Letters to the Editor

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Stress Testing in the Medical Evaluation of Hazmat Workers

To the Editor: I read with interest the article by Raymond et al entitled "Stress Testing in the Medical Evaluation of Hazardous Materials Duty: Results and Consequences in Three Groups of Candidates" that appeared in the May 2005 issue of the *Journal* because of the similarity to our experience at American Airlines.

At the American Airlines Maintenance Bases in Kansas City and Fort Worth, several Facilities Maintenance employees are trained as members of Hazmat teams. Their duties are varied but include cleaning up small spills of jet fuel, sulfuric and chromic acids, alkali and cyanide plating solutions. The usual duration of exposure is less than 1 hour, and level B or C protective equipment usually is worn. The Medical Department evaluates these employees with the following protocol initially, annually, and at termination of their assignment to the Hazmat team:

The Hazmat team employees fill out the OSHA Respirator Questionnaire and general questionnaires about their health and previous Hazmat exposures. They receive a focused medical examination, PFTs, blood testing (including CBC, LFTs, cholesterol, and CRP). The Medical Director reviews the results of the questionnaires and examination and calculates a modified Framingham risk score. Employees who are otherwise candidates for unrestricted Hazmat duties and whose Framingham risk score are greater than 3% over the course of 10 years are candidates for a Bruce protocol maximal treadmill. These criteria are similar to those for exercise testing suggested by the National Fire Protection Association for firefighters, ie, 40-year-old men with no cardiac risk factors.[1] Those participants who achieve more than 10 METS on the treadmill meet our requirements for full Hazmat duty, again similar to the NFPA criteria.[2] We do not use the additional exercise testing protocols discussed in the article.

Recently, we have also used electron beam tomography for repeat testing of those who previously passed the treadmill test rather than repeating the treadmill. We have identified three employees who did well on the treadmill test (ie, 12 to 13.5 METS), but poorly on the EBT, with calcium scores of 150 to 965. For the dozen employees who underwent both EBT and exercise testing, their calcium scores, even with square root or logarithmic transformations, were not significantly correlated with their treadmill performance, CRP, age or high-density lipoprotein cholesterol. The cost of the EBT test was similar to the simple treadmill test. Employees with high calcium scores, those who did not make the 10 MET level, or those who had other problems were restricted in their Hazmat duties. So far, we have had no cardiac or other medical problems in the Hazmat employees, although their Hazmat duties are very limited.

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Reply

To the Editor: We appreciate Dr. Green's comments and his sharing of the protocol used at American Airlines for evaluating employees performing Hazmat duties. We agree with him that there is certainly a place for some of the more advanced and refined risk-assessment modalities, such as the measures of exercise performance we discussed in our article and/or coronary artery calcium scoring by tomography as mentioned in Dr Green's letter and indeed endorsed by various experts.[1–3] Both exercise and coronary calcium imaging modalities have been validated to enhance accuracy of risk for cardiovascular events and total mortality,[4,5] but not specifically in a population with occupational exposures similar to Hazmat employees. The *raison d'etre* for including stress testing in their evaluation rests on the likelihood that these workers will incur heat stress in their work,[6] according to initial federal guidelines on this matter.[7,8] However, the content of examinations of such employees is discretionary, ie, left up to the examiner. We take little issue with Dr Green's use of coronary artery calcium scoring, because his protocol includes initial stress testing to demonstrate the accomplishment of 10 METS, at least for those with a 10-year Framingham Risk Score >3%. Whether this criterion is the correct one to apply to Hazmat workers subjected to heat stress and exertion is unknown. Nonetheless, the principles used in deciding whom to

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test to obtain optimal performance of the advanced testing modality (derived from Bayes' Theorem) still apply, requiring a simple pretest risk assessment to exclude those at lowest and highest risk, just as we, Dr Green, and others routinely perform. Exactly where to draw the line in pretest risk to determine the need for (or obviate) further testing is open to debate and cannot be resolved until more prospective outcome data are collected in similar populations with similar job duties. Some employers are already using protocols like the ones discussed herein, so perhaps it is time to form a national registry to enable systematic evaluation of the performance and cost-effectiveness of these risk assessment modalities in the Hazmat workforce.

