The Stiletto project: The GNU Health Federation and Open Science in the context of international epidemiological and biomedical research

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About me

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Academic & profession

- Physician
- Computer Scientist
- Genomics & Medical Genetics

Social Medicine

- Founder of GNU Solidario
- Author of GNU Health
- Animal Rights

About GNU Solidario

Non-for-profit organization

- Works globally
- Focused on Social Medicine
- Fights for the right of human and nonhuman animals
- The organization behind GNU Health
- Promotes Libre Software and Open Science

Projects from GNU Solidario

Exposoma Global

GlobalExposome

Compassionate Science, Sustainable Planet

Exposome

Exposome/ (ˈɛkspəʊˌsəʊm) /

"The cumulative measure of environmental influences and associated biological responses throughout the lifespan, including exposures from the environment, diet, behavior, and endogenous processes."

Miller and Jones (2014)

Building modern, empathetic societies for a sustainable planet

Respect
Mother nature, animals
(human and non-human)

Education
People, patients, health prof,
Politicians...

GlobalExposome

Compassionate Science, Sustainable Planet

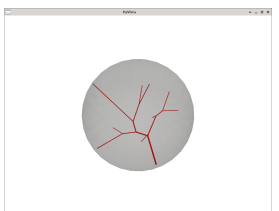
Research
Medicine, exposomics,
Agriculture,
Social sciences,
urbanism...

Collaboration
Open Science, Free Software,
Local capacity building

Stiletto Project components

STILETTO

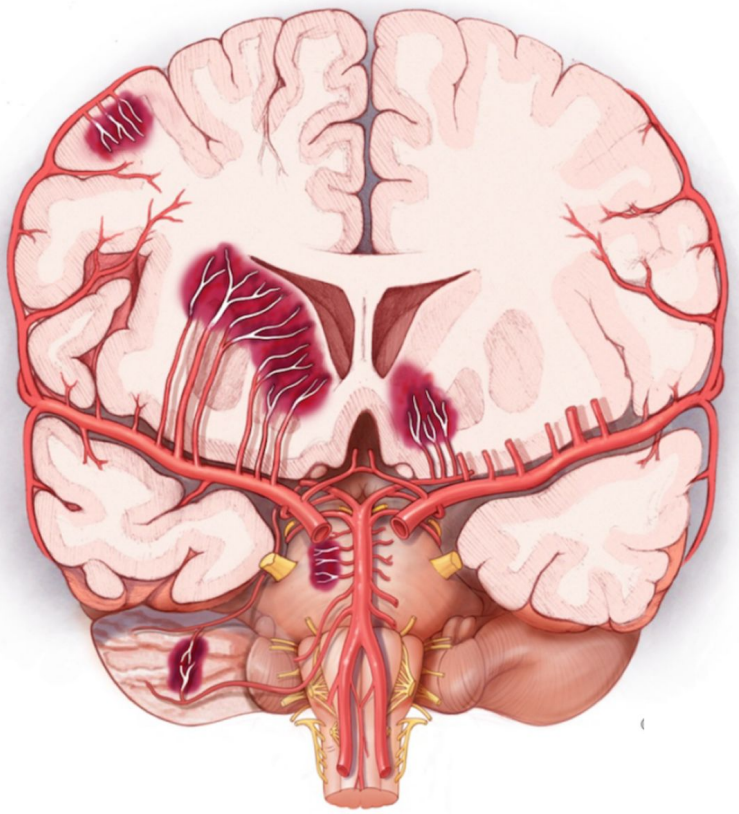
A computational model of the cerebral perforating arteries in health and disease



- Prospective, longitudinal, multicenter study
- Study of the role of the exposome in the etiology and progression of small vessel disease
- Relation among the exposome, genetics and pathology groups that made up cSVD
- Pave the way for future studies in polygenic factors in cSVD

- A computational model of the cerebral perforating arteries in health and disease
- Model and simulation of different scenarios of the perforating arteries and the Neurovascular Unit (NVU)

Intro to the cerebral microcirculation



Credit: Mayo clinic foundation for medical illustration and Research

- Small vessels (micrometers, most < 500 um)
- Brain parenchyma and subarachnoidal space
- Supply deep cerebral areas, including internal capsule, basal ganglia and thalamus.
- They play a critical role in motor, sensitive, cognitive and motional functions.
- Their malfunctioning leads to Cerebral small vessel disease (cSVD)

Stroke and small vessel disease in numbers

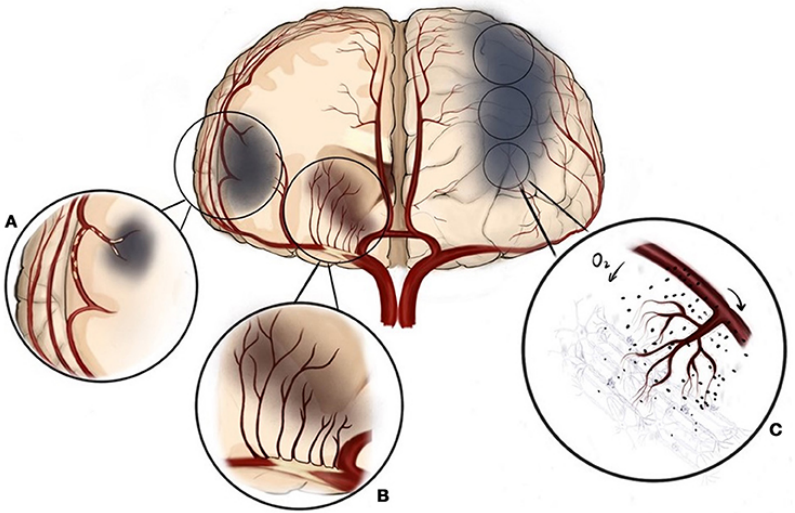
12.2 Million new cases / year
(1 every 3 seconds)
Ischemic: 88% / Hemorragic: 12%
cSVD: approx 3 M

