ORIGINAL PAPER

A NURSE-STATISTICIAN REANALYZES DATA FROM THE ROSA THERAPEUTIC TOUCH STUDY

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This article presents a reanalysis of data used to support the work of Emily Rosa's Therapeutic Touch (TT) science fair project published as an article in the Journal of the American Medical Association (JAMA) *in 1998. The purpose of this article is to take a closer look at the assumptions, data, statistical procedures, and conclusions of the* JAMA *article. This is accomplished by focusing on (1) the conclusion that there was no overall effect of TT, (2) the conclusion that TT practitioners did not perform better depending on which hand was used, and (3) the assumptions about the capability of Rosa's experiment to validate an existing skill. Reanalysis of the Rosa data suggests contradictions to the authors' conclusions. Based on this reanalysis, the authors' recommendations against the use of TT can and should be challenged because of inappropriate design and analysis as well as incorrect statistical assumptions and conclusions. (Altern Ther Health Med. 2003;9(1):58-64)*

On April 1, 1998, the *Journal of the American Medical Association (JAMA)*, published an article by Rosa, Rosa, Sarner, and Barrett[1] concluding that Therapeutic Touch Practitioners' (TTPs) performances were consisent with random guessing when asked to detect the presence of the human energy field (HEF). This publication in a well-respected journal shocked and surprised the alternative and complementary health community. Hardest hit were Therapeutic Touch practitioners (TTPs). The publication received a great deal of attention because it represented the work of 9-year-old Emily Rosa from Loveland, Colo. In letters to the editor of *JAMA*, published in December 1998, many criticized the research and publication of the article,[2-12] and 1 person praised it.[13] Newspaper stories, television interviews, and opportunities for Emily to speak at prestigious academic institutions followed the publication. The assumption, in many cases, was that the authors' data were accurate and their conclusions were valid, though many people may not have appreciated the way the research was conducted and other studies have produced different results.[14, 15] Some practitioners criticized the conclusions because they thought the research methods were inappropriate, but relatively little attention was devoted to whether the authors' conclusions were supported by their data.[3,4,7-9,11] While the adult authors responded to some of their critics, their rebuttal failed to address significant flaws in their original work and did not address concerns related to ethics or statistical procedures.[16]

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AUTHORS OF THE ROSA STUDY

Dr Stephen Barrett is a well-known provider of information for healthcare practitioners and consumers. His frequent contributions to publications and his corporate Web site (http://www.quackwatch.com) offer criticism of alternative and complementary healthcare modalities. He is a member of the Council for Scientific Medicine that sponsors the journal *Scientific Review of Alternative Medicine* and often is hailed as a defender of "legitimate" medical practice.

Larry Sarner, another author, lists an affiliation with the National Therapeutic Touch Study Group (NTTSG). No corporate identify for NTTSG has been found to date. Mr Sarner has no apparent professional affiliations in healthcare and lists no evidence of research skill in the article, though he is credited with performing some of the statistical analyses.

Emily Rosa's mother, Linda Rosa, RN, opposes the teaching and use of Therapeutic Touch in healthcare institutions.[17] She is a former elected official of the Rocky Mountain Skeptics, but lists no credentials as a researcher in the article.

Emily Rosa, a 9-year-old fourth grader at the time of the original work, is the second author listed on the article and like the other authors, she lists no credentials for research.

Given the backgrounds and commitments of the adults involved in this project, it is important to determine if their data support their own conclusions or contrary conclusions. The purpose of this article is to take a closer look at the data and conclusions by focusing on 3 specific issues. First, do their data support their major conclusion that TT has no overall effect? Second, do their data support their conclusion that TT practitioners did not perform better depending on which hand was used? Third, are their assumptions about the capability of Emily's experiment to validate a TTP's skill, when it exists, supported by power analyses of the design?

THE EXPERIMENT

Barrett[18] described Emily Rosa's experiment in these words:

> During the past two years, Rosa's daughter Emily has tested 21 TT practitioners to determine whether they could detect one of her hands near theirs. Each subject was tested ten or twenty times. During the tests, the practitioners rested their forearms and hands, palms up, on a flat surface, approximately 10 to 12 inches apart. Emily then hovered her hand, palm down, a few inches above one of the subject's palms. A cardboard screen was used to prevent the participants from seeing which hand was selected. The practitioners correctly located Emily's hand only 122 (44%) out of 280 trials, which is no better than would be expected by guessing. A score of 50% would be expected through chance alone.