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Hexavalent chromium study's conclusions unjustified

To the Editor: Luippold et al[1] assert that their study of hexavalent chromium, a known lung carcinogen, demonstrates an "absence of an elevated lung cancer risk" in workplaces in which hexavalent chromium exposures had been reduced by changes in production processes. Their data do not support this conclusion for the following three reasons.

First, the impact of the well known selection bias known as the "healthy worker effect" on the results of lifetable analyses is readily apparent in this study. The magnitude of this bias can be assessed by the proximity of the standardized mortality ratio (SMR) for "all cause" mortality to 1.00. In the Luippold study, the SMR for all causes combined is 0.59 (95% confidence interval = 0.39–0.85), as it is for deaths from heart disease, the largest subcategory. This powerful bias would mask anything but a very large increase in lung cancer risk.

Second, the length of follow-up in this study is too short to permit meaningful conclusions. Not a single worker in Plant 2 had been followed for more than 18 years (the average length of follow-up was 10 years), and 40% of the Plant 1 population had been followed for fewer than 10 years. Because, as the authors themselves state, "the average latency for lung cancer may be longer than 20 years," this study would be extremely unlikely to detect a real increased risk of lung cancer.

Finally, this study is very small, with a total of 27 observed deaths from all causes. Given that the expected number of lung cancer deaths is a paltry 3.75, the chromium exposure would have to more than double the risk of lung cancer, and nine lung cancer deaths would have had to have been observed before the SMR would have reached a level of statistical significance based on the Poisson distribution (SMR 2.4; $P < 0.05$). But even in the Gibb study, the most robust study of hexavalent chromium carcinogenicity, the SMR in the highest exposure group, in which exposures were approximately 15 times greater than the present study, was only 2.24 (95% confidence interval: 1.60–3.03).[2] Because the Luippold study could not have detected an increase in lung cancer even at the highest exposure level in the Gibb study, it is obviously statistically underpowered to detect any increase in cancer at lower exposure levels.

In summary, the conclusions promoted by the authors of this study are not supported by their data. The Occupational Safety and Health Administration currently is promulgating a new hexavalent chromium exposure standard.[3] Several industry groups[4] cited the Luippold study in their comments opposing the OSHA proposal, although it provides essentially no useful information in understanding the lung cancer risk associated with hexavalent chromium exposure.

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Reply

To the Editor: Dweck et al question our recent paper, based on an inaccurate representation of our conclusion, quoting a fragment taken from the abstract. The entire conclusion from the abstract, as published, is as follows: "The absence of an elevated lung cancer risk may be a favorable reflection of the post-change environment. However, longer follow-up allowing an appropriate latency for the entire cohort will be needed to confirm this conclusion." Not only the language of the abstract, but that of the entire paper is appropriately tempered and unlikely to mislead readers.

Dweck et al. criticize our study by pointing to methodological issues of low statistical power and short follow-up, both of which they acknowledge we had already discussed in our report. Although we agree that their remaining point –the "healthy worker effort" –would impact all-cause mortality and particularly heart disease mortality, we would remind the reader that it also is well known that this bias has little or no impact on cancer mortality.

Dweck et al further criticize the paper on nonscientific issues, including industry funding, the timing of publication, and the questionable "purpose" of publishing what they consider an uninformative report. We commend the industry for sponsoring research of their own employees and contend that publishing results—positive or negative—in the peer-reviewed scientific literature should not be discouraged. We have provided readers with information that can be evaluated at face value or combined with other similar results. Indeed, recently OSHA sought information about the availability of "updated analyses" on earlier-reported U.S. cohorts.[1] Our paper, which includes the plant studied by Pastides[2] and one other, provides that update. Moreover, as mentioned in our paper, the results represent only these two U.S. plants from what was originally intended to be a combined study of all employees of four low-lime or no-lime chromate chemical production facilities in the United States and Germany. The reason we separated the U.S. and German plants was that for the U.S. plants, exposure data consisted exclusively of air-monitoring results, whereas for the German plants, the most extensive exposure data were biomonitoring (urine and blood) measures, and air-monitoring results were fewer and limited to a few years. We regret that the results from the German plants have not been published yet. Ironically, the German paper, based on a larger cohort, followed longer and with higher exposure levels, was submitted (to a different journal) around the same time as the U.S. paper but was held up in review for several months and, only after the OSHA hearings ended, was rejected. We have since revised that report and submitted it again for peer review and publication.