100 M live with stroke sequeleae
1 of 4 persons will suffer a stroke
In 2035 incidence will increase 35%

Second cause of death
Leading cause of permanent disability

USD 452 billions global cost

cSVD
25% stroke cases
Causes the 45% dementia cases



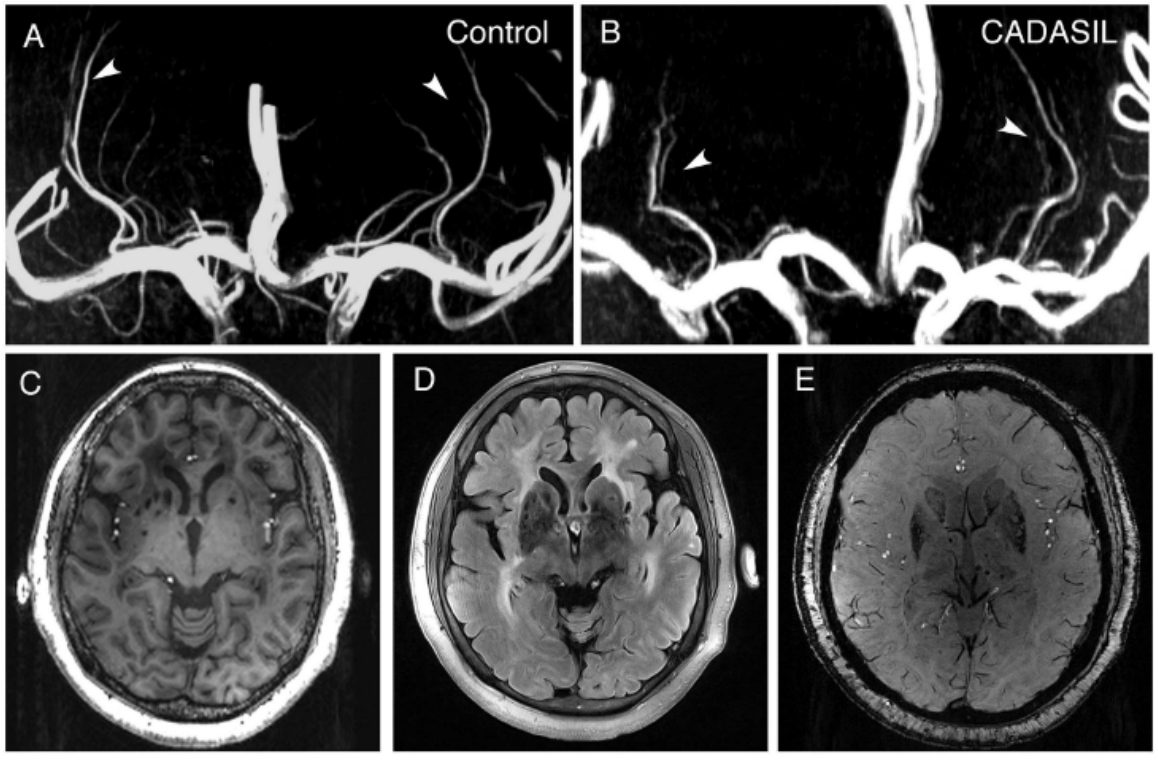
Front. Neurol., 21 August 2018
Sec. Endovascular and Interventional Neurology

Sources: World Stroke Organization (2022) / CDC / SAFE Europe

Cerebral small Vessel disease (cSVD) - Classification

CSVD types		
Type 1	Atherosclerosis (“sporadic”)	Hypertension, diabetes, hyperlipidemia
Type 2	Cerebral Amyloid Angiopathy	
Type 3	Monogenic	CADASIL (notch3), CARASIL (HTRA1), MELAS, Fabry’s disease,..
Type 4	Inflammatory / immuno-mediated	Wegner granulomatosis, Churg-Strauss, connective tissue vasculitis (Lupus, Sjögren, sclerodermia, rheumatoid vasculitis..), microscopic polyangiitis, IgA vasculitis (Henoch-Schönlein purpura)
Type 5	Venous collagenosis	
Type 6	Others	Post-radiation angiopathy, non-amyloid microvasculature degeneation in Alzheimer disease

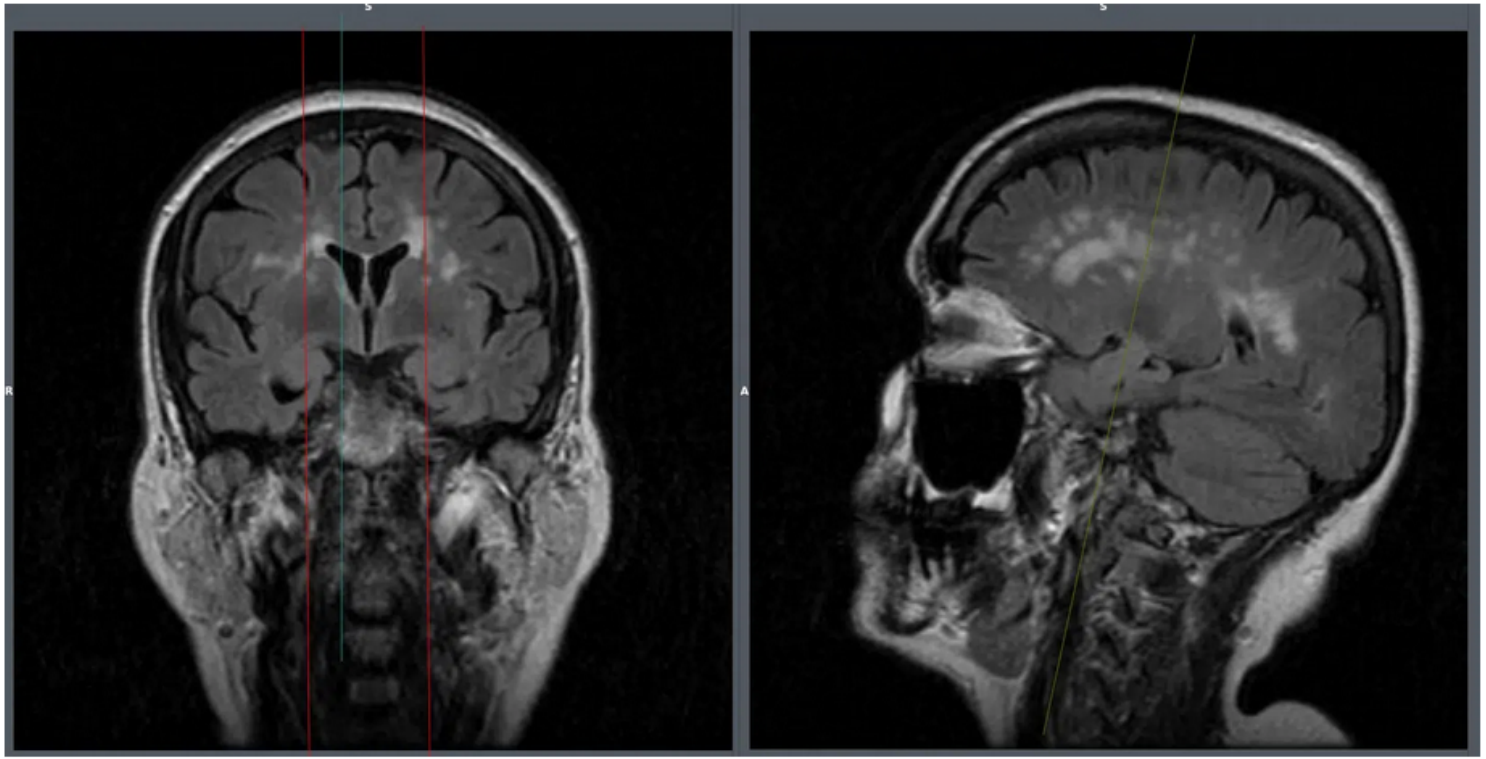
Radiological Markers in cSVD



- Main markers
  - Leukoaraiosis / WMH
  - Microbleeds
  - Lacunar infarcts
  - Increased perivascular space (basal ganglia)
  - Cerebral atrophy (loss of volume)

