

June 20, 1949

Dr. H. Brieger,
Associate Professor and Director,
Division of Industrial Medicine,
The Jefferson Medical College of Philadelphia,
1025 Walnut Street,
Philadelphia, Pennsylvania.

Dear Doctor Brieger:

I shall undertake to answer your question concerning the collection of samples of urine. This is a difficult problem, and, as you have indicated, it has plagued a number of people, including Doctor Hamlin and his analyst, since, in my opinion, they have not taken the trouble to consider carefully the physiological and clinical factors involved.

The variability of spot samples of urine, with respect to their lead content, is quite high. Certain known factors enter into this, of which the most important is the relative rate of water excretion. Attempts have been made to correct for this variation by measuring the specific gravity and making a calculation based thereon. This procedure, we believe to be unsatisfactory for physiological reasons, although the specific gravity can be used very roughly to interpret the significance of the analytical findings. The variability due to spot sampling can be eliminated largely by the collection of large samples of urine. Thus, for example, if a reliable person will follow instructions for the collection of a sample of urine at his home, excellent results can be obtained. We have been doing this for years with certain groups of men, and the results are reliable to a remarkable degree. The workman in a lead trade bathes and changes his clothing before going home, and then returns to the plant, where he changes into his work clothing, putting his personal clothing in a clean locker in the clean part of the locker-room. Such a person, if he is careful, is actually clean, and if he exercises reasonable caution, can obtain samples free of contamination. We have him collect his urine in a gallon jug which is delivered to his home sealed in a paper bag, and which is returned to the bag after every use. When he has voided 2 1/2 to 3 liters of urine, the sample is ready for delivery to the Laboratory, and this is done by having the samples collected by a person responsible to the Laboratory. Under suitable circumstances the employee himself can deliver the sample to the Laboratory before he changes back into his work clothing. I enclose herewith instructions which we issue to men for the collection of such samples. These written instructions are supplemented by a verbal discussion in which every effort is made to impress upon the man the necessity for care in his own interest. We use such samples taken periodically from a representative group of persons in every occupation in a plant, for the purpose of measuring the current control of lead exposure.

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A variant of this procedure, when samples of large volume cannot be obtained, or when, for some reason, it is desirable to omit them, consists in collecting spot samples under carefully controlled conditions with respect to cleanliness of the man and surroundings. If we are interested primarily in the general level of lead absorption on the part of a group of individuals with homogeneous employment, we obtain one sample from each of a number of persons. The variability of the results under these conditions will equalize itself, and we will be able to see the overall order of magnitude of the occupational hazard from a study of the combined results. Actually the mean value of samples of small volume, will be approximately the same as the mean value of samples of large volume, if a proper number of persons is represented in the sampling program. The only difference that will exist will be that results both higher and lower will be obtained in the series of samples of small volume. That is, the range of values will exceed the range of values of large samples.

Now all of the above relates to the measurement of occupational lead exposure periodically. For this purpose the results are reliable whether obtained from samples of large volume or small. When, however, one wishes to determine the status of an individual, either for his safety or for diagnostic purposes, it is absolutely necessary to have more than one sample. Also it is desirable, for physiological and pathological reasons, to sample more than one material. For this reason in diagnostic work we always obtain a sample or samples of blood and a sample or samples of urine. The combined results on these two materials will tell you everything that can be learned, and there is no other way, short of sacrificing the man and analysing his tissues, of determining these facts. For example, the lead concentration in the blood in a given individual may be quite high, while at the same time his urinary excretion of lead may consistently low. This is a very unusual situation, but it does occur, and therefore in the individual case one must always be on the look-out for it. On the other hand, the effects of slight or moderate lead exposure are revealed by the analysis of the urine much more clearly and consistently, than by analysis of the materials, obtained in two totally different ways, one can discern, clearly, discrepancies which may point to the contamination of one or the other of the samples. All of these considerations are highly important for diagnostic and medico-legal purposes, and a great deal of our medical confusion is based on the fact that an increased number of people are making analyses on various materials without having the foggiest idea of the physiological considerations on which the interpretation of such analytical results must depend. This is where Hamlin and his analyst find themselves, for I am sure from the cursory examination of their data that they are confused by physiological variation, plus not infrequent contamination of their samples, plus irregular analytical results obtained by a method which has a rather large error. The combination of these errors and the inevitable variability plus a willingness on their part to ignore what they regard as aberrant clinical findings have led

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them to conclude that safety, in terms of lead excretion, can be defined on a much higher level than that which we have given. I make this statement deliberately and on good evidence, since I studied with considerable care the original analytical and clinical data of one of their papers. Theirs is a dangerous viewpoint in terms of the present hazards in the lead trades since it is an honest opinion, while at the same time being a source of justification to a number of people who feel that their efforts in safeguarding their employees are adequate.

Sincerely yours,

Robert A. Kehoe, M. D.

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