From the Editor

Technology in Performing Arts Healthcare Research

Two articles in this issue of *Medical Problems of Performing Artists* use specific technologies to advance our understanding of particular aspects of performance health. Clemente et al. 1 used three-dimensional accelerometers to measure the motion of the head, jaw, and neck in pianists. Saito et al.2 used electromyography (EMG) in the soleus muscles of dancers along with transcranial magnetic stimulation to show that the corticospinal tract adapts to the demands of dancing. These two examples of the use of technology in performing arts medicine research led me to review past issues of the journal to get a better sense of which technologies have been more or less frequently used and how they have contributed to the state of the art. I am not claiming that this is a formal examination of this topic, and I invite anyone who is interested to do a more rigorous study of the use of technology in performing arts medicine research.

First, we should put this idea in context. Clearly, technology is a major and growing component of both the performing arts themselves—music, dance, theater, circus arts, and the various esthetic sports—and healthcare. From the metallurgy of brass instruments to the construction of a dance floor to the computer systems that store recorded performances, nearly everything that a performing artist does relies on one or more types of technology. Likewise, healthcare professionals rely on technology to create acoustically accurate stethoscopes, magnetic resonance imaging equipment, and electronic health record systems.

Performing arts healthcare professionals use several technologies in order to provide care and services for our patients and clients. While most of these are identical to the equipment and instruments that are used in other healthcare settings, we may use them in a certain way to focus on specific aspects of performance. When these technologies are used in performing arts healthcare research, they are often being applied in an even more specialized role to isolate a key variable in a complex process. Technology, in the form of specialized instrumentation, can allow us to measure a range of variables that are not visible to the naked eye or happen too fast for us to see accurately. It can also permit us to make quantitative observations in situations that we would typically see qualitatively.

The single most commonly used technology in performing arts healthcare research is electromyography (EMG), typically performed as surface EMG (sEMG). Twenty articles in volumes 1 to 28 used EMG, sometimes in conjunction with other technologies. Articles in MPPA examining musical performance with EMG have included pianists, violinists, violists, cellists, and trumpeters, while its use in dance has included patellofemoral pain in ballet and grand battement devant. The use of EMG in music performance research was reviewed in a 2000 article by Kjelland,3 and its use in dance was reviewed in a 2011 article4; the lead author of that article was Donna Krasnow, who has just become MPPA’s Associate Editor for Dance.

Another article used EMG to standardize data obtained from a force plate on which a dancer made certain moves. Use of various types of force plates is one of the next most common technologies that have appeared in MPPA; 13 such articles were found in the first 28 volumes. At first, force plates were rather large objects on which a dancer would stand, but more recently, smaller, flexible force measurement devices have been used inside the shoes of dancers and on oboes, violin chinrests, and trumpets. An equal number of articles have used motion analysis to study both dance (ballet) and music, including piano, bowed strings, and banjo.

Fewer articles used audiometers or dosimeters to measure hearing-related phenomena, imaging technology to study anatomy (of performers and of violins), and MIDI technology to collect data on keyboard performance. The limited number of articles using ultrasound, computerized tomography, and magnetic resonance imaging is a bit surprising, given the widespread use of these technologies in other types of healthcare. Ultrasound in particular is becoming more widely applied in a variety of healthcare settings now that handheld units are more capable and less expensive.5

Over 20 articles describe the use of other technologies to measure physiological aspects of performance. “Wearable technology” has become a reality in the last few years, and it has been used to measure energy expenditure in dancers and cellists.

What have we learned from articles that have used these diverse technologies to study health issues in performing artists? The review article by Krasnow et al.4 found:

- that elite dancers demonstrate different and superior motor strategies than novices or non-dancers; that dancers perform differently when using a barre as opposed to without a barre, both in terms of muscle activation patterns and weight shift strate-
gies; that while skilled dancers tend to be more consistent across multiple trials of a task, considerable variability is seen among participants, even when matched for background, years of training, body type, and other variables; and that dance teachers recommend methods of achieving movement skills that are inconsistent with optimal biomechanical function, as well as inconsistent with strategies employed by elite dancers. 4(p3)

The earlier review by Kjelland3 on EMG and EMG with biofeedback (BF) stated that “not all applications of EMG-BF have been found to be successful; indeed, some of the early reports of the benefits have been debated and disputed since the earliest applications of the technology.” While it’s hard to point to specific advances in performing arts medicine that can be attributed to the use of specific technologies, most would agree that they have provided us with a better understanding of some components of performance.

How can technology help us advance performing arts medicine in the future? I would like to see a more rigorous review of the biomechanics of instrumental performance, similar to the paper by Krasnow et al.4 We would then be in a position to map out research strategies that could identify areas where real progress is possible. On the clinical side, a study using handheld ultrasound (or another imaging technology) in instrumentalists with performance-related musculoskeletal disorders might identify some objective evidence of injury that could then be screened for, monitored, and treated. As technology improves, we may be able to take advantage of wearable technology to improve early detection of overuse injuries. Or a new technology that doesn’t even exist today may come along in the next few years that will revolutionize how we treat performing artists. The next several years could be a very productive time for performing arts medicine.

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