The article also described the participants. Of the 21 participants tested, 9 were nurses (8 RNs and 1 LPN), 7 were massage therapists, and 2 were lay practitioners of TT. The 3 additional participants were a chiropractor, a medical assistant, and a phlebotomist.[1]

THERAPEUTIC TOUCH: A BRIEF DESCRIPTION

Dolores Krieger, PhD, RN, and Dora Kunz developed TT in the early 1970s as a modern healing technique that has its origins in several ancient healing practices. TTPs propose to use conscious intention to clear blockages and balance the flow of the human energy field (HEF). Krieger[19] stated that no physical contact is necessary during the TT process because the HEF is believed to extend beyond the physical body.

The Krieger-Kunz method specifies that TT can be learned and involves the phases of centering, assessment, and rebalancing. Centering is an inner state of quietude achieved through breathing or other brief meditative techniques to gain a sense of inner peace. The assessment detects imbalances in the HEF through the perception of subjective cues emanating from the field. During assessment, the palms of the hands face toward the person and move bilaterally and symmetrically from the top of the head down to the feet. Both hands sweep in unison laterally from the center of the body outward. The aim is to perceive energy imbalances in the field by noticing areas of difference through cues such as sensations of heat, cold, tingling, pressure, or pulsations. TTPs assess both the front and back of the person with the hands held about 6 inches from the person's body. Rebalancing is accomplished by moving or positioning the hands in various ways to consciously direct or modulate the subtle energy of the field.[19]

Smith[20] noted that the experimental protocol of Rosa et al did not approximate TT assessment because practitioners use various modes of sensory awareness, and they are not limited to the use of 1 hand hovered over a specified area of the body. She described TT as an appraisal and repatterning process of mutual interaction of practitioner and client. In other words, according to TT proponents, the practice of TT is a complex, mutual therapeutic interaction between a client with a health problem and a TTP who is focused on helping the client gain relief and begin the healing process. In this experimental lab situation, Emily Rosa was not a client with a health problem and was most likely biased against the use of TT. The intent of the TTP was not on assessment and healing but on detecting the presence of a hand hovering over his or her hand on the other side of a cardboard barrier. Therefore, the design of the experiment did not attempt to approximate a TT encounter between a client and a TTP.

MAJOR CONCLUSION AND SUPPORTING DATA

The major conclusion advanced by the authors states that "... the null hypothesis cannot be rejected at the .05 level of significance for a 1-tailed test, which means that our participants, with only 123 of 280 correct in the two trials, did not perform better than chance."[1] Barrett's Web site and the research article have different reports of the number of successes (122 and 123, respectively) without an explanation for the discrepancy.

The authors' statistical conclusions may seem reasonable at first glance; however, 3 problems exist. First, the data do not support the conclusion that the participants were guessing. Second, the authors assume incorrectly that their study design could validate a TTP's skill, if such skill exists. Third, the data contradicts the authors' conclusion about the effect of which hand was used. These mistakes are quite serious.

Rosa et al present confidence intervals for the number of correct answers out of 10 trials for the first and second phase of the experiment. The first confidence interval is consistent with random guessing. This is immediately obvious because the confidence interval[1] includes the value 5.00. However, the confidence interval for the second set of trials (13 subjects) shows a confidence interval[1] that does not include 5.00. The value of 5.00 is the expected value for random guessing, the parameter assumed to apply in such a case. The absence of the assumed parameter implies that the sample is not consistent with the assumption. The correct interpretation is that the subjects in the second set of trials performed in a manner inconsistent with random guessing. This issue is critical because the scientific method that underscores the authors' work requires acknowledgment that their experiment produced a result that is inconsistent with random guessing. Moreover, it suggests that the authors performed 2-tailed tests against the random-guessing hypothesis and ignored the fact that the tests showed that the data were inconsistent with random guessing in the second phase. Additionally, when combined, as the authors did in their conclusion above, the 280 trials produced an aggregate number of 123 correct answers. This result also is inconsistent with random guessing when properly tested using a 2-tailed test against a null hypothesis of random guessing at an α level of .05.

Random guessing is difficult for many to understand. A random guesser has no advantage in selecting a correct answer or an incorrect answer. Likewise, true random guessers do not know when they guess correctly. The consequence is that true random guessers rarely guess correctly exactly 50% of the time and have no advantage guessing correctly or incorrectly. Random guessers will usually score either less than 50% or more than 50% correctly, but they will never know whether they guessed correctly or not, and they cannot count on guessing correctly at least 50% of the time in such a test. If the subjects in the Rosa experiment were randomly guessing, the number of correct (and incorrect) answers would fall between 124 and 156 in 95% of experiments involving 280 trials (Table 1).