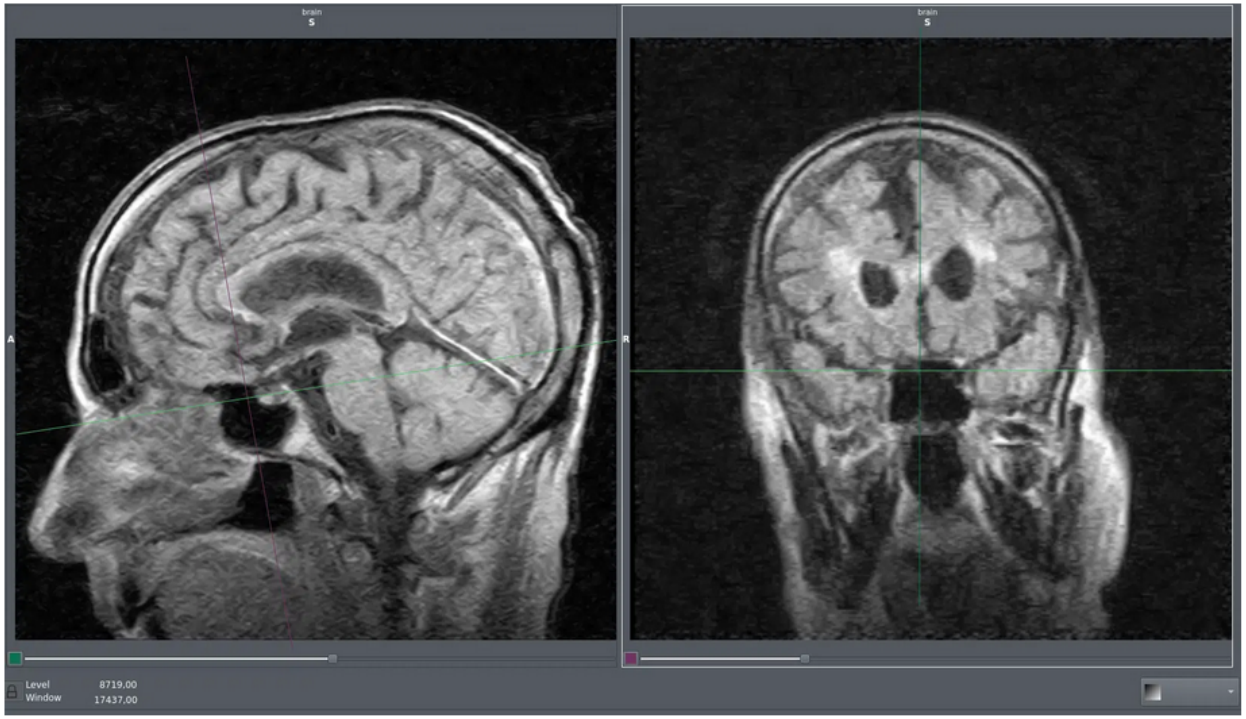
Fuente: Lenticulostriate Arteries and Basal Ganglia Changes in Cerebral Autosomal Dominant Arteriopathy With Subcortical Infarcts and Leukoencephalopathy, a High-Field MRI Study
Front. Neurol., 09 August 2019 (Sec. Applied Neuroimaging)
Volume 10 - 2019 | https://doi.org/10.3389/fneur.2019.00870

cSVD monogenic (CADASIL)



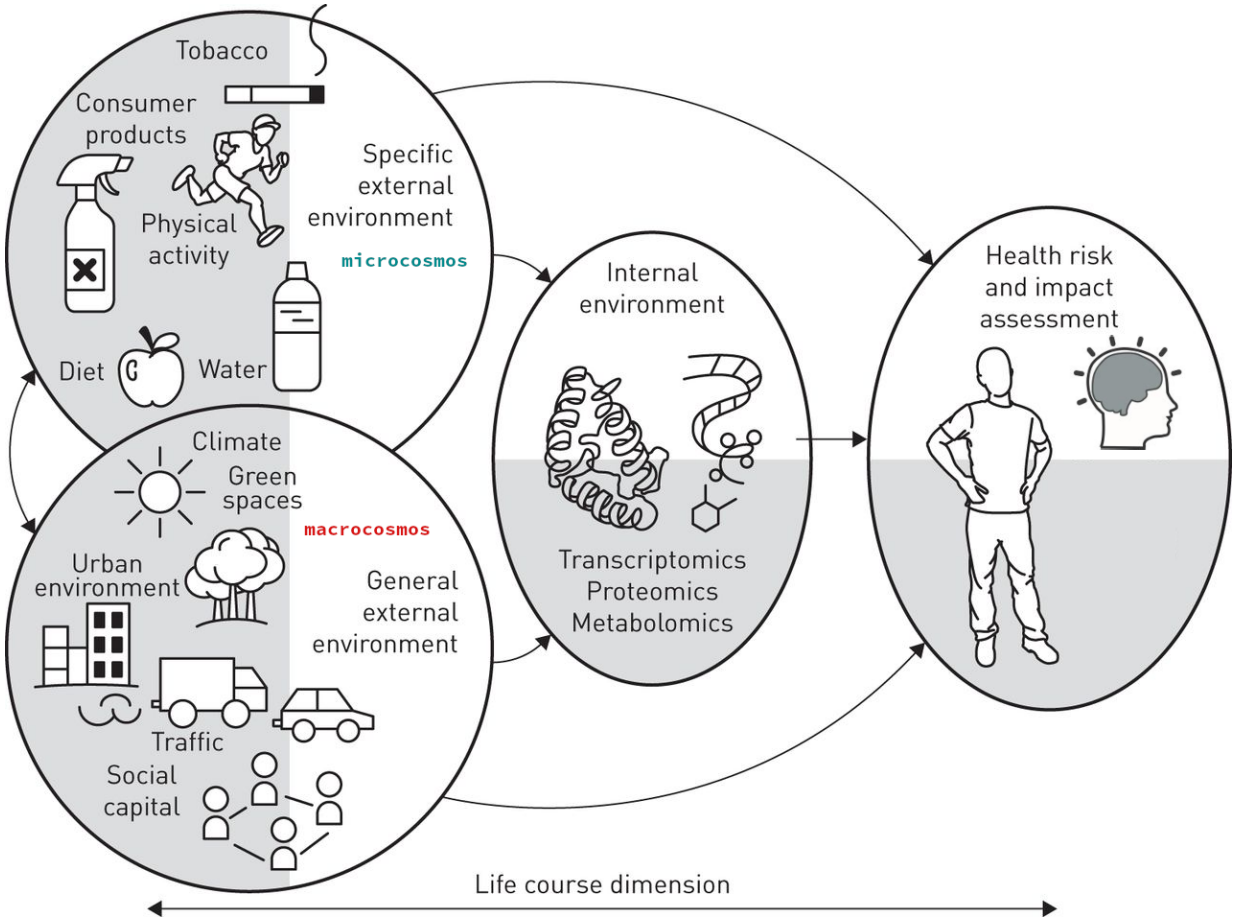
Magnetic Resonancce showing multiple lessions in white cerebral white matter in a patient with CADASIL

Sporadic cSVD



Magnetic Resonance from a elderly patient showing white matter hyperintensities and brain atrophy compatible with small vessel disease

Exposome, macrocosmos, microcosmos & cSVD



Adapted from
https://publications.ersnet.org/content/errev/25/140/124

Some variables

Macro

- Polution (PM2.5)
- Socioeconomic Status
- Urbanization degree ”Operating Sectors“ (GNU Health)
- Living and sanitary conditions

Micro

- Diet
- Psycho-social stress
- Physical activity
- Alcohol
- Smoking

WHR / BMI

Inflammation biomarkers

IL6, fibrinogen, hs-PCR...

