

A Call for Removal of Total Leukocyte Count

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Healthcare systems in many countries, including the United Kingdom, are under severe stress. Amongst the causative factors are inadequate funding, increasing clinical workloads as populations age, and understaffing of healthcare workers which together raise the risk of worker “burn-out” [1,2]. Any measures which exacerbate these problems should be identified and addressed.

One such measure relates to the widespread but unnecessary use by haematology laboratories of the total White Blood Cell (WBC) count which is one of the most frequently requested and reported laboratory tests. The total leukocyte or WBC count is the sum total of neutrophil, lymphocyte, monocyte, eosinophil, and basophil counts. Traditionally, the total WBC count was performed

in a haemocytometer whilst the differential count was carried out separately under the microscope as the “100-cell slide differential”, the counts of each cell type then being expressed as a percentage of the total WBC count; it was only then that the absolute counts could be determined. Today, modern blood analysers count thousands of these cells directly, add the cell counts, recalculate their percentages, and provide us with the total WBC count along with two differentials - the percentages of each cell and their absolute counts (Figure 1). This is a common but needless and potentially harmful way of reporting a laboratory result.

WBC	8.1	(4.5 - 11.0)	RBC	3.72	(3.80 - 5.20)
RBC	3.72	(3.80 - 5.20)	Hgb	123	(117 - 161)
Hgb	123	(117 - 161)	Hct	0.37	(0.35 - 0.47)
Hct	0.37	(0.35 - 0.47)	MCV	100.0	(81.0 - 102.0)
MCV	100.0	(81.0 - 102.0)	MCH	33.1	(27.0 - 35.0)
MCH	33.1	(27.0 - 35.0)	MCHC	331	(310 - 360)
MCHC	331	(310 - 360)	Platelet	211	(140 - 400)
Platelet	211	(140 - 400)	RDW-CV	13.9	(11.6 - 14.8)
RDW-CV	13.9	(11.6 - 14.8)	MPV	11.20	(9.60 - 12.00)
MPV	11.20	(9.60 - 12.00)	Neutro #	2.18	(1.80 - 7.70)
Comment CBC	* Comment CBC		Lymph #	5.10	(1.50 - 4.00)
Neutro %	26.80		Mono #	0.63	(0.20 - 0.95)
Lymph %	63.00		Eos #	0.15	(0.00 - 0.70)
Mono %	7.80		Baso #	0.04	(0.00 - 0.15)
Eos %	1.90				
Baso %	0.50				
Neutro #	2.18	(1.80 - 7.70)			
Lymph #	5.10	(1.50 - 4.00)			
Mono #	0.63	(0.20 - 0.95)			
Eos #	0.15	(0.00 - 0.70)			
Baso #	0.04	(0.00 - 0.15)			

Figure 1: Complete blood cell count with (left panel) and without total WBC and percent leukocyte differential (right panel).

In practice, only absolute counts of the five types of leukocytes are needed. An abnormal total WBC count calls for the finding of the cell type which is the cause of the aberrant result. However, if absolute cell counts are available, why should we use total WBC count and its percentage differential - they provide no additional information. It is absurd to have 11 numerical results where five fulfil the purpose (Figure 1).

More importantly, use of the total WBC count can be misleading and potentially dangerous in clinical practice. For example, the total WBC count may be within the reported normal range yet one or more of its cell-component counts can be either above or below their specific reference range(s) (Figure 1). This can result in a clinician missing an important diagnostic clue. Such a potentially unsafe situation was reported as early as 1903 among parasite-infested patients who exhibited eosinophilia but had a normal total WBC count [3]. The reverse situation may also occur where absolute counts of individual WBCs are within their normal ranges but, by chance, are skewed in such a way that their sum total WBC count is outside the reference range. In practice, both situations may obscure an important, even vital, diagnostic clue along with, in some cases, the need for an unnecessary return visit to a clinic and/or a phlebotomy centre for a repeat blood test.

The situation is especially noteworthy when the total WBC count is reported without its differential. In clinical settings where automatic leukocyte differential counts are available, there is no sound reason for such a practice. In fact, because an abnormal total WBC count will likely prompt the clinician to reorder the test along with a leukocyte differential count, providing a total WBC count without its differential can be questioned on ethical grounds. First, such an approach, as mentioned above, ignores the fact that a normal total WBC may hide potentially useful diagnostic information where an individual cell component count is abnormal. Second, repeating the Complete Blood Cell (CBC) count doubles the initial cost, commonly priced at US \$10-\$30. Third, repeating

any test increases the risk of an abnormal result by chance. A WBC count is part of the CBC count and, by repeating the latter, the odds of a chance error in at least one result (including seven red cell parameters and the platelet count) increases many-fold.