Table 1 displays cumulative probabilities in the critical region of a binomial distribution for the results of random guessing trials based on a statistical calculator found on the World Wide Web.[21] In 280 trials, an unexpected result would involve fewer than 124 or more than 156 correct (or incorrect) answers. An experienced researcher would employ a 2-tailed test to invalidate a null hypothesis of random guessing. Such a test would result in a rejection of the null hypothesis of random guessing for the data in the Rosa paper. This is a critically important issue. The entire edifice of Western, scientific hypothesis testing is that researchers seek evidence to reject their null hypotheses. When researchers want to accept, rather than reject the null hypothesis, they violate the most fundamental principles of science. Under these circumstances, the consumer of research has to be even more vigilant than usual against the possibility that the results are inaccurate. First, the reader must ascertain that the researchers did not formulate a flawed null hypothesis. Second, the reader must assess whether the researchers used inappropriate statistical tests that are not sensitive to the effects. Third, the reader must determine whether the researchers simply ignored results that favor the rejection of a more correctly stated null hypothesis, when the data suggest that the correct null hypothesis is false. Last, readers must satisfy themselves that the researchers did not violate these significant principles of the scientific method as one among many ways of critically appraising a scientific report.

The authors' own table[1] contained evidence to conclude that something was wrong, and they should have performed tests against the binomial distribution. Then they would have rejected the null hypothesis of random guessing for the second phase and the aggregated data, rather than concluding that their data were consistent with random guessing. Instead, they used *t* tests, which produce results similar to the binomial but with less precision because they are approximations to the binomial rather than exact binomial tests. In addition, the authors based their major conclusion on the use of a 1-tailed *t* test. A 1-tailed test is not appropriate because it is not a complete and objective test against a null hypothesis of random guessing.[22,23] While a 1-tailed test is interesting, it fails to allow for the possibility that the skill level at this particular task is inconsistent with random guessing and below the levels normally seen in random guessing. Because the experiment deviated considerably from the routine practice of TT, the authors should have considered that TTPs might violate the random guessing assumption from below as well as from above.

Based on 280 trials, the value of k in Table 1 represents the number of correct responses. The cumulative distribution function (CDF) is the cumulative probability of a result with k or fewer correct responses out of 280 trials. The probability of exactly k correct responses can be calculated by subtracting the CDF for k-1 correct answers from the value for k correct answers, but the important information is that the probability of 123 or fewer correct answers is in an extreme region of the distribution if random guessing occurred. In essence, random guessers do not answer correctly as infrequently as the participants in the Rosa study.

TABLE 1 Cumulative tail probabilities for number of correct answers in 280 binomial trials (probability of correct answer=.5)*

Binomial lower tail		Binomial upper tail	
k†	**CDF at k**	**k**	**CDF at k**
97	.0000	156	.9758
98	.0000	157	.9819
99	.0000	158	.9866
100	.0000	159	.9902
101	.0000	160	.9929
102	.0000	161	.9950
103	.0000	162	.9965
104	.0000	163	.9976
105	.0000	164	.9983
106	.0000	165	.9989
107	.0000	166	.9993
108	.0001	167	.9995
109	.0001	168	.9997
110	.0002	169	.9998
111	.0003	170	.9999
112	.0005	171	.9999
113	.0007	172	1.0000
114	.0011	173	1.0000
115	.0017	174	1.0000
116	.0024	175	1.0000
117	.0035	176	1.0000
118	.0050	177	1.0000
119	.0071	178	1.0000
120	.0098	179	1.0000
121	.0134	180	1.0000
122	.0181	181	1.0000
123	.0242	182	1.0000

*Computed values derived from binomial distribution.[21]
†k indicates number of correct guesses out of 280 trials; CDF at k, cumulative probability of a number of correct answers ≤ k.

