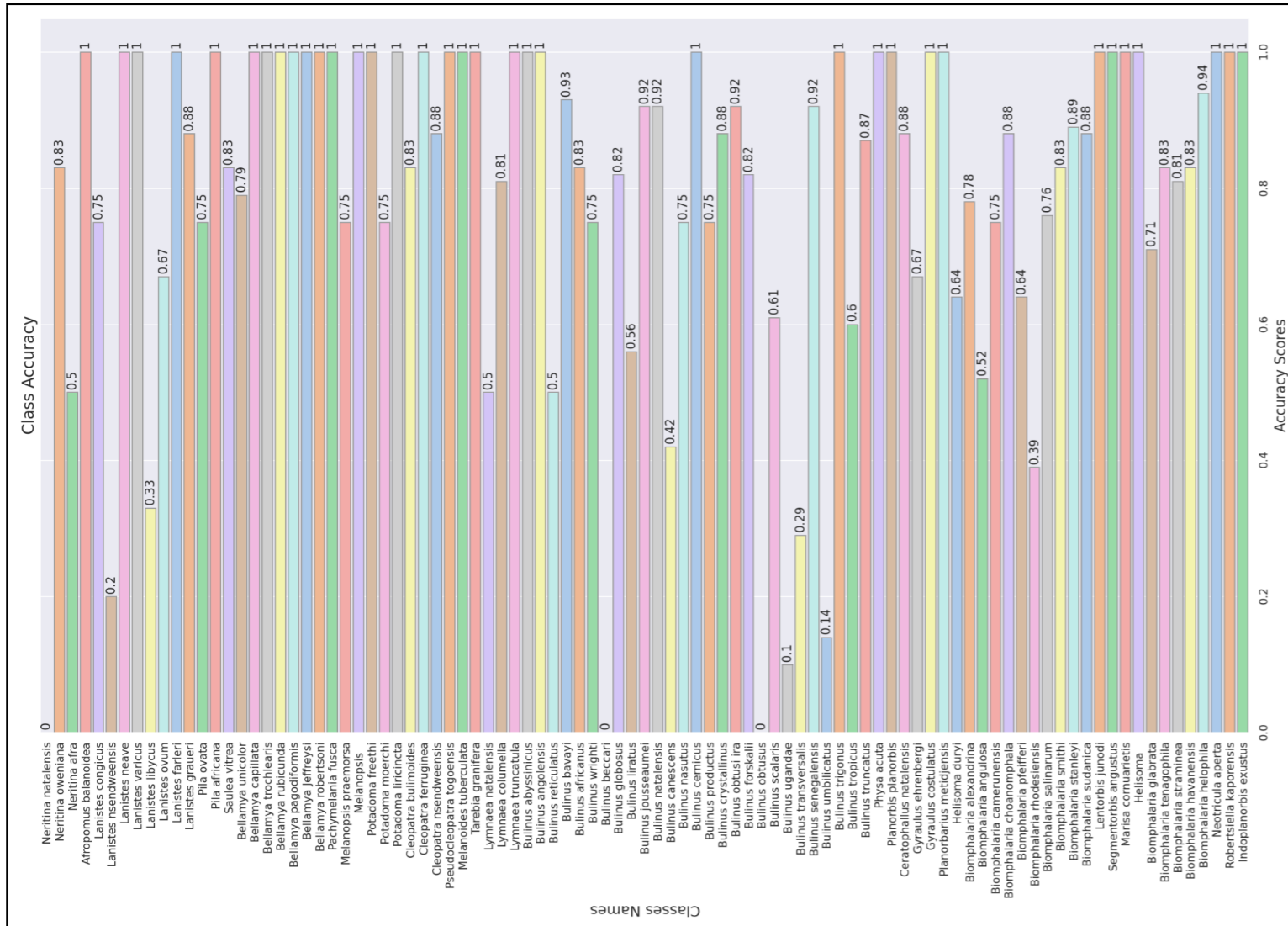
Example:

Bulinus africanus - 83%

Bulinus globosus - 82%

Bulinus senegalensis - 92%

Bulinus umbilicatus - 14%

Bulinus truncatus - 87%

Biomphalaria pfeiferi - 64%

Biomphalaria sudanica - 88%

World Health
Organization

Snail App. Web interface

The webapp is live at: https://who-snail-api.aicrowd.com/

Please submit an image of a snail, and our AI model will make a prediction about the risk of Schistostomasis, and the species the snail belongs to.

| Choose File | No file chosen | | **Predict!** | Select region ⌄ |

Genus	Species	Confidence	
Gyraulus	Unknown		27.50 %
Gyraulus	convexiusculus		27.04 %
Brotia	Unknown		16.60 %
Segmentina	hemisphaerula		15.05 %
Melanoides	jugicosta		13.81 %

Schistosomiasis ?

