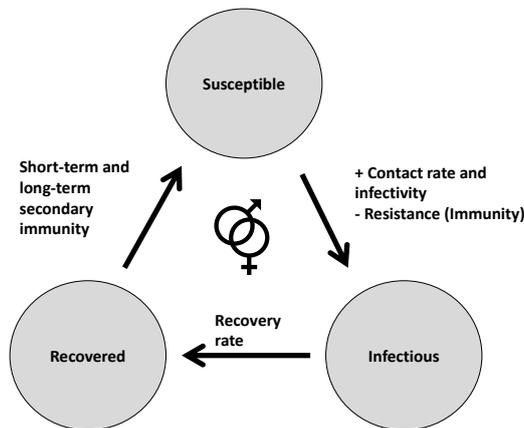


# IEMNews



A schematic representation of a classical Susceptible-Infectious-Recovered (SIR) model that considers disease spread by contact with infected individuals. The level of immunity of individuals in the population should modify the transmission and recovery rates by affecting susceptibility and infection time.

## The effect of sex on our immune system

To work in the field of evolutionary biology means to deal with questions that are dynamic, challenging and often with unexpected solutions. To do biomedical research, on the other hand, implies tackling issues that have direct effects on people's health using very high research standards. But what about combining these two fields? I was fortunate to realize the importance and pleasure of applying evolutionary thinking to medical problems while I was studying medicine at Damascus University and have therefore decided to pursue a career in evolutionary medicine research. This year, I have joined the Institute of Evolutionary Medicine in Zurich as a Ph.D. candidate working on the difference in the immune system between women and men. This difference has been well documented in medical literature but the evolutionary reasons behind it have not been fully understood yet. There seem to be trade-offs between susceptibility to infections and the risk to develop autoimmune diseases which apparently cause differences in the immunocompetence between the two sexes.

There are several possible explanations for the differential regulation of the immune system. Since each sex occupies a different reproductive role, the two sexes use different

strategies to maximize their reproductive fitness. According to one hypothesis, females invest more resources than males in each progeny they produce. Therefore, females use slower but steadier reproductive strategies which require more investment in maintenance and longevity. Males, on the other hand, invest less in longevity and more in reproduction following a "live fast, die young" strategy. These different strategies result in sex-specific optima for investment in both longevity and reproduction rates. We think that this contributes to the different immunocompetence levels between the two sexes. Moreover, the physiological and anatomical differences between females and males imply different costs of certain diseases. Many diseases can be more costly to women than men and vice versa. We predict that each sex invests more in fighting the diseases more costly to it. Testing these hypotheses requires interdisciplinary, theoretical and empirical, approaches.

We want to use mathematical modeling, formulating ideas in mathematical equations rather than words, to make predictions about the effects of the mentioned factors on the immune system. We can then collect empirical data to test these predictions. In-

