# Leibniz Institute for Natural Product Research and Infection Biology - Hans Knöll Institute



# Quantitative image analysis of cell colocalization in murine bone marrow





### 1. Introduction

The bone marrow is home to early and late-stage B cells and long-lived plasma cells. This joint study of experiment and theory investigates the spatial colocalization of different types of cells in the bone marrow by applying an image-based systems biology approach. This approach includes: generating confocal laser scanning microscopy images of histological sections from murine bone marrow, automated and quantitative image analysis and realistic computer simulations of the experimental system for hypothesis testing. In particular, we tested the observed spatial collocalization of cells in the bone marrow against computer simulations based on the hypothesis that cells are uniformly distributed in the bone marrow.



#### 2. Image-based Systems Biology

Workflow diagram of the quantitative image analysis





Setup of random cell position (RCP) model: numerical experiment

First, the stroma (white) from the input image is reconstructed in the model. This is followed by filling the excluded areas (gray) as determined during the image processing. Afterwards, the same number of B cells (blue), eosinophils (red) and plasma cells (green) as observed in the original image, are simulated as circular cells that are randomly placed in available image areas.



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## 4. Conclusion

- The image-based systems biology approach represents a comprehensive strategy for identification of spatial correlations in microscopy images of biological systems.
- The spatial organization of the three cell types in the bone marrow is not random.
- B cells and plasma cells have significantly increased contact numbers with stromal cells and also eosinophils reside in close proximity to the stroma.
- B cells and eosinophils form clusters of cells among themselves having significantly increased numbers of contacts.
- Cellular aggregates exist between colocalizing plasma cells and eosinophils in a loose fashion without direct contacts.

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