Interpretation of three sets of leukocyte counts (the total WBC count, their five component fractions, and five absolute numbers) rather than one becomes especially problematical in populations with a high variability in their neutrophil count. This is the case in Africa, the Middle East, and South Asia where hundreds of millions of healthy people (8% to 20% of their total population) have benign (familial or ethnic) neutropenia [4,5]. In this condition, the absolute neutrophil count (and often the total WBC count) is low but it oscillates and sometimes is normal; and, in the states of stress such as during an infection, both cell counts increase as in those without ethnic neutropenia. In such populations, the interpretation of leukocyte counts is more demanding; it requires examination of more than one absolute neutrophil count of an individual and his/her family members. We are acutely aware of the frequent misunderstanding of the total WBC, percent and absolute differential counts among health care workers, patients, medical students, and health policy decision-makers in one such population [6].

An additional and important factor is that information overload in clinical practice is a growing problem. Consider a computer screen with 500 laboratory data points for one patient (Figure 2): which data can be ignored safely, and which should prompt the appropriate action?

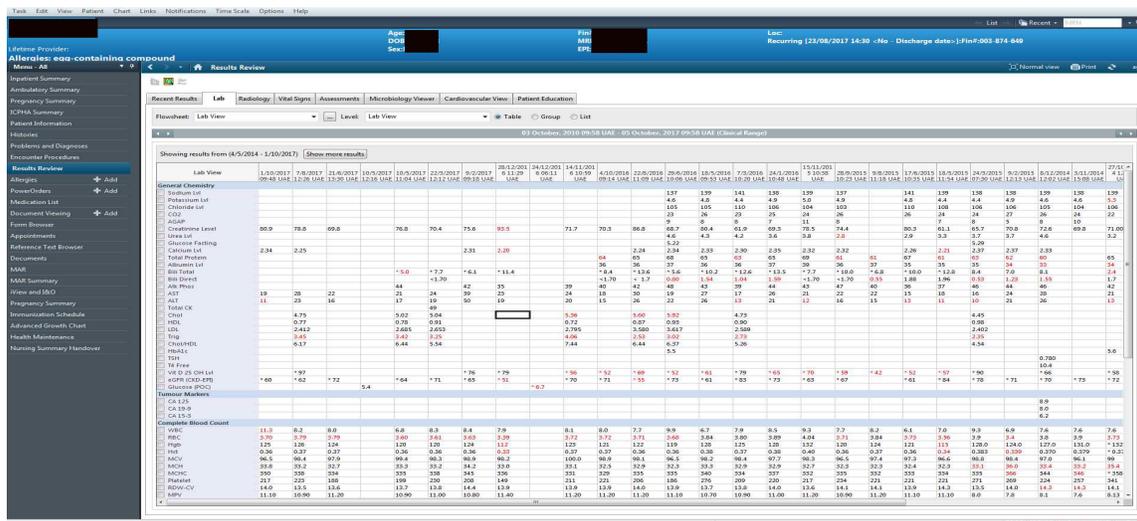


Figure 2: Computer screen with 500 laboratory data points. (Source: hospital information system Cerner).

In information theory, Shannon's law states that the speed of information processing is a function of bandwidth and signal-to-noise ratio [7]. This is a universal law that applies to the human mind. The bandwidth of the human mind is biologically constrained

and becomes smaller with fatigue or interference by extraneous factors. Indeed, for this reason we attempt to reduce outside noise in clinics and hospital wards during the examination of patients. Furthermore, we seek to reduce fatigue by restricting the number

of patients seen by healthcare workers during the day, the length of working hours, and the frequency of on-call duties. The visual display of quantitative information should be approached likewise in a prudent manner [8].

The latter issue is a life calling of the legendary ‘Information Man’, Edward R. Tufte who has said that some numerical data are best presented in tables [8,9]. This is true for CBC results which includes leukocyte counts (Figure 1). Tufte advises exclusion of decoration and anything else that diverts attention away from the essence of the message. Thus, by removing the total WBC count and percent differential from CBC reports, we shall follow in his spirit and improve information processing. However, this might not be easily accomplished since the practice of medicine is an art with ancient roots, rituals and traditions. How are we to understand otherwise when the total WBC and percent differential (without absolute counts) were tabled in a didactic case presentation published recently in one of the most renowned medical journals? [10].

In conclusion, in the age of information, the use of total WBC count and percent differential has become a ‘noise’ and ‘decoration’ in laboratory reports. Their continued use is likely violating an old medical principle of *primum non nocere* and therefore should be discontinued from the practice whenever this is possible. This can be achieved promptly and simply in the laboratory by “tweaking” the modern haematological analysers and, in medical journals, by amending editorial standards. This will remove unnecessary remnants of manual cytometry and eliminate an exercise in absurdity - calculating leukocyte sum total and percentages from

their absolute counts. By using only absolute leukocyte counts, we will be reconfirming our allegiance to common sense and the principle of clinical parsimony.

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