Arterial pressure

Sex

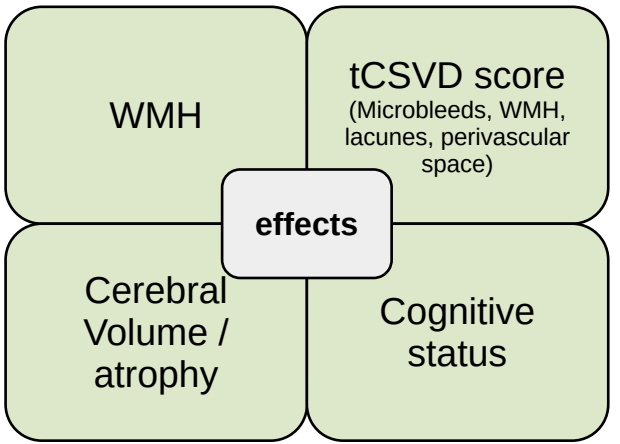
Pathology group

Sporadic, genetic, autoimmune..

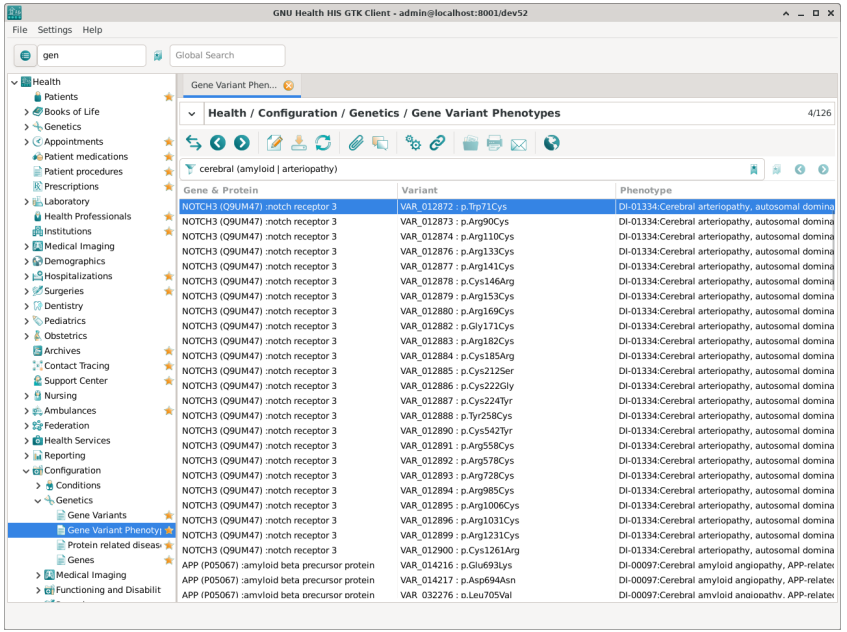
Polygenic Risk Score

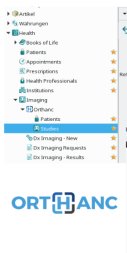
PRS-cSVD

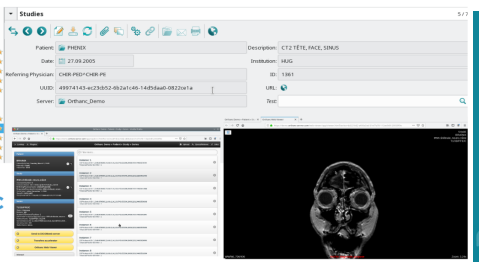
Age

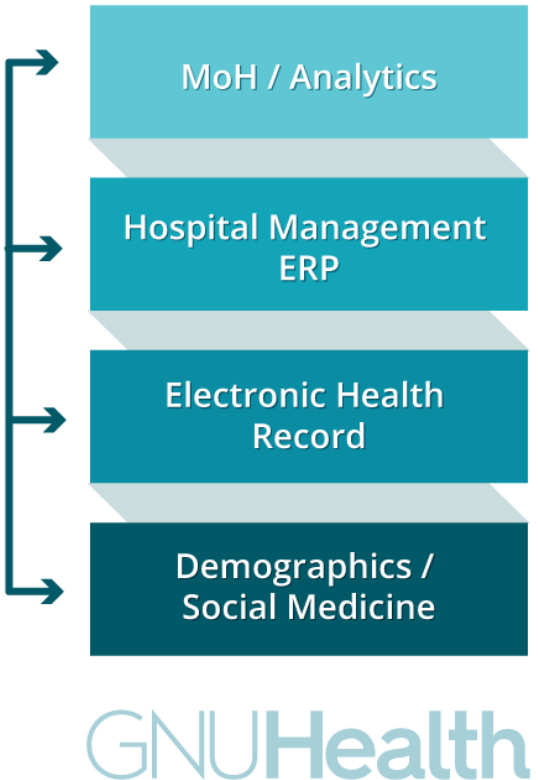


Data collection: The GNU Health ecosystem









- Demographyc information
- Social Medicine
- Lifestyle
- Domiciliary Units / urbanism degree
- Clinical history / variables of interest
- Medical Imaging / Radiology
- Laboratory / biochemistry
- Genetics (phenotypes, natural variants, family history)
- ICD-11
- Data anonimization
- Reporting

GNU Health Information System

Collecting and aggregating data from participating entities: Federated Health Network & Information System

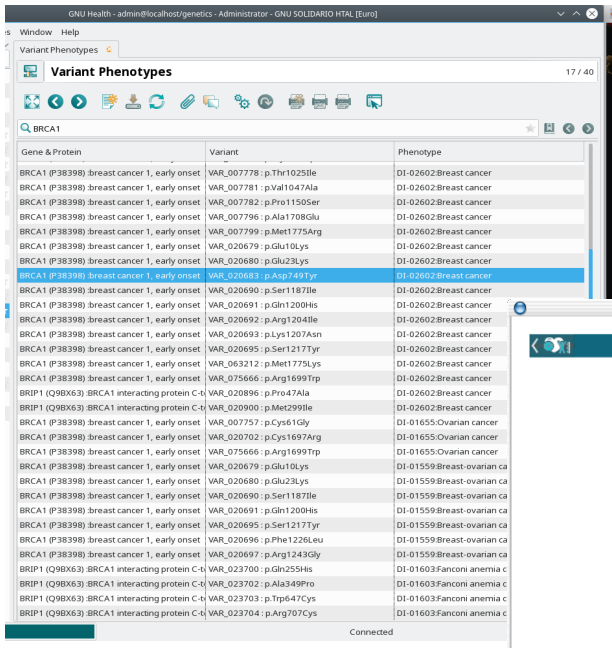
THALAMUS

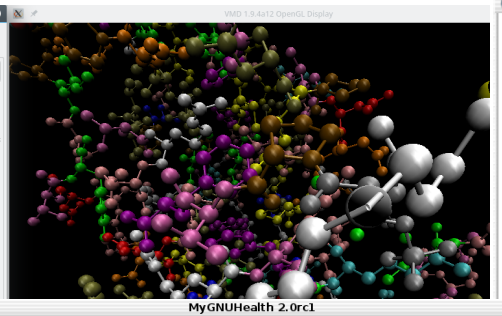
Participating centers ("nodes")