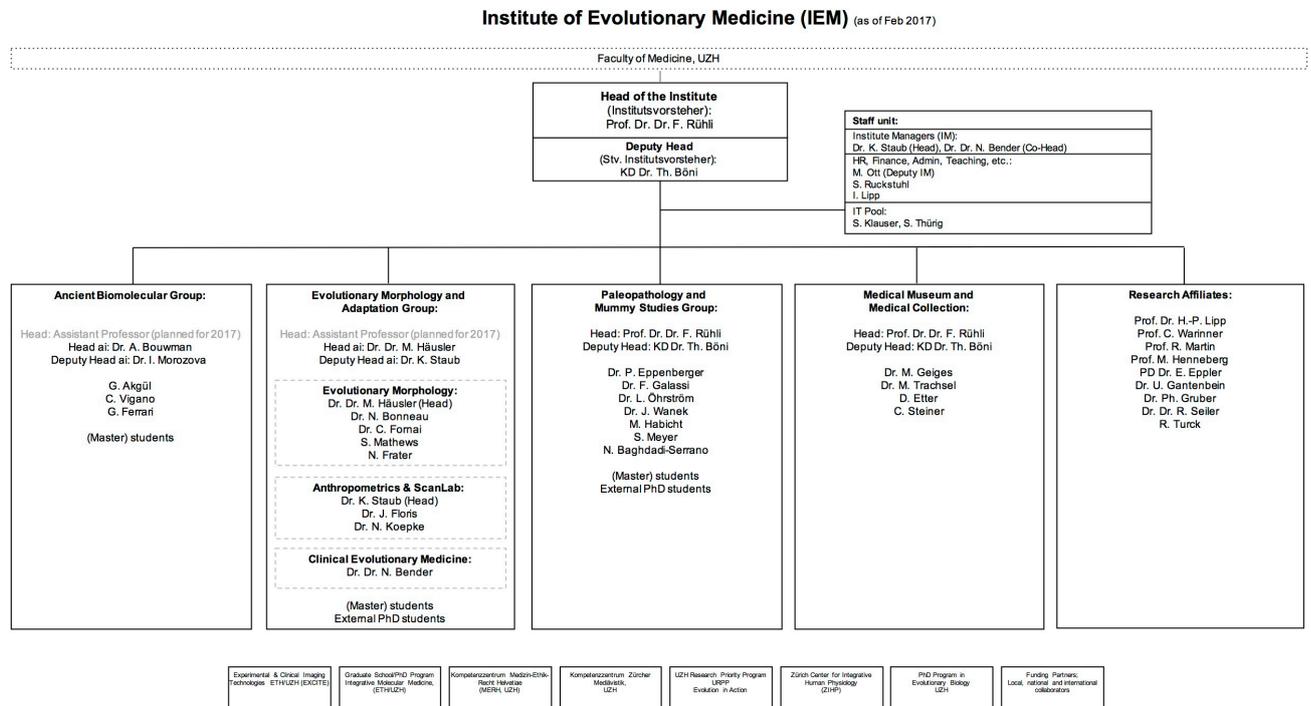
cidence rates, recovery times, viral loads, and other measurements may prove us right or wrong! The two sexes may have different interests in combating certain pathogens depending on their life cycles and impacts; therefore, we can test our predictions by comparing the immune response against these pathogens.

Research in evolutionary medicine has a direct impact on people's health. We hope that our research will shed more light on the difference in immunity between women and men and the evolutionary reasons behind that. We hope that this understanding will help design more effective prevention and treatment protocols that take into account any potential difference in treatment efficacy and side effects. Many current medical practices are tested on small samples that are sexually and ethnically biased. Nonetheless, there is a growing interest now in more personalized approaches that take into consideration the individual needs of the patient. We hope that our research will inform the field of personalized medicine better and help develop it further in the nearby future.

**Lafi Aldakak, MSc.**

**PhD Student, Evolutionary Morphology and Adaptation Group**

# IEM organigram



## Vision and mission statement

We are a leading international and globally connected research, teaching and service institute which is part of the medical faculty at the University of Zurich. We analyse ancient biological material and associated data to better understand modern human health issues and diseases. Due to specialist scientific expertise, excellent infrastructure and state-of-the-art methodologies, we are able to work on various interdisciplinary research questions in the context of the field of Evolutionary Medicine. Our core competencies include:

- In the area of morphology: Clinical Anatomy; Variability and adaptation of body morphology as a function of sex, robustness, time (Microevolution), socio-economic factors (etc.); Macroevolution of joint pathologies.

- In the area of imaging: application of modern imaging techniques (MRI, terahertz) on historical tissues; Radiological diagnosis of pathologies.

- In the area of ancient DNA: Co-evolution of diseases and the human genome (evolution of human pathogens, microbiome analyses etc.); Service for Archaeology/Historical Anthropology (paternity testing, sex determination).

- Maintaining a novel medical museum for the public and a medical history object collection for the scientific community.

- Ethical considerations for research on historical human tissues.

We will increase the recognition of the research field of Evolutionary Medicine and expand academic teaching of the subject within and outside the Faculty of Medicine. This will be of a sustainable value for our stakeholders at the University of Zurich, in the research community of evolutionary medicine and adjacent areas, to the economy and ultimately for society in general.

## Spotlight on our activities



The IEM 3D Full Body Scanner during the Zurich Science Days «Scientifica 2017».

## Words from a new member of the IEM



Enrique Rayo, MSc.  
PhD Student Ancient Biomolecular Group  
Institute of Evolutionary Medicine  
University of Zurich

The field of Palaeomicrobiology - the microbiological study of ancient material, is changing by the day. Thanks to high-throughput sequencing methodologies, the retrieval of DNA from human remains is no longer limited to skeletal samples, and soft tissues have become an important source of ancient biomolecules. Examples of this kind of elements vary from coprolites to mummified tissues – both natural and artificial, medical and museum collections or autopsy material. The power of analysis is such that allows reconstructing not only whole genomes of pathogens, but entire symbiotic bacterial communities or microbiomes.