The data presented by Rosa et al[1,24] fall in the critical region for a null hypothesis of random guessing when an alpha value of .05 (their choice) is employed and a 2-tailed binomial test is performed (Table 1).[21] Before they tested the participants, the probability that 280 trials would result in more than 156 correct answers or fewer than 124 correct answers was less than 5%. Statistical hypothesis testing requires the performance of the following steps. First, one must specify a region in which the outcome is unlikely to fall if the null hypothesis is true; ie, the participants are actually guessing. Second, one must collect data appropriate to the test. Third, one must determine if the data fall in the critical region specified in the first step. Fourth, if the data fall in the critical region, one must reject the null hypothesis. The authors' data, when analyzed using an exact binomial test, falls in a symmetric region around the value of 5.00 that had a small probability of occurrence under the random-guessing hypothesis. Hence, their data are inconsistent with the null hypothesis of random guessing. The authors may argue that they believe that the TTPs should have performed better than random guessers. However, what occurred is that the authors' data, when properly analyzed, result in a rejection of the random-guessing hypothesis. On this point alone, the data suggest poor design and analysis characteristics.

WAS THE RESEARCH DESIGN FAIR TO THE PARTICIPANTS?

Each participant was tested 10 times in the experiment. Subjects who scored correctly at least 8 times out of 10 trials had a second set of 10 trials. If participants scored 7 or fewer correct answers on the first trial, they failed the test. The researchers, according to their own protocol, should not have tested participants who failed the first set of tests a second time. However, the authors violated this aspect of their protocol in the second phase of their work by retesting several participants who had already failed. Such a procedure would be scrutinized by a human subjects review committee, had one been consulted, and violates the authors' statements regarding their protocol.

The probability that a single, 10-trial phase of the Rosa experiment would validate the skill of a TTP is displayed in Table 2. For a subject with long-term skill levels as presented in the first column of Table 2, the probability of having that talent validated by single phase (10 trials) of the 2-phase Rosa protocol is presented in the second column. The term "long-term skill level" refers to the performance of a TTP in a very large number of identical trials. A TTP who did this exercise 1,000 times and scored 667 correct answers would have a long-term skill level of 2 of 3. Similarly, a TTP who did this exercise 1,000 times and scored 750 correct answers would have a long-term skill level of 3 of 4. A reasonable question is: Would the Rosa procedure validate the skills of an individual TTP who had such long-term skill levels? Table 2 assists in answering precisely this question. The first column of Table 2 represents a TTP's long-term level of ability to detect an HEF under the authors' experimental design. The corresponding entry in column 2 is the probability that the TTP would achieve 8 or more correct answers in 10 trials (the author's, single-phase success criterion) based on the long-term skill level in the first column. That is, column 2 represents the probability that a TTP will "pass" the Rosa test a single time. As discussed below, most biomedical researchers set the power of their statistical tests at .80.

Using the Rosa design, TTPs with the long-term skill levels assumed in the article, are unlikely to pass the test. A person with a long-term skill level of 3 of 4 correct answers has only a 53% chance of passing. In fact, the conventional power level of 80% does not occur until the test subject has a long-term skill level that exceeds 84%. Despite this discrepancy, the authors[1] assert that their test would detect such a skill if present at levels of 2 of 3, or 3 of 4. The authors did not report a power analysis for this design. Unfortunately, the test as designed and used is biased against validating individual participants' skills due to its inadequate statistical power.

In addition, the Rosa protocol, contrary to usual research standards, calls for 2 rounds of testing. The probability of passing the 2-phase protocol rather than just a single phase is significantly lower. The probability of an individual TTP passing both phases of the Rosa protocol is displayed in Table 3. The probabilities in the second column of Table 3 are based on 2 independent sets of 10 trials, both of which would have to be passed at the level of 8 or more correct responses.

These probabilities result by squaring the probability of success for a single phase from the second column of Table 2 to reflect the fact that the TTP has to succeed on 2 separate sets of trials rather than a single trial. As previously discussed, the test participants in the Rosa experiment had a much lower chance of demonstrating their competence in a set of 10 trials than required in most biomedical research. In fact, for a person with a long-term talent of 2 correct in 3 trials, the TTP has less than a 10% chance of passing the 2-stage protocol. For a person with a long-term talent of 3 correct in 4 trials, the TTP has less than a 28% chance of passing the 2-stage protocol. In both cases, the power of the Rosa design is below the standard of 80% used in the biomedical community.

TABLE 2 Power of the Rosa protocol to detect TT skills when present*

Long-term probability of success	Power of 1 phase of protocol to detect TT skill†
.0500	.0000
.1500	.0000
.2500	.0000
.3500	.0048
.4500	.0274
.5500	.0996
.6500	.2616
.7500	.5256
.8500	.8202
.9500	.9885

*Computed values derived from binomial distribution.[21]
†TT indicates Therapeutic Touch.

