

7.3 NEW Wells Score and D-Dimer for Pulmonary Embolism

Recall from problem 3.3 that a pulmonary embolism (PE) is blood clot in the lungs. A PE typically occurs when a blood clot that formed in a leg or pelvic vein breaks off and ends up in the lungs. This can cause shortness of breath, chest pain, low blood pressure, and death.

Assume that computed tomographic pulmonary angiogram (CTPA) is a perfectly accurate test for PE, but we can't obtain a CTPA on every emergency department (ED) patient who has a slight possibility of PE. This is because a CTPA involves ionizing radiation, exposure to intravenous contrast, and ties up an imaging resource that may be needed by other patients. Assume that the risks and harms of a CTPA outweigh the benefit of identifying a PE when the probability of PE < 3% .(1) We will consider two tests to help decide whether to obtain a CTPA on a patient with symptoms possibly suggestive of PE: 1) the simplified Wells Score, and 2) the plasma D-Dimer level, which we met in problem 3.3.

The Wells score stratifies patients into low-, moderate-, and high-risk groups. Here are data on the prevalence of PE in 6013 patients in different Wells Score groups.(2)

Wells Risk Group	Wells score Range	PE+	PE-	Total	P(PE r)
Low	< 2	229	2513	2742	8.4%
Moderate	2-5	586	2220	2806	20.9%
High	> 5	232	233	465	49.9%
		1047	4966	6013	17.4%

D-Dimer appears at higher levels in the blood when the body's clotting system is activated, so higher values are more suggestive of PE. Data from the same 6013 patients fit the interval likelihood ratios (iLRs) in this table surprisingly well.

D-Dimer (ng/ml)	Approximate iLR
< 250	1/16
250 - 499	1/8
500 - 749	1/4
750 - 999	1/2
1000 - 1499	1
1500 - 2499	2
2500-4999	4
≥5000	8

Assume that the Wells Score and the D-Dimer are independent conditional on PE+/PE-.

- a) For patients like those in this dataset, what is the probability of PE in a patient with a low-risk Wells Score and a D-Dimer 750-999 ng/mL?
- b) What if the Wells Score is still low-risk but the D-Dimer is 500-749 ng/mL?
- c) Based on (a) and (b), what is the D-Dimer threshold for getting a CTPA in a patient with a low-risk Wells Score?
- d) What is the D-Dimer threshold for getting a CTPA in a patient with a moderate-risk Wells Score?
- e) What is the D-Dimer threshold for getting a CTPA in patient with a high-risk Wells Score?
- f) You have just derived a decision rule for obtaining a CTPA in an ED patient with symptoms suggestive of PE that uses Wells Score and D-Dimer level. Summarize the rule in words, a table, or a tree diagram.

1. Lessler AL, Isserman JA, Agarwal R, Palevsky HI, Pines JM. Testing low-risk patients for suspected pulmonary embolism: a decision analysis. *Ann Emerg Med.* 2010;55(4):316-26 e1.
2. Kohn MA, Klok FA, van Es N. D-dimer Interval Likelihood Ratios for Pulmonary Embolism. *Acad Emerg Med.* 2017;24(7):832-7.