Pathology informatics selected abstracts

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Applying ML and statistical modeling to blood product demand and inventory

July 2022—Numerous factors affect blood product inventory in hospitals. Among them are component-processing methods, geographic population characteristics, available medical procedures, diagnostic categories, and global epidemics. One constant factor is that the management of a hospital's product inventory is typically influenced by a blood bank supervisor's or manager's experience with local blood product use, as well as by regional blood product supply chain and distribution practices. Unfortunately, these factors often lead blood bank staff to over--order components, thereby wasting thousands of units and millions of dollars annually. To address this issue, the authors collected retrospective blood product inventory data from four local hospital blood banks, linked the data to demographic and clinical information from recipients of blood products, and processed the information to create a daily aggregated data set reflecting daily blood product demand, inventory level, waste, and number of patients with different clinical characteristics. They used this data set to create a hybrid demand-forecasting algorithm that combined two machine-learning models—seasonal and trend decomposition using LOESS (STL) and Extreme Gradient Boosting (XGBoost)—to handle changing patterns in seasonality and nonlinear dependencies and identify clinical predictors. The authors fed the derivate data, or data-driven demand predictions, from this algorithm into a previously published inventory-optimization method. The final data output was a daily ordering strategy, based on quantity, for red blood cell units. The authors also developed an alternate ordering strategy that pooled semiweekly demand predictions to address the last-mile split-delivery problem for blood suppliers, in which the same location receives multiple deliveries of blood products numerous times over a short period. The authors evaluated the daily and semiweekly ordering strategies, retrospectively, from 2012 to 2018. The study identified 227,944 RBC transfusions for 40,787 patients. Using the hybrid daily-demand forecasting model, the predicted mean daily RBC demand (92.8 units) was not significantly different from the actual mean historical daily RBC demand (92.4 units; $P = 0.163$). However, the model's proposed mean daily RBC unit ordering quantity (92.4 units) was significantly lower than the actual historical mean ordering quantity (103.7 units; $P < 0.001$). Translating this into practice, the novel proposed daily ordering strategy was able to reduce mean RBC unit inventory levels from 1,270 to 782 units (38.4 percent) per day without affecting patient care (based on a shortage of units) and cut costs by 43 percent. The semiweekly ordering strategy produced metrics similar to those of the daily ordering strategy, with the primary benefits being a 62.6 percent reduction in ordering frequency (days per month orders were placed) and more efficient delivery of blood products. The authors concluded that by using a combination of machine learning, statistical modeling, and inventory optimization, blood banks can make data-driven blood product inventory decisions that will lead to less waste, more efficient processes, and significant cost saving for blood suppliers and health care organizations.

Li N, Arnold DM, Down DG, et al. From demand forecasting to inventory ordering decisions for red blood cells through integrating machine learning, statistical modeling, and inventory optimization. *Transfusion*. 2021. doi:10.1111/trf.16739

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Value of BlocDoc in the digital pathology workflow

Pathology laboratories increasingly are centralizing their histology operations and moving routine tissue processing off site. However, a pathologist may want to examine a tissue block remotely for a number of reasons, such as when there is a discrepancy between the number of biopsies procured and the number that appear on the slide, when troubleshooting a tissue floater on a slide to determine if the contaminating piece of tissue is present in the

block, or when there is concern that not all pieces of tissue on a glass slide were scanned and thereby viewable in a whole slide image (WSI). While whole slide imaging allows pathologists to review slides remotely, there was no digital option for examining paraffin blocks remotely until Spot Imaging (Sterling Heights, Mich.) introduced the BlocDoc device. BlocDoc captures the cut surface of paraffin blocks and uploads the images into the laboratory information system (LIS). It also provides a polarized view of the block, allowing users to visualize tissue embedded deeper within the block. The anatomic pathology laboratory at Gravina Hospital, Caltagirone, Sicily, Italy, installed several BlocDoc devices as part of the lab's digital workflow. The instruments were positioned adjacent to the lab's microtome/sectioning stations, and technicians scanned the cassettes before and after sectioning without a significant impact on their time or routine. They used the scanned two-dimensional barcodes on their blocks to link the BlocDoc images to a case page in the hospital's Pathox LIS. This allowed the pathologists to compare the images of the cut surfaces of paraffin blocks with the WSI thumbnail, or macro image, when signing out cases. The laboratory at Gravina Hospital has used BlocDoc to digitize 11,248 cut surfaces of paraffin blocks. The authors found that it took approximately four seconds to scan each block and upload the TIFF image into the LIS. As a result, they were able to readily detect errors, such as inconsistencies between tissue in the block versus on the glass slide or in the WSI. The authors reported that pathologists missed fewer discrepancies with multiple large fragments of tissue—for example, transurethral resection of prostate, nasal polypectomies, and piecemeal uterine myomectomies—using BlocDoc plus WSI than using WSI alone. The pathologists also missed fewer discrepancies with BlocDoc on tiny specimens. BlocDoc failures were rare (less than 0.1 percent of all cases) and primarily due to network connection issues. The authors concluded that BlocDoc introduced a quality control step into the lab's digital workflow that allowed digitized slides to be easily matched and tracked with corresponding paraffin blocks. Moreover, this device offers pathology labs a solution to satisfy validation guidelines that require WSI to be an accurate reproduction of the original glass slides.

Editor's note: CAP TODAY *pathology informatics abstracts contributor Liron Pantanowitz, MD, is a co-inventor of the BlocDoc device.*

L'Imperio V, Gibilisco F, Fraggetta F. What is essential is (no more) invisible to the eyes: The introduction of BlocDoc in the digital pathology workflow. *J Pathol Inform*. 2021;12:32. doi:10.4103/jpi.jpi_35_21

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