Big Data and Machine Learning in Plastic Surgery: A New Frontier in Surgical Innovation

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Summary: Medical decision-making is increasingly based on quantifiable data. From the moment patients come into contact with the health care system, their entire medical history is recorded electronically. Whether a patient is in the operating room or on the hospital ward, technological advancement has facilitated the expedient and reliable measurement of clinically relevant health metrics, all in an effort to guide care and ensure the best possible clinical outcomes. However, as the volume and complexity of biomedical data grow, it becomes challenging to effectively process "big data" using conventional techniques. Physicians and scientists must be prepared to look beyond classic methods of data processing to extract clinically relevant information. The purpose of this article is to introduce the modern plastic surgeon to machine learning and computational interpretation of large data sets. What is machine learning? Machine learning, a subfield of artificial intelligence, can address clinically relevant problems in several domains of plastic surgery, including burn surgery; microsurgery; and craniofacial, peripheral nerve, and aesthetic surgery. This article provides a brief introduction to current research and suggests future projects that will allow plastic surgeons to explore this new frontier of surgical science. (*Plast. Reconstr. Surg.* 137: 890e, 2016.)

In the era of evidence-based medicine, a vast amount of information is collected on patients.[1,2] This information has become increasingly useful in guiding treatment and optimizing clinical outcomes in medical care. The result is an ever-expanding volume of data containing complex patterns that may extend beyond the physician's ability to use traditional data processing techniques such as regression and multivariate analysis for interpretation.[1,2] As innovators, plastic surgeons must then adapt to the growing trend of "big data," and find ways to tap its resources to deliver more efficient health care and improved surgical outcomes.

The answer may lie in "machine learning." A subfield of artificial intelligence, machine learning involves generating algorithms capable of knowledge acquisition through historical examples. Machine learning has already been applied successfully to big data problems in various sectors, with applications including speech recognition and search engine optimization.[3] In medicine, the IBM Watson Health (International Business Machines Corp., Armonk, N.Y.) cognitive computing system has used machine learning approaches to create a decision support system for physicians treating cancer patients, with the intention of improving diagnostic accuracy and reducing costs. Initially trained at Memorial Sloan Kettering Cancer Center using large volumes of patient cases and over 1 million scholarly articles, the project now has 14 participating cancer centers.[4,5] All of these centers contribute to an ever-expanding corpus of information that helps

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