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On an Ethic of Occupational and Environmental Medicine: Response to Doctors Guidotti, Lippin, Key, and Anonymous

To the Editor: Few papers of this writer had as long a gestation as "Occupational medicine and its moral discontents."[1] Fewer have been awarded as much attention, in this case—*inter alia*—by a distinguished professor,[2] a leading practitioner,[3] the president of the college of the profession,[4] and a valued philosopher of medicine.[5]

The philosopher reacted negatively, charging that my paper belittled the ethics of personal obligation—the primary subject of professional codes of ethics—and focused too narrowly on the need for structural change in the practice of occupational medicine alone, neglecting changes that must occur simultaneously in the allied health professions,[6] the health care system, and associated infrastructure. The plea is "guilty on both charges."

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There does appear to be an unpredetermined fraction of individual "free will," the expenditure of which we are individually accountable. There is, however, little agreement, in the course of every day, on how to integrate the factors of the presumed moral calculus (not least because there may be no such computation, only a moral sense in reason's process).[7]

Thus, the most common practices of the health professions assume "free-willed" moral agents, as in that procedural icon of medical ethics, the solicitation of "voluntary informed consent." The patient's or research subject's signature is taken as valid evidence with near-universal acceptance, despite knowledge of the binding and blinding circumstances of a social atom that in his or her natural state does not exist, let alone think, alone: a perfect example of *ignorantia affectata,* the useful lie, perhaps the most common moral fallacy found in the biomedical sciences.

Fortunately, as Guidotti makes clear, much of the assumed factor integration in the moral calculus is done for us, collectively by others, ie, by the choice of society itself, using, as Lippin describes, rules dictated by a selection of political economy.

Collectively or individually, choice is present; however, the claim should be made, consciously or subconsciously, these decisions have method and direction, both of which are polarized by the pessimism or optimism of the decision-maker. In responding to Dr Key, who spoke of "building bridges" between labor and management, I noted that those bridges, as illustrated by the career of one of his predecessors, the late Dr Norbert Roberts, are built by rejecting the pessimism of even great philosophers.

Isaiah Berlin, an historian and philosopher of immense stature, uses radical surgery on the Romantic reaction to Kant, by Fichte, Herder, Goethe, the Schlegels, Schelling and Hegel, and visible in Darwin's progressive dynamic of species change. At bottom, the Romantics and Darwin reacted to Kant's pessimistic *weltanschauung*: "From the crooked timber of humankind no straight thing can be made."[8] Berlin responded to the rationalizations of totalitarians in our time, that used, arguably misused, ideas of the Romantic period that unify conceptual architecture. Rationalizations of human aggression, however, are opportunistic and necessarily tied only to Kafkan vagaries, certainly not to the sometimes bizarre but always creative *naturphilosphie* of the reaction, where we find optimism in the metaphor itself: *timber grows crooked when the twig is twisted!*

The Romanticists rediscovered—and acknowledged—the *conatus* of *The Lens Grinder,* the ultimate optimist who was both Baruch and Benedict de Spinoza, that defeats the infinite regress of mechanistic reductionism and resurrects the horizon of reality, the optimism that permits us to persist each day in the iron grip of trial-and-error discovery and application in science and the art of medicine. They reinforced the emerging synthetic paradigm of biomedical and psychosocial science, supported by the acceptance of ideas of "human ecology," "well-being" and 'holistic medicine" or, as my favorite uranium miner said, "the whole ball of wax" approach to health and health care practice and research.

Looking back, we find no exit from a path illuminated by Bertrand Russell: "all rational conduct of life is based upon the method of the frivolous historical game in which we discuss what the world would be like if Cleopatra's nose had been half an inch longer.[9]

Looking forward, in deciding what is good or true, in the struggle for personal and professional integrity, for sanity, we cannot descend *als ob* Kant was right.

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