In fact, the understanding of this inner ecological world is a whole field by itself. All the surfaces of the human body are covered by thousands of microbes, including skin, mouth, the urogenital tract, and viscera. An immense number of microbial cells inhabit the human body, ascending to almost 40 trillion living in complex, dense and balanced communities. They help us in digestion, nutrition, immune system and also neural development. So important is for health, that changes in the host environment that disrupts the microbiome may cause or aggravate diseases like obesity or inflammatory bowel disease. As with many other conditions of today, a look into the past can shed light into the path of better diagnoses and treatments, and the research of an-

cient human microbiota can provide a deeper understanding of the ancestral human microbiome and how it has changed during human evolution.

My PhD project at the IEM is part of the University Research Priority Program “Evolution in Action”, and I will use innovative Next Generation Sequencing (NGS) methods on preserved soft tissues – from Egyptian Canopic Jars and medical collections - to study the evolution and diversity of the human microbiome. The project is also part of the multipronged interdisciplinary Canopic Jar Project, funded by the Swiss National Science Foundation, that focuses in generate data of great importance to the research fields of medicine, human genetics and Egyptology.

I am a biologist by training and I completed my Master degree at the University of Barcelona in Biological Anthropology, specialized in Ancient DNA laboratory work. Last March, I had the opportunity of joining at the IEM as a new PhD student, and I am looking forward to do my contribution in such a multidisciplinary group.

## IEM-publications (selected publications since last IEM News Dec/2016)

Alterauge A, Kellinghaus M, Jackowski C, et al. (2017). The Sommersdorf mummies—An interdisciplinary investigation on human remains from a 17th-19th century aristocratic crypt in southern Germany. *PLoS ONE*, 12(8):e0183588.

Budnik A, Henneberg M (2017). Worldwide increase of obesity is related to the reduced opportunity for natural selection. *PLoS ONE*, 12(1):e0170098.

Charlier P, Galassi F, Bouabdallah F, et al. (2017). A medical training skull in a portrait attributed to Annibale Carracci (ca. 1580-85). *Journal of the Neurological Sciences*, 375:402-403.

Cramer L, Brix A, Matin E, et al. (2017). Computed Tomography-Detected Paleopathologies in Ancient Egyptian Mummies. *Current Problems in Diagnostic Radiology*, Jun 8 (Epub).

Dobson F, Hinman RS, Hall M (2017). Reliability and measurement error of the Osteoarthritis Research Society International recommended performance-based tests of physical function in people with hip and knee osteoarthritis. *Osteoarthritis and Cartilage*, Jun 22 (Epub).

Eckstein M, Vaeth M, Fornai C, et al. (2017). Store-operated Ca<sup>2+</sup> entry controls ameloblast cell function and enamel development. *Journal of Clinical Investigation*, 2(6):e91166.

Eppenberger P, Galassi F, Rühli F (2017). A brief pictorial and historical introduction to guaiacum - from a putative cure for syphilis to an actual screening method for colorectal cancer. *British Journal of Clinical Pharmacology*, 83(9):2118-2119.

Galassi F, Habicht M, Rühli F (2017). Poliomyelitis in Ancient Egypt? *Neurological Sciences*, 38(2):375.

Galassi F, Henneberg M, de Herder W, et al. (2017). Oldest case of gigantism? Assessment of the alleged remains of Sa-Nakht, king of ancient Egypt. *The Lancet Diabetes & Endocrinology*, 5(8):580-581.

Galassi F, Toscano F, Armocida E, et al. (2017). Giovanni Boccaccio's (1313-1375) disease and demise: The final untold tale of liver and heart failure. *HOMO Journal of Comparative Human Biology*, Jun 13 (Epub).

Genoud M, Isler K, Martin R (2017). Comparative analyses of basal rate of metabolism in mammals: data selection does matter. *Biological Reviews of the Cambridge Philosophical Society*, Jul 27 (Epub).

Hirsch AC, Hotz G, Rosendahl W, et al. (2017). CT-Osteoabsorptiometry (CT-OAM) - a new investigation technique in the field of mummy research. *Anthropologischer Anzeiger*, 74(1):1-7.

