STA 114: Statistics

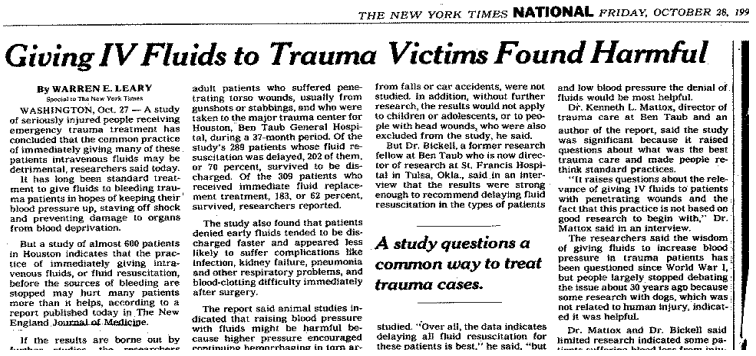
Notes 1. Statistical Inference in Real World

Examples

1. **Medicine.** Immediate care to victims with stab injuries[1].

   Description. To study[2] whether early injection of IV fluids could be harmful to patients with penetrating injuries to the torso, data were collected at Ben Taub General Hospital in Houston under two treatment settings. In the early resuscitation group, 309 patients were given fluids before they reached the hospital. Another 289 patients in the delayed resuscitation group did not receive any fluid until they reached the operation theater. The study recorded 193 patients surviving in the early resuscitation group and 203 patients surviving in the delayed resuscitation group.

   NYT Summary.



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Giving IV Fluids to Trauma Victims Found Harmful

By WARREN E. LEARY
Special to The New York Times

WASHINGTON, Oct. 27 — A study of seriously injured people receiving emergency trauma treatment has concluded that the common practice of immediately giving many of these patients intravenous fluids may be detrimental, researchers said today.

It has long been standard treatment to give fluids to bleeding trauma patients in hopes of keeping their blood pressure up, staving off shock and preventing damage to organs from blood deprivation.

But a study of almost 600 patients in Houston indicates that the practice of immediately giving intravenous fluids, or fluid resuscitation, before the sources of bleeding are stopped may hurt many patients more than it helps, according to a report published today in The New England Journal of Medicine.

If the results are borne out by

adult patients who suffered penetrating torso wounds, usually from gunshots or stabbings, and who were taken to the major trauma center for Houston, Ben Taub General Hospital, during a 37-month period. Of the study's 289 patients whose fluid resuscitation was delayed, 202 of them, or 70 percent, survived to be discharged. Of the 309 patients who received immediate fluid replacement treatment, 183, or 62 percent, survived, researchers reported.

The study also found that patients denied early fluids tended to be discharged faster and appeared less likely to suffer complications like infection, kidney failure, pneumonia and other respiratory problems, and blood-clotting difficulty immediately after surgery.

The report said animal studies indicated that raising blood pressure with fluids might be harmful because higher pressure encouraged continuing hemorrhaging in torn ar-

from falls or car accidents, were not studied. In addition, without further research, the results would not apply to children or adolescents, or to people with head wounds, who were also excluded from the study, he said.

But Dr. Bickell, a former research fellow at Ben Taub who is now director of research at St. Francis Hospital in Tulsa, Okla., said in an interview that the results were strong enough to recommend delaying fluid resuscitation in the types of patients

A study questions a common way to treat trauma cases.

studied. "Over all, the data indicates delaying all fluid resuscitation for these patients is best," he said, "but

and low blood pressure the denial of fluids would be most helpful.

Dr. Kenneth L. Mattox, director of trauma care at Ben Taub and an author of the report, said the study was significant because it raised questions about what was the best trauma care and made people rethink standard practices.

"It raises questions about the relevance of giving IV fluids to patients with penetrating wounds and the fact that this practice is not based on good research to begin with," Dr. Mattox said in an interview.

The researchers said the wisdom of giving fluids to increase blood pressure in trauma patients has been questioned since World War I, but people largely stopped debating the issue about 30 years ago because some research with dogs, which was not related to human injury, indicated it was helpful.

