

# RESEARCH

## Cardiac Auscultation Can Be Taught Better: New Auditory Training Program Teaches Students to Distinguish Innocent and Pathological Murmurs with 90% Accuracy

John P. Finley MSc MD FRCPC<sup>1</sup>, Rachel Caissie PhD<sup>2</sup>, Pamela Nicol MPH<sup>3</sup>, Brian Hoyt<sup>4</sup>, Darlene MacAulay<sup>1</sup>

<sup>1</sup>*Department of Pediatrics, Dalhousie University*

<sup>2</sup>*School of Human Communications Disorders, Dalhousie University*

<sup>3</sup>*School of Paediatrics and Child Health, University of Western Australia*

<sup>4</sup>*Department of Physiology and Biophysics, Dalhousie University*

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### Abstract

Auscultation of the heart is one of the basic skills of physical examination. Despite the capabilities of technology in assessing the heart, initial assessment still begins with auscultation to distinguish normal from abnormal and decide whether imaging or other tests are appropriate. This article reviews evidence that current performance and teaching of this skill is of a poor standard. Newer more effective teaching methods are outlined including auditory training, which has been studied at Dalhousie with encouraging results. Students and teachers should take advantage of improved teaching methods and resources to achieve better auscultation performance.

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Recognition of abnormal heart sounds and murmurs is of crucial importance in detecting heart disease in both children and adults. Recognition of normal heart sounds and murmurs on the other hand, is of great importance in ruling out cardiac disease as well as avoiding unnecessary expensive investigations and the anxieties that may often accompany these investigations.

Despite the importance of this skill, there is ample literature in the last two decades documenting extremely poor performance of heart auscultation by physicians and physicians in training.<sup>1-5</sup> Medical schools devote hours of their curriculum to teaching the skill, but the effectiveness of this teaching remains questionable. Even at Dalhousie, where I have taught for years the results of our graduates after practicing for some years, are not impressive.<sup>6</sup> Even pediatric residents have difficulty in recognizing innocent murmurs with current teaching methods as shown in several studies.<sup>3,7,8</sup> It appears that auscultation is both challenging to learn and challenging to teach.

In the relatively sparse literature analysing teaching techniques of auscultation of the heart, a few factors improving learning and performance have been noted. Principal among these is the importance of repetition of hearing the heart sounds, which might seem obvious as repetition is important in the acquisition of most skills.<sup>5</sup> Nonetheless many teaching programs tend to

emphasize a variety of examples rather than repetition of few common examples, both normal and abnormal. With the reduction of available inpatients with abnormal heart sounds in the current era, recorded heart sounds either on CD ROM or online have become popular as a teaching tool.<sup>6-10</sup> The literature documenting the impact of these is very sparse.<sup>7-11</sup> The value of teaching on a cardiology rotation has been questioned by some<sup>7</sup> and promoted by others.<sup>8</sup> The effectiveness of group teaching by an expert using live patients has been suggested<sup>12</sup> but little attention has been given to a comparison between self learning and expert-led classroom teaching.<sup>10</sup>

Further aggravating the lack of analyses of teaching methods, the objectives of teaching heart auscultation frequently are not clear. For example, medical school curricula typically emphasize a variety of pathological murmurs and usually one or two non-pathological murmurs. The objective thus appears to be the recognition of a variety of pathologies rather than the ability to distinguish normal from abnormal as a primary objective. With respect to children and adolescents, the importance of distinguishing between rare pathological murmurs and very common innocent or non-pathological murmurs assumes great importance. Innocent murmurs are present in over 50% of normal young children, while pathological murmurs can be expected in less than 1%. The inability to distinguish normal from abnormal murmurs can

lead to unnecessary investigation as noted above with a consequent burden on the health care system in Canada. In a recent survey of new referrals to the IWK Children's Heart Centre over 67% proved to have innocent murmurs.<sup>13</sup> These findings have been mirrored in other institutions worldwide.<sup>14</sup>

### Auditory Training

Given the importance of auscultation, it is timely to investigate new methods of teaching this skill, which would lead to better learning and better retention of the skill by physicians. At Dalhousie and the University of Western Australia we have trialed a new method of teaching which emphasizes both repetition and comparison of normal and abnormal. It uses the methods of auditory discrimination derived from hearing and speech training experience. These methods are validated for auditory discrimination training in patients with developmental language deficits, are supported by neuro-psychological evidence,<sup>15-18</sup> and are well suited for sound recognition training in subjects with normal hearing.

The objective of our auditory training program<sup>19</sup> was to distinguish between innocent and pathological murmurs. No medical background is needed, as students learn to discriminate between sounds as phenomena.

### Methods

Subjects included 3 groups of student volunteers age 20-31 with normal hearing: 21 students with no medical training, 120 senior Australian medical students and 36 Dalhousie 2nd year medical students. After a pre-test of 20 random murmur recordings from pediatric patients played on computer, all groups performed an approximately one hour auditory training protocol. Murmurs were randomly presented in groups of four with the subject identifying them as normal or abnormal. There is an increase in auditory task difficulty as the student progresses, with the requirement of 6 consecutive correct answers before advancing, analogous to video games. A post-test of 20 random recordings occurred immediately after training and again 2 months later. Control groups of 60 Australian medical students and 17 Dalhousie students had no intervention between pretest and 2 month followup.

### Results

Our results showed that non-medical students improved their mean scores from 72.9 (55 - 95%) to 90.4% (70 - 100%) ( $p = 0.001$ ). Australian medical

students improved from 76.0 (43 - 100%) to 92% (70 - 100%) ( $p < 0.002$ ). Dalhousie students improved from 79.7 (45 - 100%) to 92.1% (70 - 100%) ( $p = 0.005$ ). These improvements declined after 2 months to 80.1% ( $p < 0.002$ ) for nonmedical students, for Australian students to 82% (50 - 100%) and for Dalhousie students, to 84.2% (65 - 100%,  $p = 0.015$ ) resulting in non significant increases over the pre-test scores. Controls had no change over 2 months. Students were enthusiastic about the program.

### Conclusion

This new auditory training program rapidly teaches students to distinguish innocent and pathological murmurs with 90% accuracy, as assessed soon after the training. Murmur recognition declines in the absence of practice, as is the case with other skills. Reinforcement sessions will likely be important and have the potential to restore skills with a brief intervention. This is being investigated currently at Dalhousie.

We are optimistic that auditory training offers a new and more effective approach to teaching murmur recognition, emphasizing repeated normal-abnormal comparisons. As an online resource it is well suited for independent study, mastery learning and continuing education. Medical education is not necessary for success with the program as seen by the success of the non-medical students. The program may be very useful for nurses and other health professionals. Curricular changes to emphasize distinction of normal versus abnormal using training programs should improve auscultation proficiency. Credentialing bodies such as the American Board of Internal Medicine are already testing auscultation proficiency and it is crucial for medical schools to improve their teaching in this area.

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