**Docket #:** S19-339

Machine Learning Algorithms to Differentiate Among Pulmonary Complications After Hematopoietic Cell Transplant

Stanford researchers have developed machine learning algorithms to characterize and diagnose lung graft-versus-host disease (GVHD) subtypes from volumetric chest computed tomography (CT). Pulmonary complications, including infections chronic graft-vs-host disease, are highly prevalent in patients after hematopoietic cell transplantation, but distinguishing between these conditions clinically is challenging and can lead to delayed diagnosis and treatment. A quantitative method to differentiate among these pulmonary diseases can augment providers' abilities to act more quickly and with greater precision in delivering targeted therapy.
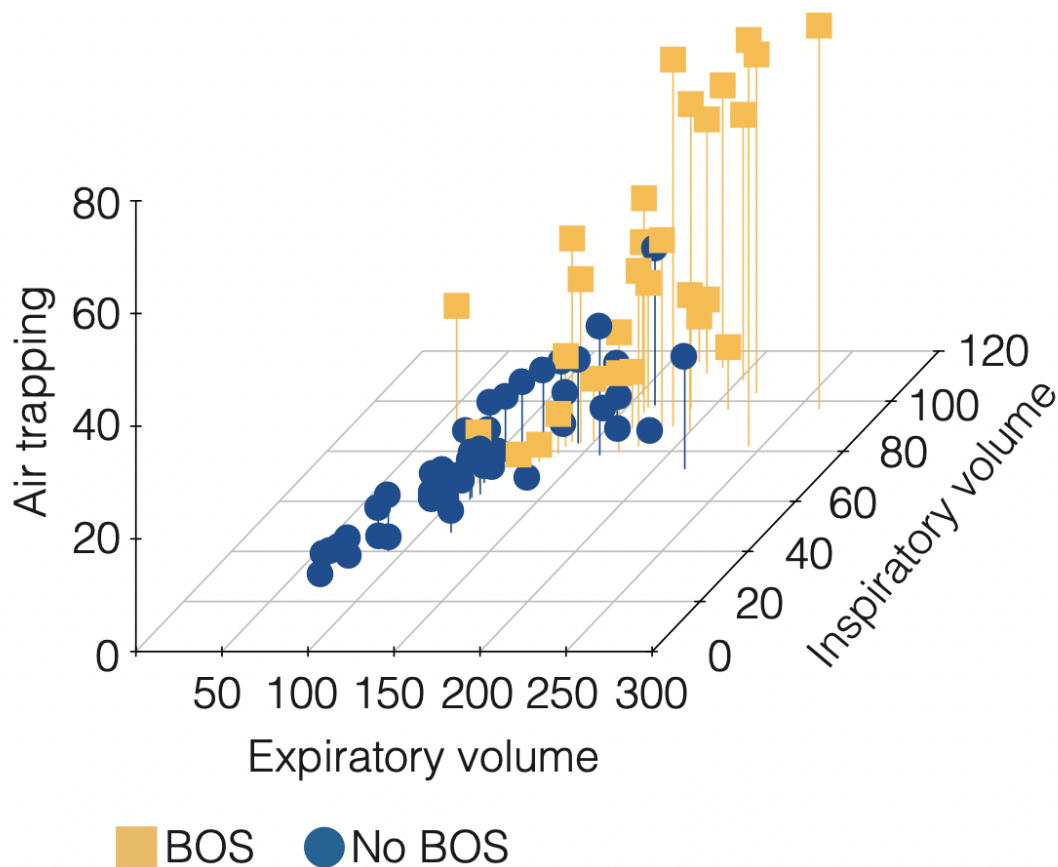
The graphic above and the interactive, three dimensional figure below illustrate the separation of patients with BOS versus patients who do not have BOS, exclusively by the percentage of air trapping in their lungs and their inspiratory and expiratory lung volumes when adjusted for percentage predicted. Additional clinical data are not used and not required to allow for classification of patients into distinct categories that assist in critical management decisions by clinicians.

[Three dimensional results of patients of volumetric CT chest of patients with BOS versus patients without BOS](#)

The interactive, three dimensional figure at the site listed below shows the distinct spread of four clusters of patients who have received stem cell transplant and who split into categories that represent clinically distinct phenotypes of sclerotic skin from GVHD (cluster 1), normal lung (cluster 2), early BOS (cluster 3), moderate and advanced BOS (cluster 4).

[Three dimensional results of clustering analysis of volumetric CT chest](#)

Stage of Development

- The prototype has been built and will be tested on an external medical center (University of Michigan) in collaboration with a leading bone marrow transplant physician in that center and with the developer of the algorithm for parametric response mapping.
- The AI algorithms perform classification of GVHD based on the output of volumetric CT chest.

Applications

- Diagnosis of early lung GVHD and other subtypes of pulmonary complications after HCT.

Advantages

- **Novel**- There are currently limited quantitative or algorithmic approaches to address this clinical challenge in a reproducible, scalable manner.
- **Can distinguish subtypes** which require different therapies, which are emerging and are being actively researched in academic and commercial settings.
- **Earlier diagnosis** enabling more precise treatment and better outcomes in a high risk patient population with a high risk of morbidity and death from these conditions.
- Earlier and more precise diagnosis allows for less costly intervention and reduction of complications that produce tremendous financial strain on medical centers.

Publications

- Sharifi, Husham, Yu Kuang Lai, Henry Guo, Mita Hoppenfeld, Zachary D. Guenther, Laura Johnston, Theresa Brondstetter, Laveena Chhatwani, Mark R. Nicolls, and Joe L. Hsu. "Machine learning algorithms to differentiate among pulmonary complications after hematopoietic cell transplant." *Chest* 158, no. 3 (2020): 1090-1103.
- Sharifi, H.*, Guenther, Z.*, Leung, A.N.C., Johnston, L., Lai, Y.K., Hsu, J.L., Guo, H.H. "Head-to-head Comparison of Qualitative Radiologist Assessment With Automated Quantitative Computed Tomography Analysis for Bronchiolitis

Obliterans Syndrome After Hematopoietic Cell Transplantation." *Journal of Thoracic Imaging* Accepted and in press, 2021 May 12.

Patents

- Published Application: [20220039770](#)

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