Dr. Mattox and Dr. Bickell said limited research indicated some pa-

2. **Law.** State of New Jersey vs. Pedro Soto *et al.*

   Description. What came to fore in this (now famous) case[3] was the question of racial profiling in police stops. The Public Defender's office in Woodbury, New Jersey alleged that African-American drivers who violated traffic rules were being stopped at a much higher rate than their white counterparts. This allegation, in turn, questioned the validity of the evidence acquired by the state police against nineteen African-American motorists for carrying contraband, who were initially stopped for traffic violation at the southern end of New Jersey Turnpike. Police records on stops made by the state troopers on 35 randomly chosen days (in the period April '88 – May '91) between exits 1 and 3 on the turnpike, showed a total of 892 stops, of which 127 were blacks, 148 were whites and the race of the remaining 617 were not recorded[4].

   Verdict[5]. By New Jersey Superior Court judge, Robert E. Francis:

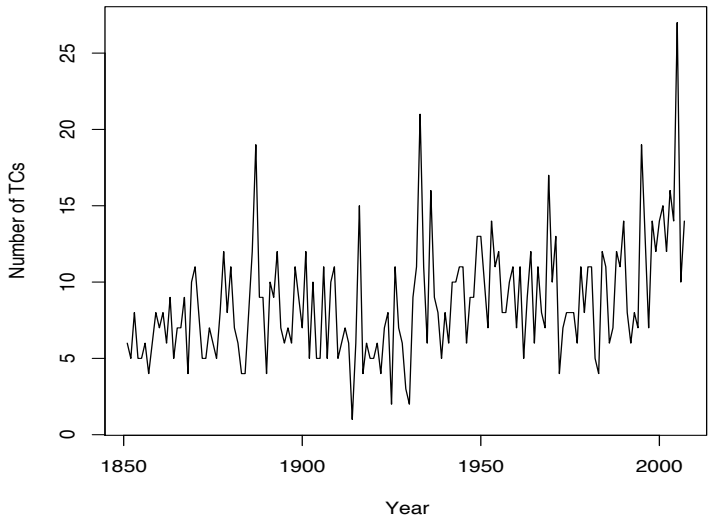
   > ...unrebutted statistical evidence of disproportionate traffic stops against African-American motorists established de facto policy of targeting blacks for

investigation and arrest and thus established selective enforcement violating the equal protection and due process clauses.

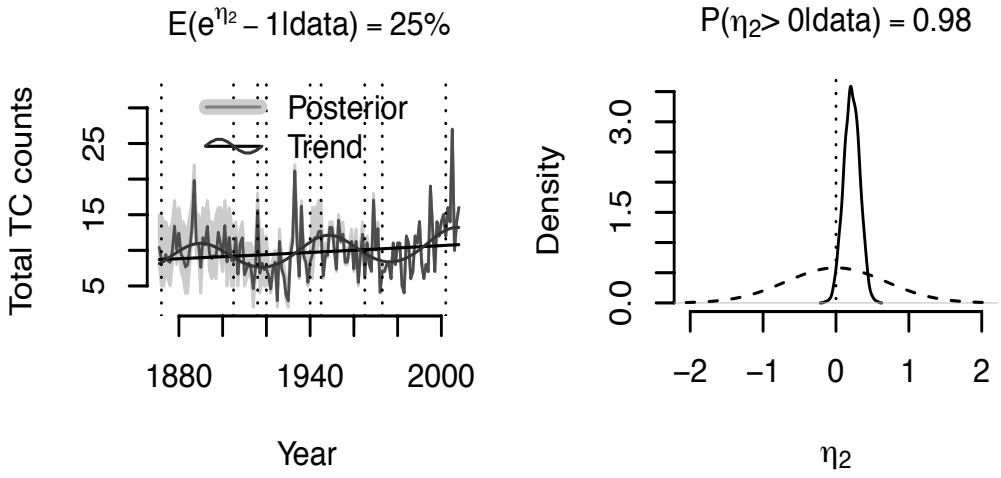
Charges were dismissed against all 19 defendants.

3. **Climate Study.** More hurricanes now than before.

   Description. Whether global warming is resulting in a more volatile climate is hotly debated. One of the pursued signs is the alleged increase in hurricane activity[6]. One measure of this activity is the number of hurricanes (these are very well defined, need to meet several criteria to be called a hurricane, and even more to earn a name) during the yearly hurricane season. For the Atlantic basin, tropical cyclone (of which hurricanes are the most dangerous variety) records date back to mid nineteenth century[7]. The plot below shows the recorded number of tropical cyclones against the year of occurrence.