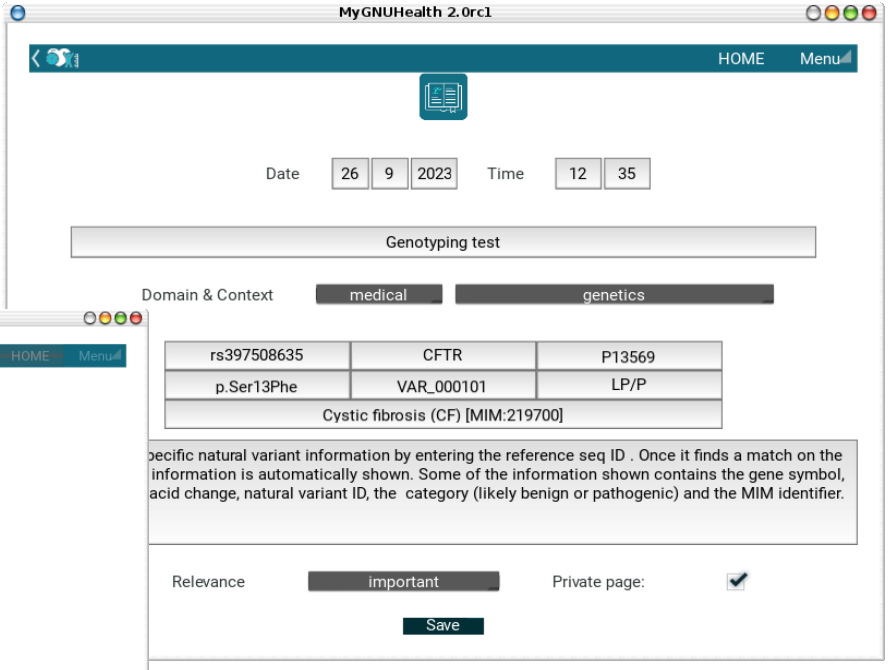
Nodes | Message Server | Information System

Collecting and updating information from MyGNUHealth PHR

Research







Work with the GNU Health installed base

Work with the GNU Health installed base

... and Academic institutions / the GNU Health Alliance

UNER

GNU Health ALLIANCE OF ACADEMIC AND RESEARCH INSTITUTIONS

Leibniz Universität Hannover

Adopted by UNITED NATIONS UNIVERSITY

unitec

KYOTO UNIVERSITY FOUNDED 1897 KYOTO JAPAN

MAC2 bioIDi

... and medical & surgical partners

Collaboration



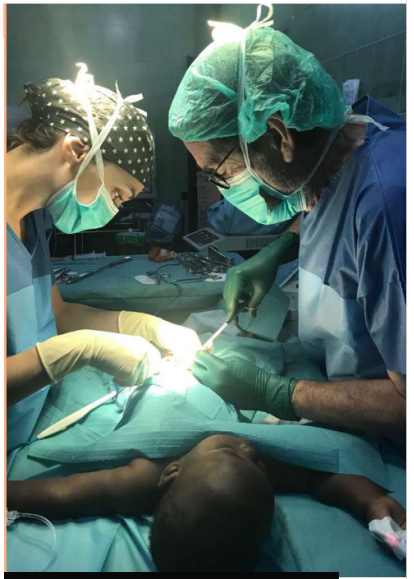

GNU Health

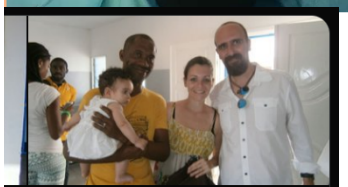
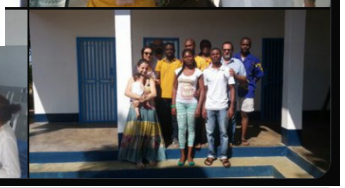
Social Medicine at the heart of Africa