Alpha-value Calculation Error on Individual Subject Trials

Rosa et al stated that they calculated the requirement that individual subjects score 8 or more correct out of 10 trials to establish an alpha value less than .05, but it is actually .055. At first glance this appears to be quite generous; first impressions can be deceptive. Why do researchers consider alpha values at all? The alpha value protects researchers from error. A distinguished researcher with a reputation to protect would not want to conclude that a phenomenon existed and later discover that it did not. In this case, the authors wanted to make sure that they did not conclude that TTPs could detect the presence of Emily's hand if they were merely guessing. In this experiment, alpha is the probability of meeting the test criteria when the participant is guessing. One might debate whether an alpha value of .055 is appropriate for a fourth grader's science fair project. In fact, the usual standard in biomedical research work is .05. But this value of alpha is used when the researchers have reputations and the consequences of an error could include the death of future patients treated with a protocol that proved ineffective in the research process.

Even in statistics, there is a concern with appreciating wholeness. The alpha value is usually set to protect the researcher from falsely concluding that an effect exists when it does not. Rosa et al would not conclude that TTPs passed their test until they passed 2 phases. This additional roadblock affects the power of their design, as described above. It also affects the alpha value. The correct procedure for calculating α in this design is by answering the following question: What is the probability that individual participants will pass 2 phases of the Rosa protocol if they are actually guessing?

Because participants must pass both phases, one must calculate the alpha value as the probability that an individual TTP will achieve a score of 8 or more correct answers on each of 2 phases of the protocol when they are really guessing. When we take into account the whole process that a TTP has to complete, the alpha value is .003025 (the square of .055). This means that there is a little more than 3 chances in 1,000 that a random guesser would successfully pass the test. The authors never discuss the decreased alpha level that results from their arbitrary imposition of a 2-phase process. Together, the lower-than-standard power and the lower-than-standard alpha levels combine to ensure a significantly reduced probability that even a highly talented TTP would ever pass such a test. It also means that the authors would be highly unlikely to falsely conclude that such ability exists when it does not. Unfortunately, this is accomplished in an inappropriate and unscientific manner and at a cost that included a significant reduction in the ability to identify a talent when it exists.

TABLE 3 Probability of passing 2 phases of Rosa protocol*

Long-term probability of success	Power of 2 phases of protocol to detect TT skill†
.0500	.0000
.1500	.0000
.2500	.0000
.3500	.0000
.4500	.0008
.5500	.0099
.6500	.0684
.7500	.2763
.8500	.6727
.9500	.9771

*Computed values derived from binomial distribution.[21]
†TT indicates Therapeutic Touch.

If the authors had wanted 20 trials, they could have calculated an alpha value that would protect them from error at about the .05 level. In 20 trials, 14 correct answers would produce an alpha value less than .05. For a fourth-grade science fair project, this would have been quite adequate. This success criterion also would increase significantly the power for the 2 of 3 TTP (approximate power=49%) and the 3 of 4 TTP (approximate power=79%). However, neither of these values would provide the standard of 80% used in the biomedical community. It is clear that Rosa et al intended to require 20 trials, yet they calculated their alpha level based on only 10 trials. Even under these conditions, the risks faced by TTPs that their skills would not be validated far exceed a fourth grader's risk of error. The authors' protocol is unscientific as well as unfair.

Unsupported Conclusion Regarding the Effect of Hand

The authors asserted that participants failed to demonstrate a significant difference in their performance when comparing which of the participant's hands was selected. In fact, the authors cite several participants' "rationalizations" for failure; eg, "The left hand is the 'receiver' of energy and the right hand is the 'transmitter.'"[1] However, reanalysis of the hand data shows that the participants performed better when the left hand was selected and that the authors' analysis was incorrect. The authors do not specify exactly how they tested the hand data. Two appropriate statistical tests for the hand data would be the χ^2 test or the Fisher exact test to analyze contingency table data. Table 4 displays the authors' hand data organized as a contingency table with the Fisher exact and χ^2 test results.

The authors may have performed 2 *t* tests against their null hypothesis of random guessing, 1 for each hand. If they did that, it would have been inefficient and inappropriate. As well, such a procedure is warned against in 1 of their own citations.[25] Once again, the authors advance a conclusion that is actually contradicted by their own data when analyzed with more appropriate statistical tests. In addition, the authors' presentation of the hand data violates usual conventions regarding clarity, as follows: "Of the 72 tests in which the right hand was placed above the participants' right hand, only 27 (38%) had correct responses. In addition, 35 (44%) of 80 incorrect answers involved the allegedly more receptive left hand —consistent with randomness."[1] The rationale for presenting the details of this part of their work in this way is difficult to determine when compared with the tabular display of the same information in Table 4.