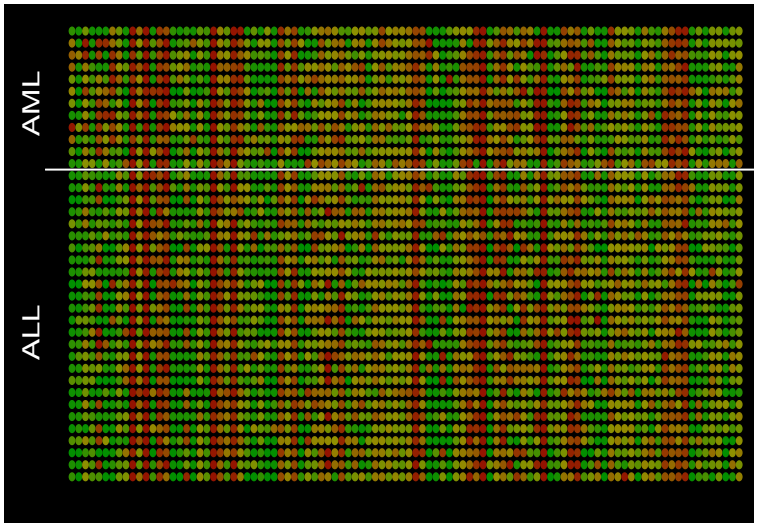


   Conclusion. The jury is still out on this – and perhaps will remain out for a while. What makes things complex is that technology for detecting tropical cyclones has changed drastically over the last 150 years. First it was ship logs, then ships with radio, then came aircraft reconnaisance and finally satellite imaging. Is the apparent upward trend in the plot due to real change in climate or simply an artifact of better detection?



4. **Biotechnology.** Classify acute leukemia based on gene expression level.

   Description. Acute leukemia is classified into two categories[8], those arising from lymphoid precursors (acute lymphoblastic leukemia or ALL) and those arising from myeloid precursor (acute myeloid leukemia or AML). Although this categorization is well established, no satisfactory single test existed for labeling a test tumor into one of these two classes. An accurate labeling usually required a long series of highly specialized laboratory tests performed by trained hematopathologist. Around mid and late 1990s, the advent of the DNA microarray technology[9] changed the face of biological research, enabling one to measure simultaneously the expression levels of thousands of genes. Expression levels are reflection of genes' activeness in producing m-RNA's which in turn produce proteins – the essential molecular vehicles of a body's functioning. The plot below shows a randomly chosen set of 100 genes from a total set of 3051 genes whose expression levels were measured for 27 ALL patients and 11 AML patients. Each dot represents a patient (along the row) and a gene (along the columns) with a red/green color code indicating how well expressed that gene was for that patient.



Results. A classifier based on 50 genes labelled the acute leukemia type of 34 patients from an independent sample with 100% accuracy.

References

[1] Professor Andrew Gelman's website: `http://www.stat.columbia.edu/~gelman/teaching/literacy/`.

[2] "Immediate versus delayed fluid resuscitation for hypotensive patients with penetrating torso injuries", W. H. Bickell et al., *New England Journal of Medicine, 27 Oct 94*, v. 331, pp. 1105-1109.

[3] "Counting cars in a legal case involving differential enforcement", N. Terrin and J. Kadane, *Statistics in the law, Ed. J. Kadane, Oxford University Press, New York, 2008*, pp. 154-158.

[4] "Missing Data in the Forensic Context", J. Kadane and N. Terrin, *Journal of the Royal Statistical Society, Series A (Statistics in Society) 1997*, v. 160, pp. 351-357.

[5] New Jersey Legislative Black and Latino Caucus: `http://www.njleg.state.nj.us/legislativepub/reports/police.pdf`.

[6] "Uncertainty in Hurricanes and Global Warming", K. Trenberth, *Science, 2005* v. 308, pp. 1753-1754.

[7] "Counting Atlantic tropical cyclones back to 1900", C. W. Landsea, *EOS Transactions, American Geophysical Union, 2007*, v. 88, pp. 197-208.

[8] "Molecular classification of cancer: class discovery and class prediction by gene expression monitoring", Golub et al. *Science, 1999* v. 286, pp. 531-537

[9] Wikipedia page on DNA microarray: `http://en.wikipedia.org/wiki/DNA_microarray`.