http://health.gnu.org




ONGD CAMINOS CRUZADOS

Cirugía Solidaria

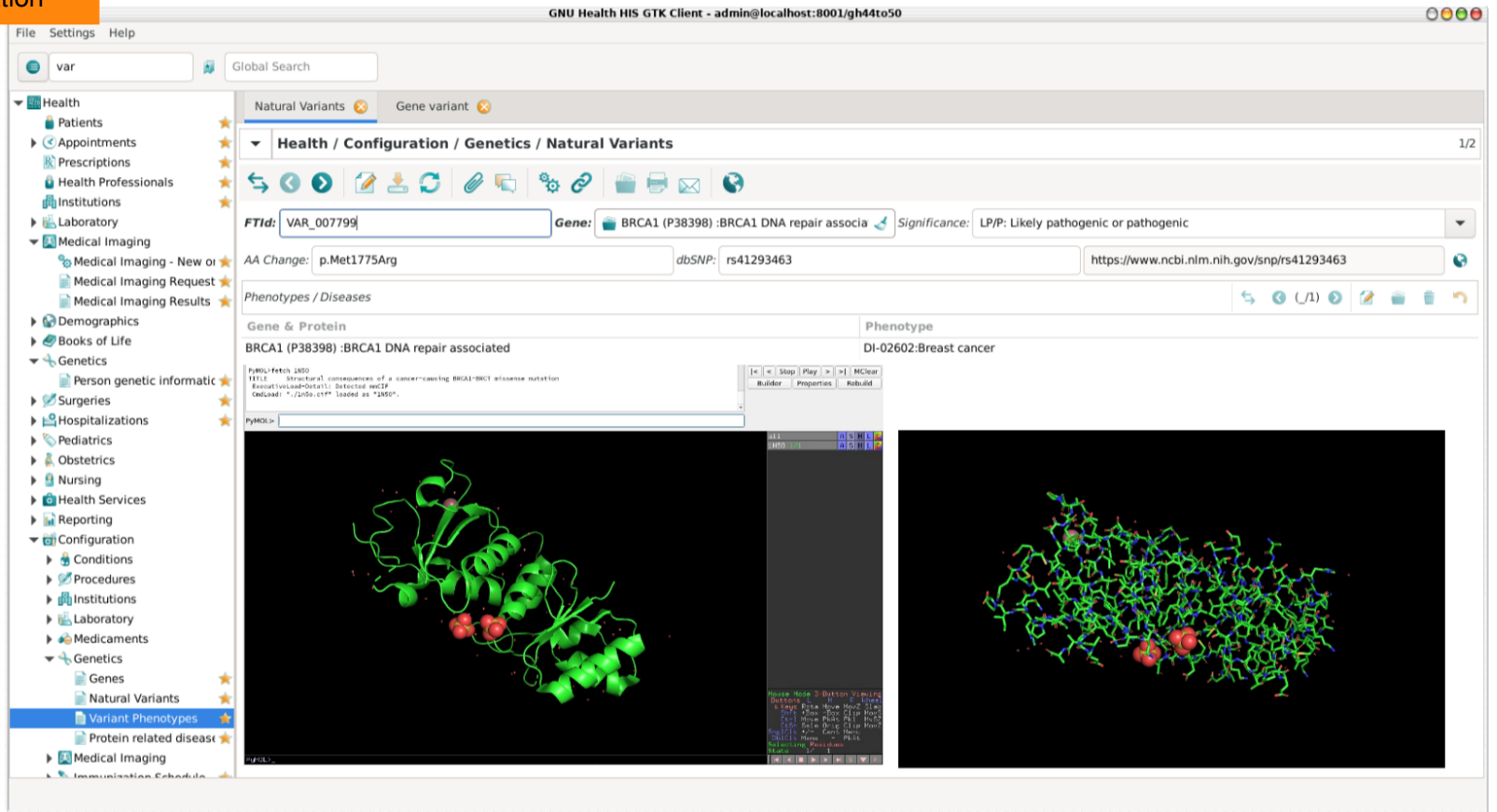
Insolàfrica

ITARA

Fundación Recover Hospitales para Africa

Genomics and Medical Genetics

Collaboration

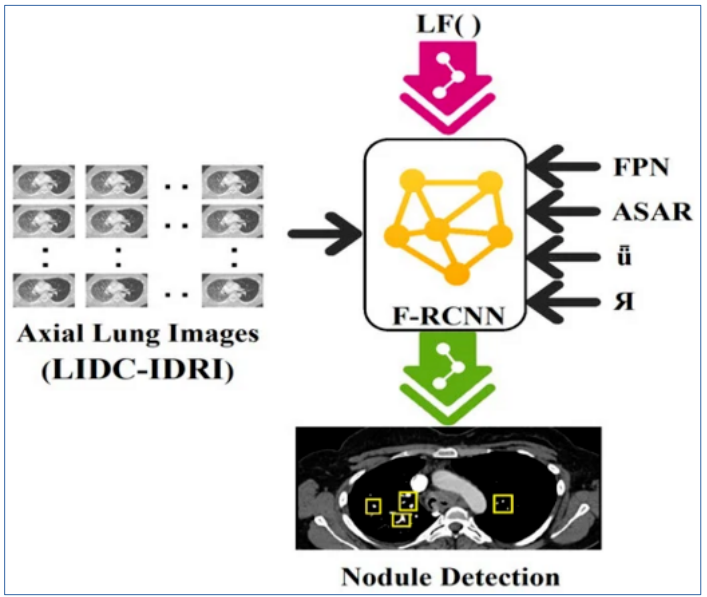


Open Science: Using GNU Health in the context of a BRCA1 gene mutation and the structural representation of its protein BRCA1-M1775R ("PDB source: 1N5O *Structural consequences of a cancer-causing BRCA1-BRCT missense mutation*") with PyMOL.

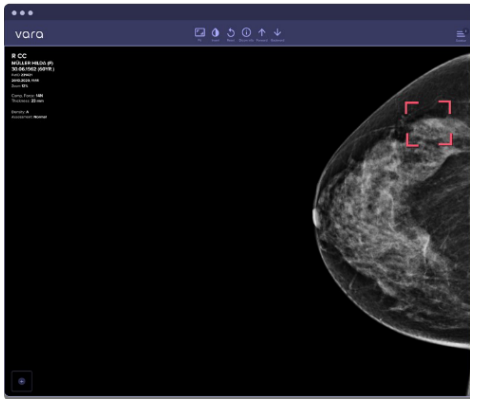
Medical Imaging & Orthanc

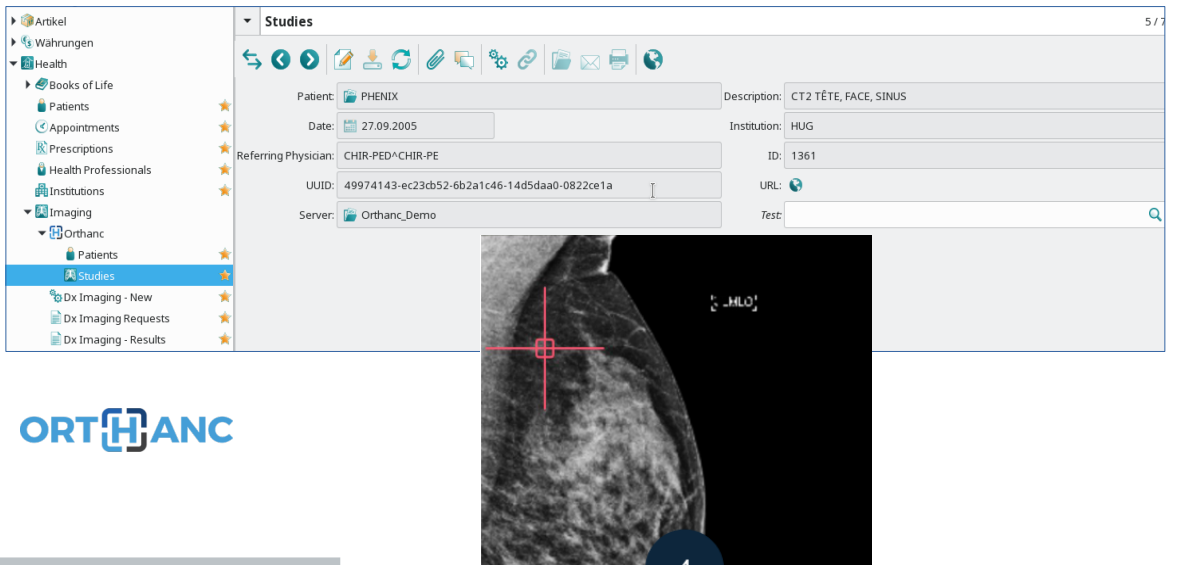
Collaboration

Some examples of use cases of GNU Health and Orthanc for the early detection of breast and lung cancer



GNU Health used in "Early Detection of Lung Nodules Using a Revolutionized Deep Learning Model"