Lucas T, Henneberg M (2017). Use of units of measurement error in anthropometric comparisons. *Anthropologischer Anzeiger*, Aug 1 (Epub).

Koepke N, Zwahlen M, Wells JC, et al. (2017). Comparison of 3D laser-based photonic scans and manual anthropometric measurements of body size and shape in a validation study of 123 young Swiss men. *PeerJ*, 5:e2980.

Mathews S, Burkhard M, Serrano N, et al. (2017). Glenoid morphology in light of anatomical and reverse total shoulder arthroplasty: a dissection- and 3D-CT-based study in male and female body donors. *BMC Musculoskeletal Disorders*, 18(1):1-15.

Panczak R, Moser A, Held L, et al. (2017). A tall order: small area mapping and modelling of adult height among Swiss male conscripts. *Economics and Human Biology*, 26: 61-69.

Papandreou A, Bopp M, Braun J, et al. (2017). Individual development of excess weight through-out school career in an urban setting: a longitudinal record linkage study. *Swiss Medical Weekly*, in print.

Rohrmann S, Haile SR, Staub K, et al. (2017). Body height and mortality - mortality follow-up of four Swiss surveys. *Preventive Medicine*, 101:67-71.

Seiler R, Galassi F, Rühli F (2017). Fauchard, Boerhaave, and the pathogenesis of periodontitis in the 17th and 18th centuries. *European Journal of Oral Sciences*, 125(3):227-228.

Seiler R, Piombino-Mascoli D, Rühli F (2017). Dental investigation of mummies from the Capuchin Catacombs of Palermo (circa 18th-19th century CE). *HOMO Journal of Comparative Human Biology*, May 31 (Epub).

Tardieu C, Hasegawa K, Haeusler M (2017). How Did the Pelvis and Vertebral Column Become a Functional Unit during the Transition from Occasional to Permanent Bipedalism?. *Anatomical Record*, 300(5):912-931.

Tello E, Martinez JL, Jover-Avellà G, et al. (2017). The Onset of the English Agricultural Revolution: Climate Factors and Soil Nutrients. *Journal of Interdisciplinary History*, XLVII(4):445-474.

Traversari M, Ballestriero R, Galassi F (2017). A likely case of goiter in the Madonna col Bambino dormiente (1465/1470) by Andrea Mantegna (1431-1506). *Journal of Endocrinological Investigation*, 40(2):237-238.

van Schaik K, Eisenberg R, Bekvalac J, et al. (2017). The Radiologist in the Crypt. *Academic Radiology*, 24(10):1305-1311.

Viganó C, Haas C, Rühli F, et al. (2017). 2,000 Year old  $\beta$ -thalassemia case in Sardinia suggests malaria was endemic by the Roman period. *American Journal of Physical Anthropology*, Jul 6 (Epub).

## Upcoming events

- Meeting of the German Society for Anthropology (GfA), Geislingen a. d. Steige, September 18-22, 2017
- Special Seminar Series on Evolutionary Medicine, Max Planck Institute for Evolutionary Biology, Plön, November 16, 2017
- Swiss Public Health Conference, Basel, November 22-23, 2017

## New IEM-members

The IEM is happy to welcome the following members to the institute:

- Enrique Reyó, MSc. (PhD Student Ancient Biomolecular Group)
- Lafi Aldakak, MSc. (PhD Student Evolutionary Morphology and Adaptation Group)
- Linda Vinci (Master-Student ETHZ, Evolutionary Morphology and Adaptation Group)

## Selected media reports

- NZZ am Sonntag, 25 December 2016
- SRF 10vor10, 31 January 2017
- Repubblica, 9 February 2017
- 24 Heures, 24 March 2017
- Der Bund, 24 March 2017
- Tagesanzeiger, 26 March 2017
- Science News, 21 April 2017
- Washington Post, 17 May 2017
- SRF Tagesschau, 17 May 2017
- NY Times, 2 June 2017
- Die Zeit, 12 June 2017
- Phys Org, 27 July 2017
- Science Daily, 27 July 2017
- Salzburger Nachrichten, 28 July 2017
- Berliner Morgenpost, 30 July 2017
- Zürichsee-Zeitung, 1 September 2017

Editorial:

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