ETHICAL ISSUES RELATED TO THE EXPERIMENT

The research reported by Rosa et al also raises many ethical issues. For example, the design of the protocol and the disparity between the data presented and the conclusions offered raise issues of scientific integrity as well as the question of whether the manuscript was adequately peer reviewed. The statistical tests used were inadequate to discern differences when those differences were present.

No information was given in the paper regarding when, or if, the participants were told about the authors' biases against TT. The subjects apparently gave their consent based on the information that the project would be published as a fourth-grade science project, not in a peer-reviewed medical journal. The level of adult participation in this project, including recruitment of subjects, experimental design, data analysis, and hypothesis testing would appear to invalidate it as a 9-year-old's school science fair project. It is not clear if the purpose of the research, the affiliations, and potential biases of the researchers were provided to the subjects. However, these details would be necessary to establish informed consent by the participants.

The research project was clearly not fair to individual TTPs in relation to the power to detect their skills when present. The research protocol was violated because participants who failed in the first phase were included in the second phase, though the protocol stated that only participants who passed the first-test would be tested again. In addition, inclusion of previously failing participants could so bias the outcome in the second phase that even high-performing TTPs would have their effect counteracted by low-scoring participants.

The statistical tests used are inadequate to discern differences when those differences are assumed to be present. The authors either did not use alternative tests, such as the binomial distribution, the χ^2, or the Fisher exact test, or did not acknowledge the results of such tests if they were performed.

CONCLUSION

This article presents a reanalysis of the data presented by Rosa et al.[1] This independent reanalysis results in conclusions that contradict those advanced by the authors. Specifically, their conclusion that the results of 280 trials were consistent with random guessing is contradicted by the fact that 123 correct responses is actually outside the range of likely values for random guessers. The authors' own calculated confidence interval[1] for the mean number of correct answers for the second phase does not include the hypothesized value of 5.00. This alone should have alerted the authors and *JAMA* readers that failing to reject a null hypothesis of random guessing was incorrect. Appropriate tests of the authors' hand performance data also result in contradictions of the authors' conclusion that a hand effect was not present in their data. Furthermore, the ability of their design to validate the skill of a TTP is inadequate and results in a systematic bias against individual participants and TT.

The review, publication, and widespread acceptance of the conclusions of this article are disturbing. The analyses presented, as demonstrated above, are seriously flawed. Rosa et al may be able to explain their discrepant conclusions and why a reanalysis of their data produces different conclusions. Pending a rationale that explains the flaws in the authors' assumptions and conclusions, there is no justification for using this article to influence policies and procedures in hospitals and educational settings regarding the teaching and practice of TT. Use of this article is also inappropriate in efforts to influence policies regarding licensing and regulation of health professionals and continuing education.

Well-designed research on alternative and complementary health practices must meet the requirements for fairness.[26] Misguided efforts at research and testing procedures that are clearly biased serve no useful purpose in the process of assessing the utility of alternative and complementary health practices.[20,26] Professional researchers must exercise the same high level of critical and objective work regardless of their potential biases. Even seasoned and mature researchers may have trouble in this regard. Part of the preparation of professional and ethical researchers includes supervision and consultation to enable them to avoid allowing bias to enter into their work. To forego the usual standards of objective evaluation, as appears to have happened in this case, substitutes bias and prejudice for science and reason. Perhaps the rule of caveat emptor should prevail. However, as recently as January 22, 2001, well-respected researchers uncritically cited the Rosa article,[27] suggesting that its misunderstanding and misuse are not likely to disappear in the near future.

Healthcare consumers, providers, educators, planners, administrators, and decision makers need reliable sources of information when making informed healthcare decisions. However, the conclusions of Rosa et al and the data presented in support of those conclusions have been reanalyzed. This reanalysis leads to significant questions about the credibility of the conclusions, such as their assertion that there is no basis for the use of TT by healthcare professionals.[1] The authors may contest this reanalysis of their data and conclusions. Until their conclusions can be validated by replication of the experiment, research consumers, including healthcare consumers, practitioners, health

TABLE 4 Contingency table display and results of statistical tests on Rosa hand data

Hand	Correct	Incorrect
Right	27	45
Left	43	35

Fisher exact test *P* value:	.0344 (2-tailed)
χ^2:	4.6746
χ^2 *P* value:	.0306

planners, and administrators may choose to question the validity of the authors' conclusions and the utility and accuracy of their article.

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