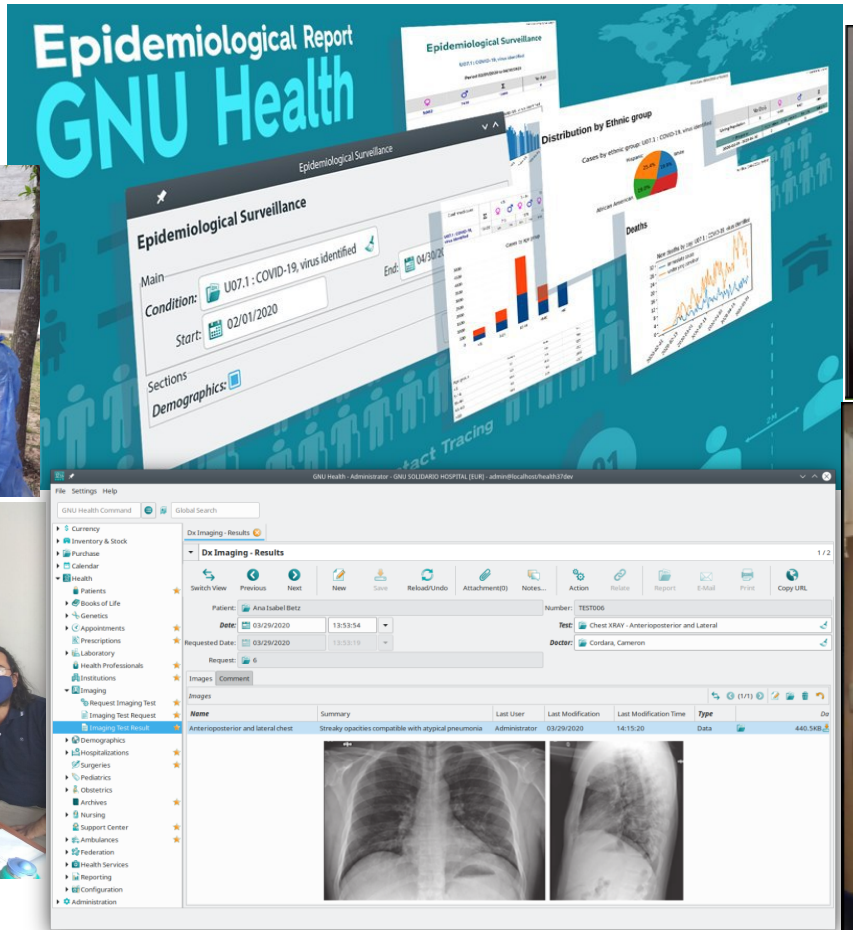


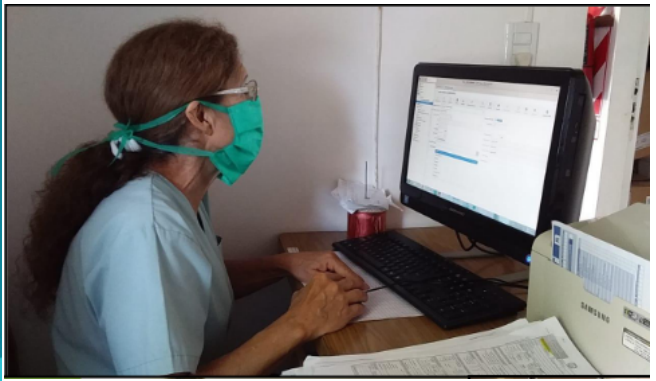


ORTHANC

GNU Health in pandemic context

Collaboration





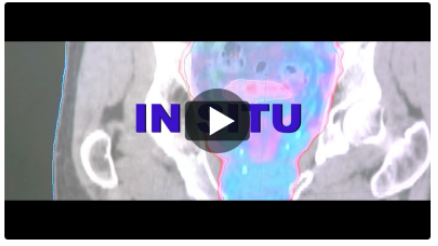
Mental Health and its socioeconomic determinants

Collaboration

Learn from previous research projects related to Social Medicine

Dra. Natalia Luxardo
Univ Buenos Aires
CONICET

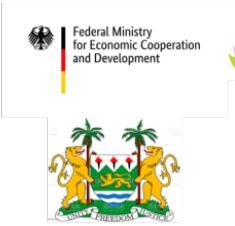
Dr. Fernando Sassetti
Univ Entre Ríos
Cátedra Salud Pública



GNU Health was used to collect and process the demographic, clinical, epidemiological and socio-sanitary information from the participating centers

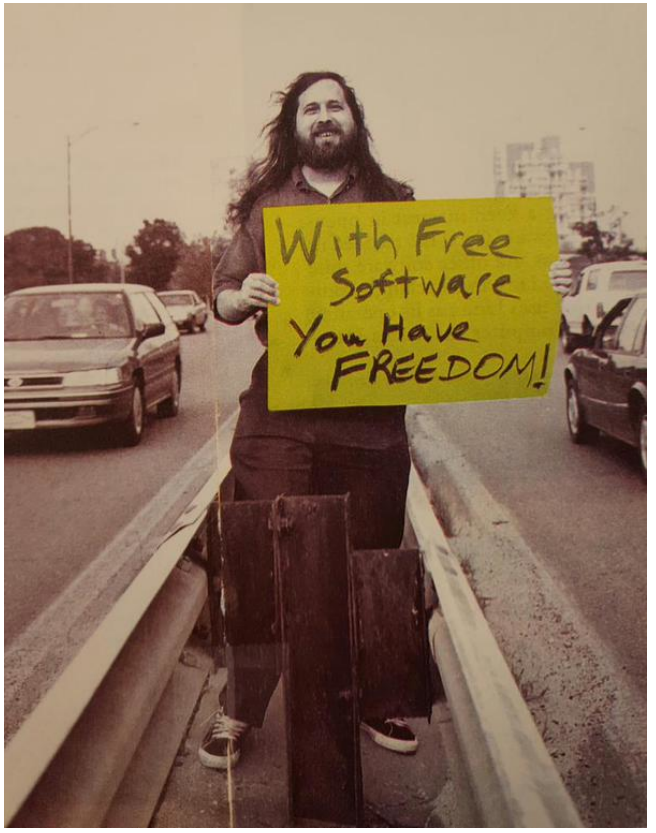
100% Free Software and Open Science

Digital
Public
Goods
Alliance



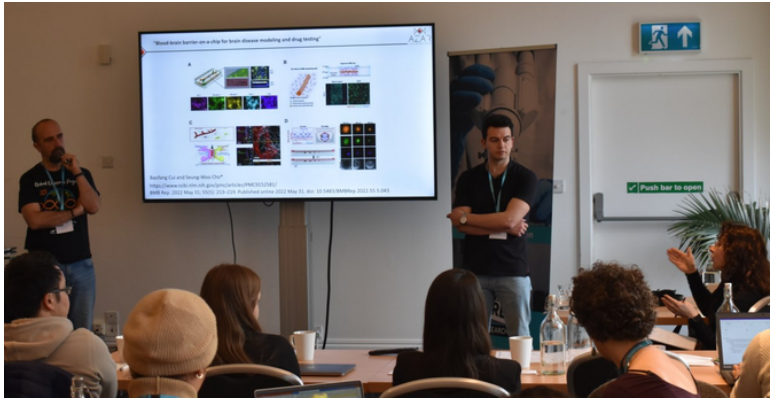
We are Free/Libre Software, not "~~open source~~"

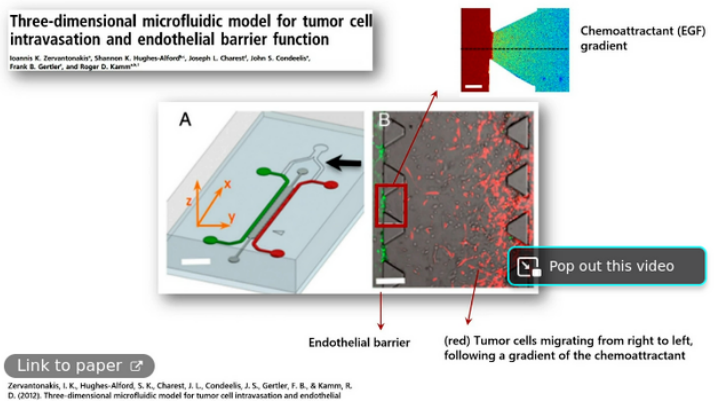
- Free/Libre software is a philosophy and movement (free culture & science)
- It's about collaboration, solidarity, equity and privacy
- Big tech companies have taken over part of the movement, making "open source" their business.
- The term "Free Software" respects RMS (father of the movement) will and the organizations behind the movement.

