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[Hopkins WA \(1943\)](#). Patulin in the common cold. IV: Biological properties: extended trial in the common cold. *Lancet* 2:630-635.

Key passages

**Biological Properties: Extended Trial in the
Common Cold**

W. A. HOPKINS, M D DUBL, M R C P I
SURGEON COMMANDER, ROYAL NAVY

V.—Statistical Note

MAJOR GREENWOOD, D SC LOND, F R C P, F R S
 PROFESSOR OF EPIDEMIOLOGY AND VITAL STATISTICS IN THE
 UNIVERSITY OF LONDON

(*London School of Hygiene and Tropical Medicine*)

The purely statistical question which arises in Commander Hopkins's work is a simple one—assuming that the treated and control populations do not differ in any *material* way, except in regard to the fact of treatment, what is the probability that such divergent percentages of cure would emerge?

It is evident that if two batches of pennies are tossed, the respective percentages of "heads" are likely to differ, and the probability that any particular difference, or a greater difference, would occur can be readily calculated. The principle involved in this stock case is fundamentally the same as in our problem, subject to a consideration I shall discuss later on.

The fundamental data are given by Hopkins in his table IV. The three sets—January, February and April—are not *in pari materia* and must not be aggregated. There is no reason why the proportion of cures

should be the same in different months. Common sense suggests that the differences of percentages are unlikely to be "chance" happenings and it will be enough to apply an exact test to the set most favourable to the hypothesis of chance deviation—the third set. Applying such a test (see Fisher, *Statistical Methods for Research Workers*, pp. 94–95) it is found that in random sampling so wide a divergence in favour of the treated would occur about 3 times in 10,000 trials. It is therefore an improbable happening. In one respect, however, treated and controls are not *in pari materia*; the former included a larger proportion of patients with symptoms of not more than one week's duration (44·4, against 33·3). But, as the following table shows and common sense suggests, this is not probably material, unless there were a special process of selection, or self selection—viz., only patients with especially "obstinate" colds presenting themselves for treatment.

	TREATED			CONTROLS		
	Patients	Recovered	% recovered	Patients	Recovered	% recovered
Symptoms of one week or less ..	} 75	41	54·7	63	5	7·9
Symptoms over one week ..						
	} 20	14	70·0	22	3	13·6

It could, of course, be tested by subtabulation, but, in view of the fact that in the first two series the proportions of treated and controls with symptoms of not more than a week's duration were virtually the same (87·0 and 85·1%), and in these series the divergence is greater, the arithmetic is needless. We may certainly say that, taken as a series, the probabilities of drawing

each pair from a common universe are extremely small.

That conclusion is all that purely statistical reasoning can establish. To revert to the illustration, if an experiment were made with batches of coins fresh from the mint, and their respective percentages of heads differed in such a way that, tested as these data have been tested, a probability of, say, less than 3 in 10,000 emerged that they came from a common universe, no sensible person would infer that the mint coins were biased. He would conclude that either (1) the samples were not *in pari materia* (there had been some "trick" in tossing), or (2) a very improbable event had happened—as it would, on the average, some 3 times in 10,000 trials. He would do so because the a priori improbability of bias in the mint coins is exceedingly great. In our case there is no such a priori improbability that the antibacterial substance might accelerate a cure; that it does do so is a tenable hypothesis. But, and this is the point always to be had in mind, what the statistician has shown is *not* that the odds are so and so many thousands to one in favour of the hypothesis that the antibacterial substance does cure, but only so and so many thousands to one against the chance that such results would emerge without *some* differentiation between the groups. Whether at other times and in groups differently chosen the same differentiation would be found can only be known when further trials have been made.

I am indebted to my colleague, Dr. W. J. Martin, who carried out the arithmetical tests.

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