No		100.00 %
Yes 💀		0.00 %

World Health Organization

External evaluation of the App.

Please submit an image of a snail, and our AI model will make a prediction about the risk of Schistostomasis, and the species the snail belongs to.

Genus	Species	Confidence	
Bulinus	globosus		55.20 %
Bulinus	forskalii		38.02 %
Ceratophallus	natalensis		3.57 %
Cleopatra	bulimoides		1.70 %
Biomphalaria	pfeifferi		1.50 %

Schistosomiasis ?

No		5.28 %
Yes 💀		94.72 %

This shell is a Bellamya and it shows no resemblance to neither Bulinus globosus or Bulinus forskalii.

**World Health Organization**

Next steps

- Additional rounds of training using new data sets

- Review of the recognition algorithm

- Launching of a global challenge for improvement of the App.

- Launching of the 1st version of the App.

- Field testing of the App. in Tanzania

- Monitoring and control the quality of the tool, Sensitivity, Specificity, Predictive Values etc., review of the pictures of sub-species received (without being biased by the response from the algorithm) and re-evaluationof the accuracy of the classification.

- Development of the version 2

World Health Organization

Thank you

World Health
Organization

The gastropod shell
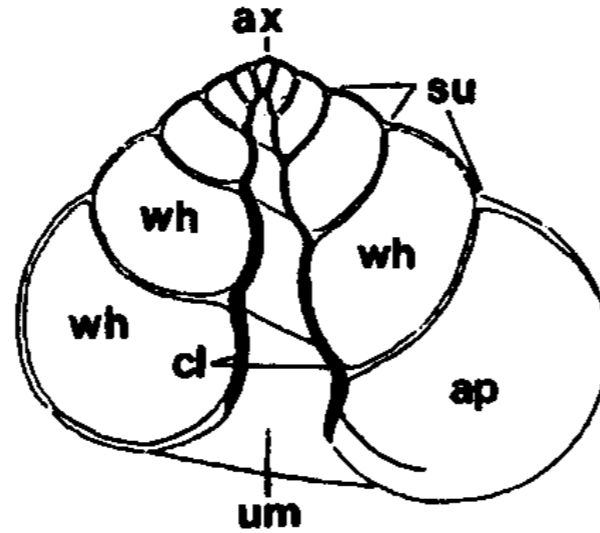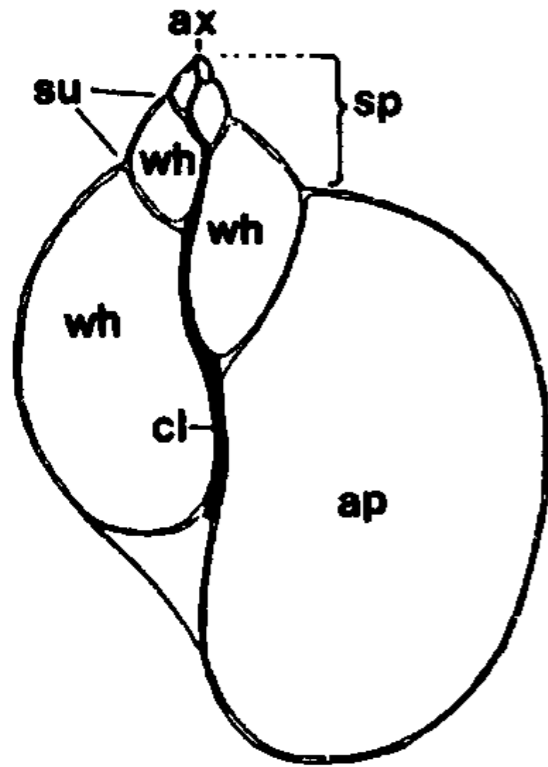
ap: aperture; ax: apex; cl: columella; sp: spire; su: suture; um: umbilicus; wh: whorl

World Health Organization