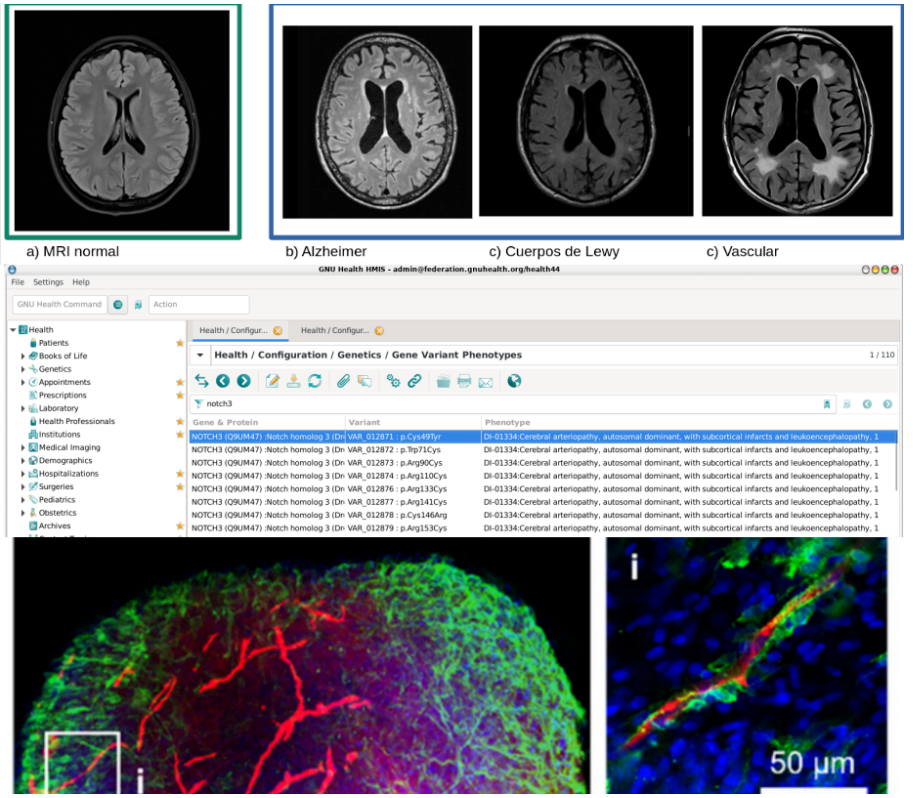


Human-relevant, cruelty free research

Organ-on-a-chip

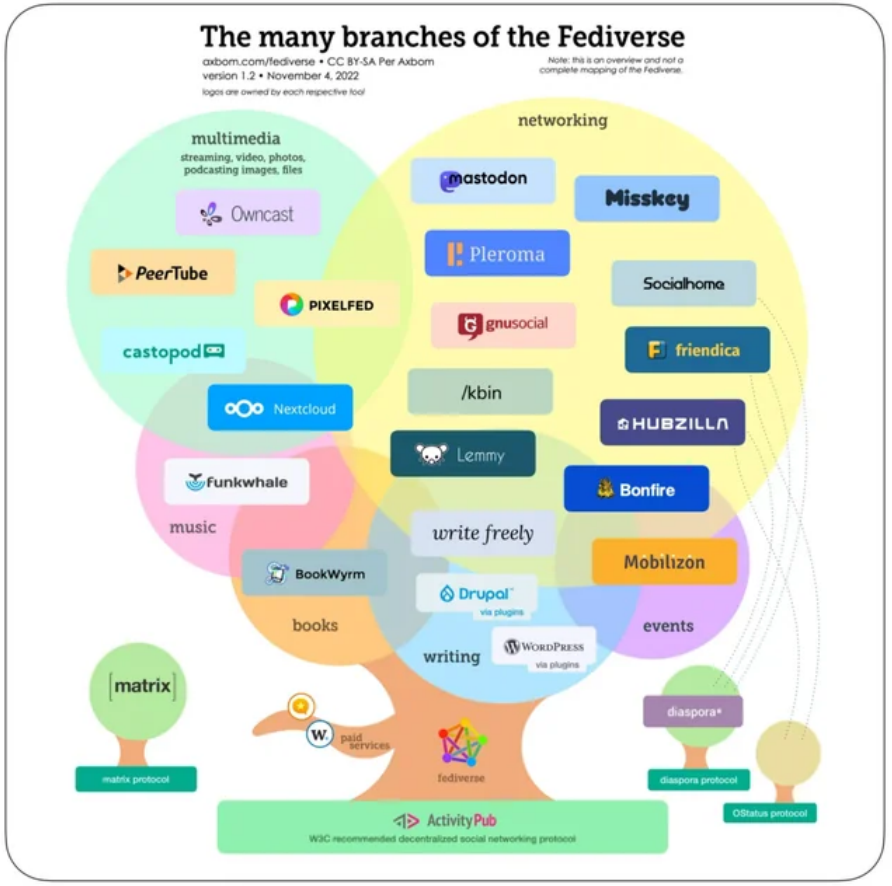






Meet and Join us at the Fediverse

Collaboration



GNU Health
https://mastodon.social/@gnuhealth

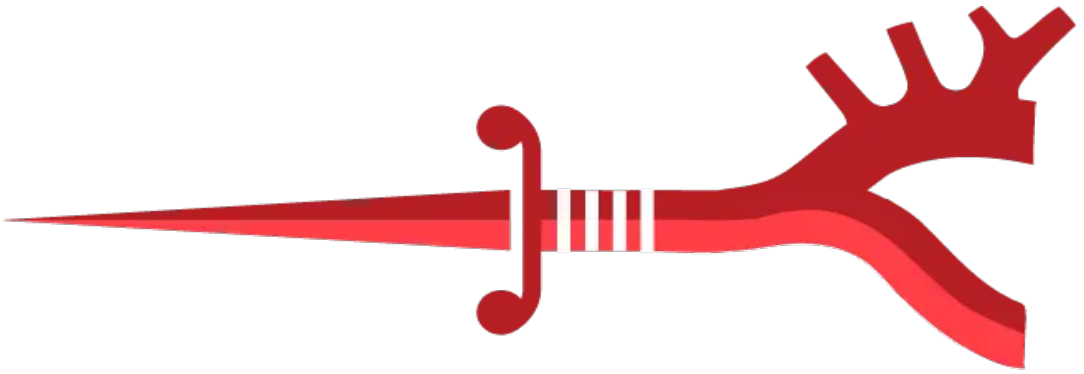
GNU Solidario
https://mastodon.social/@gnusolidario

Respect: *"First, do no harm"*

Respect
Mother nature, animals
(human and non-human)

Primum non nocere

Thank you!



STILETTO

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