

Published in final edited form as:

Perspect Biol Med. 2006 ; 49(4): 504–514. doi:10.1353/pbm.2006.0064.

Science, Medicine, and Intercessory Prayer

Richard P. Sloan* and Rajasekhar Ramakrishnan†

*Behavioral Medicine Program and Department of Psychiatry, Columbia University Medical Center, and New York State Psychiatric Institute, New York

†Department of Pediatrics, Columbia University, New York

Abstract

Among the many recent attempts to demonstrate the medical benefits of religious activity, the methodologically strongest seem to be studies of the effects of distant intercessory prayer (IP). In these studies, patients are randomly assigned to receive standard care or standard care plus the prayers or “healing intentions” of distant intercessors. Most of the scientific community has dismissed such research, but cavalier rejection of studies of IP is unwise, because IP studies appear to conform to the standards of randomized controlled trials (RCTs) and, as such, would have a significant advantage over observational investigations of associations between religious variables and health outcomes. As we demonstrate, however, studies of IP fail to meet the standards of RCTs in several critical respects. They fail to adequately measure and control exposure to prayer from others, which is likely to exceed IP and to vary widely from subject to subject, and whose magnitude is unknown. This supplemental prayer so greatly attenuates the differences between the treatment and control groups that sample sizes are too large to justify studies of IP. Further, IP studies generally do not specify the outcome variables, raising problems of multiple comparisons and Type 1 errors. Finally, these studies claim findings incompatible with current views of the physical universe and consciousness. Unless these problems are solved, studies of IP should not be conducted.

Over the years, there has been considerable interest in the possibility that religious activity may have health benefits. Most of this research has focused on whether individuals’ religious involvement benefits their own health. Over a century ago, Francis Galton (1872) dismissed this possibility, observing no benefit to the religiously active: for example, clergy did not live longer than lawyers, missionaries’ ships were no safer than merchant ships, and physicians were not known to suggest religious interventions.

Contemporary research, however, has reported positive findings: attendance at religious services or reading the Bible have been associated with reduced mortality (Helm et al. 2000; Hummer et al. 1999). However, religious involvement is strongly correlated with health-related factors, such as functional status and social support, which may confound these associations. For example, people who attend services regularly have greater functional status than those who are bedridden. The latter group is at greater risk of dying than the former, and this difference may account for the increased longevity of regular attenders. Such confounding makes it difficult to draw unambiguous causal inferences from these observational studies.

Investigations of one particular religious activity, however, may permit causal inference. In studies of distant intercessory prayer (IP), intercessors pray for randomly selected patients, usually at a considerable distance, while control patients receive no such prayer. Both groups are followed to assess health effects.

Galton dismissed this possibility, too, observing that state sovereigns, the recipients of public prayer for health and longevity, were nonetheless relatively short-lived. However, Galton's methods were *observational*, and contemporary investigations of IP are methodologically superior. Since exposure to IP can be manipulated by an investigator, randomized controlled trials (RCTs) are possible: patients can be assigned at random to prayer or to control conditions.

Several widely publicized studies employing RCTs have reported significant effects of IP (Byrd 1988; Cha, Wirth, and Lobo 2001; Harris et al. 1999; Sicher et al. 1998). Other studies, however, have been negative (Aviles et al. 2001; Krucoff et al. 2005; Matthews, Marlowe, and MacNutt 2000); the entirely negative findings of the largest study of IP have recently been published (Benson et al. 2006). The NIH is currently funding at least one such study.

Most of the scientific community has objected to giving serious consideration to such research (Sandweiss 2000; Van der Does 2000), but we live in an era of growing irrationalism, in which the most fundamental theories about the evolutionary basis of life on earth and the origins of the universe are under siege. In this paper, we consider some less obvious methodological and scientific aspects of IP studies and suggest that the supposed advantages of conducting an RCT to study this topic are far more apparent than real. We argue that studies suggesting that prayer or "healing intentions" of one group of people influences physiological processes in a group of distant patients raise significant and unresolved methodological problems. Moreover, if these studies and findings are supported, they challenge our understanding of consciousness and the physical universe.

Issues Concerning the Treatment Variable

In a typical RCT, the investigator controls exposure to the treatment agent: the treatment group receives a known dose of the agent, the control group receives none, and within-group variability in this exposure is minimal. Statistical tests contrast the effects of these two conditions.

In IP studies, control over exposure to the agent is greatly limited. In the typical RCT, the investigator is the only source of the treatment agent. In IP studies, friends, family, and members of the patients' religious congregations pray for the patients, over and above the prayers from the intercessors. Moreover, certain religious orders routinely pray for all the sick the world over. Thus, we can distinguish three types of prayer in these studies: (1) that directed specifically to the patient by the intercessors (IP) and under the control of the experimenter; (2) *supplemental* prayer (SP) directed to the patient specifically by family, friends, and others, unmeasurable and not controlled by the experimenter; and (3) *background* prayer directed generally to all the sick all over the world, similarly unmeasurable and uncontrolled.

The impact of background prayer may not be great. Assuming that prayer has quantitative dimensions (a big assumption), the amount of background prayer is enormous, but it also is spread over all the sick in the world and, therefore, the exposure of any one individual patient may be small. We focus on supplemental prayer.

