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Stethoscope: A Still-Relevant Tool and Medical Companion

To the Editor:

We read with interest the editorial by Frishman[1] entitled "Is the Stethoscope Becoming an Outdated Diagnostic Tool?" published in ***The American Journal of Medicine***. The stethoscope and the semantics of auscultatory findings were invented more than 200 years ago by the French physician R.T. Laennec (*Traité de l'Auscultation Médiate*, Paris, 1819); over the years, very few changes have been made to either the stethoscope itself or the way in which it is used. More recently, we have seen advances in the techniques used to process auscultatory signals, as well as in the analysis and clarification of the resulting sounds.[2] The characterization of sounds through recording, analysis, and auscultatory signal-processing systems provides better sensitivity and specificity in several studies.[3] The availability of novel representations of the sounds, with phono- and spectrograms (**Figure**), not only opens interesting perspectives in the context of diagnostic aids, but also in education and pedagogy.[3] The recent developments of the new intelligent communicating system also offer new perspectives in the field of e-teaching.[3]

A study conducted by our group with a population of medical students allowed us to quantify better diagnostic "performance" with new auscultatory signal-visualization tools in a setting of heart and lung disease assessment.[4] We asked a cohort of medical graduate students (n = 30) to listen to 10 sounds in order to diagnose heart and lung pathology. Medical students (second cycle of the medical studies) first heard 10 sounds; they were then asked to check the appropriate box corresponding to the diagnosis relative to the sound they had just heard, as with an acoustic stethoscope (Day 0). The same exercise was conducted by adding the visual representation of the sound with phonopneumogram or phonocardiogram and spectrograms (Day 28). At Day 0, the correct response rate was 40% to 51%. In the second instance at Day

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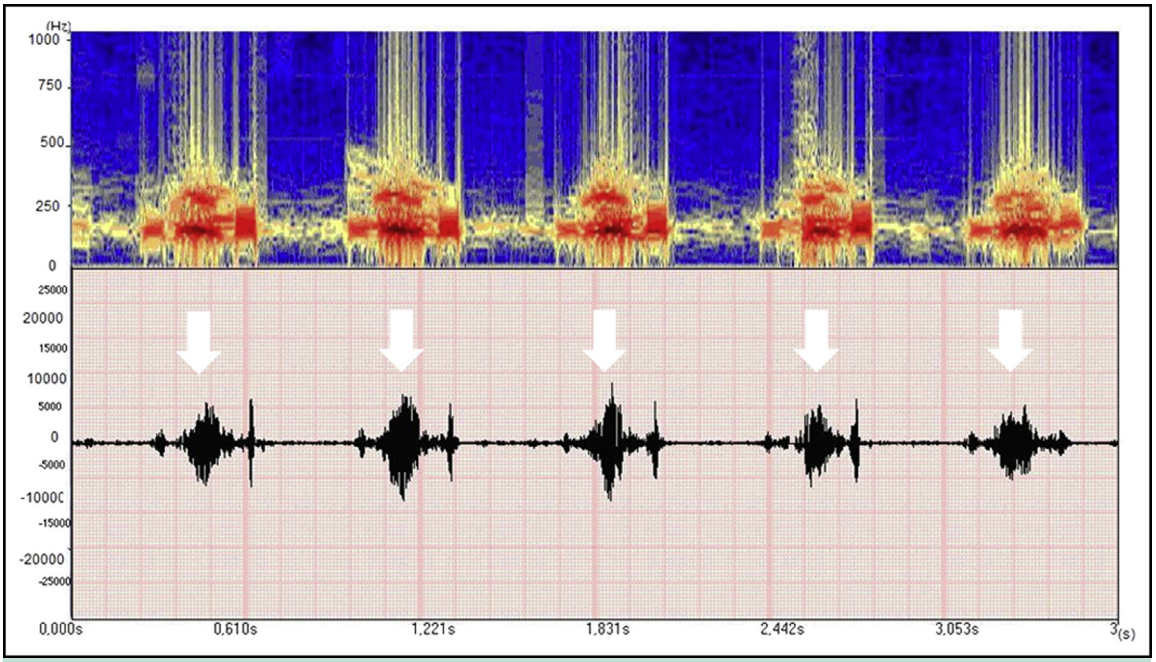

Figure Representation of a recording of a lung auscultation in a normal subject in the form of a phonopneumogram (top panel) and a spectrogram (lower panel) (data collected in the ASAP [Analyse des Sons Auscultatoires Pulmonaires, grant from the ANR Technologie 2006, France]; PRI [Perspectives et apports du développement d'un stéthoscope communiquant à l'ère de la télémédecine, grant from the University Hospital of Strasbourg, France] projects).

Table 1 Global Results in Term of Good Diagnosis With the Use of New Tools as Phono- and Spectrogram for Visualizing Sounds in 30 Medical Students

	Day 0	Day 28 Without Tools	Day 28 With Tools	Comparison Between Day 0 and Day 28 With Tools
"Good diagnosis"	45% (136)	64% (191)	80% (239)	$P < .01$
"Good diagnosis" in respiratory auscultation	51% (76)	61% (92)	70% (105)	$P = .058$
"Good diagnosis" in cardiac auscultation	40% (60)	66% (99)	89% (134)	$P < .009$

28, the rate of correct diagnosis reached 70% to 89%. Tables 1 and 2 present the details of these data. Analysis of these Tables shows that the improved performance (rate of correct diagnosis) is particularly significant for cardiac pathology. Thus, in our experience, addition of visual representation of sounds has significant implications in terms of medical education, and also in terms of decision-making, potential patient safety, and cost control.

Conventional auscultation is subjective and not easily shared. Modern medical technology allows us to optimize auscultatory findings, and hence achieve a correct diagnosis by physically characterizing sounds through recordings, visualization, and automated analysis systems.[2] The development and availability of novel tools based on innovations in science and communications technology provide the clinician (as well as the students), with an invaluable aid in order to achieve an objective diagnosis, in addition to offering increased sensitivity and reproducibility of auscultatory findings. Such advances have led not only to the development and use of new intelligent communicating stethoscope systems, but they also have contributed significantly to the revival of telemedicine, particularly as a diagnostic and teaching aid; e-teaching, and pedagogy. Thus, in our opinion, the stethoscope is not becoming an outdated diagnostic tool.

Table 2 Specific Results in Term of Lung or Cardiac Sounds Analysis With the Use of New Tools as Phono- and Spectrogram for Visualizing Sounds in 30 Medical Students

	All Students (n = 30)	
	Without Tools	With Tools
% of "Good" diagnosis	64% (191)	80% (239)
% of "Good" diagnosis in respiratory auscultation:	61% (92)	70% (105)
Normal respiratory auscultation	57% (17)	63% (19)
Crackles (chronic bronchitis)	57% (17)	60% (18)
Crackles (interstitial pneumonia)	53% (16)	70% (21)
Wheeze sibilants (acute crisis of asthma)	70% (21)	83% (25)
Stridor (lung carcinoma)	70% (21)	73% (22)
% of "Good" diagnosis in cardiac auscultation:	66% (99)	89% (134)
Normal cardiac auscultation	73% (22)	93% (28)
Aortic stenosis	60% (18)	100% (30)
Aortic regurgitation (minimal murmur)	30% (30)	70% (21)
Mitral stenosis	40% (12)	87% (26)
Arrhythmia (auricular fibrillation)	57% (17)	97% (29)

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