Quantitative Dimensions of Prayer

SP complicates the interpretation of IP studies in ways that have not been adequately examined. In RCTs, the capacity to detect the impact of a treatment agent depends largely on two factors: (1) the difference between the two groups in exposure to the agent, and (2) the expected magnitude of the effect of the agent.

The capacity to detect the effect of a treatment agent depends on how much more of it the treatment group receives compared to the control group. Figure 1A depicts a case in which the treatment agent is a new synthetic drug and so the control group receives none of it. The narrowness of the two spikes indicates that there is very little variation in the exposure to the drug within the two groups. The distance between the spikes indicates a dramatic difference in exposure, with the treatment group receiving a great deal of the drug and the control group receiving none at all.

Consider, by contrast, a trial of a nutritional supplement. In such a trial, the control group receives some of the agent through normal diet but the dose of the treatment group is many times that in the normal diet. For instance, the typical Western diet contains 15–20 mg/day of vitamin E. Studies of vitamin E supplementation typically use 50–400 mg/day. Figure 1B depicts the frequency distribution of each group's subjects at different levels of exposure to the treatment in a supplement trial. Because of natural variation in diet, the degree of exposure of the placebo and treatment groups to the supplement is more variable than in the case of the synthetic drug. Some subjects routinely consume diets that have more of the supplement than do others, so the figure shows two curves instead of two spikes. Nevertheless, as the figure shows, the difference between the treatment group, which receives the supplement plus what the ordinary diet contains, and the placebo group, which receives only what the diet contains, is still considerable: the highest exposure in the control group is still much less than the lowest exposure in the treatment group.

Figure 1C depicts a case of IP. As in the case of the dietary supplement, the treatment group receives the treatment agent, intercessory prayer, plus supplemental prayer (SP), while the control group receives only SP. However, the difference between the treatment and control groups in exposure to the treatment agent, in this case prayer, is much smaller than in the case of a synthetic drug or of a nutritional supplement. Note also that the curves are shorter and wider than in Figure 1B, indicating the likely greater variation in the degree of SP.

When SP and IP are equal in magnitude, the treatment group will receive twice the amount of prayer ($IP + SP$) in the control group (SP only), as shown in Figure 1C. However, because of the variation in SP, there is considerable overlap between the two curves. Some in the “placebo” group receive more total prayer than some in the treatment group. This overlap means the ability of the study to show a treatment effect (termed “power” in statistics) is greatly diminished: many more subjects will be needed to demonstrate the same effect when the treatment exposure is as in Figure 1C compared to 1B. The situation becomes more dire as the amount of SP increases relative to IP, as shown in Figure 1D: it becomes increasingly difficult to detect an effect of IP that represents a diminishingly smaller fraction of the total exposure to prayer ($IP + SP$). The overlap of the curves in Figure 1D indicates that exposure to prayer in the two groups is highly similar. Most of the subjects in the two groups receive similar amounts of prayer and so will not differ in outcome. Any group difference has to be from the small number in the treatment group at the right end of the exposure curve compared to the small number in the control group at the left end. Even if these subgroups have totally opposite outcomes (all successes in the treatment subgroup and only a basal success in the control subgroup), there will only be a modest difference between the groups as a whole.

As the ratio of SP to IP increases, more and more subjects are required to detect an effect of IP. If $SP/IP = 1$ —in other words, if the amount of IP equals the amount of SP, as depicted in Figure 1C—then the treatment group will receive IP + SP, and the control group will receive only SP. Under these conditions, assuming an effect size of 0.2, 766 subjects/group would be required to detect an effect of IP.¹ As the SP/IP ratio increases—as the amount of SP begins to exceed the amount of IP—the difference in exposure to prayer between the treatment and control groups diminishes, requiring more and more subjects to detect an effect. Thus, when the SP/IP ratio equals three, 7,132 subjects/group would be required to detect an effect of IP, with the same effect size of 0.2. Calculations such as these allow us to interpret the results of published IP studies.

For example, in the study of Harris et al. (1999) reporting a significant effect of IP on outcomes in heart surgery patients, each treatment subject received a daily prayer from five intercessors for 28 days. However, the study's outcome measures concerned clinical course in the coronary care unit (CCU), and the average length of stay in the CCU was only 1.1 days. Thus, exposure to IP while in the CCU would not, on average, have exceeded six prayers before the out-come variables were measured. It is not difficult to imagine that the magnitude of SP would have been substantially greater, making the SP/IP ratio so large that the number of subjects required would be too large to justify the study, regardless of the effect size.

This analysis also can be used to interpret the study by Cha, Wirth, and Lobo (2001) on the effect of IP on the outcome of in vitro fertilization (IVF), the only IP study to date with a significant effect on a single, clearly defined outcome. These investigators reported that patients who received IVF plus IP had twice the pregnancy rate of the group receiving IVF only (50% versus 26%). These dramatic results seem extremely unlikely when we recognize that SP is likely to have been quite large—it is highly likely that every subject, her partner, parents, siblings, in-laws, and friends would all have prayed for the success of the IVF procedure. We can demonstrate that these results imply that IVF alone, in the absence of prayer, has little effect, contradicting other published findings (Pandian et al. 2005). The validity of these data has been questioned, especially in light of the fraud conviction of the second author and the dissociation from the paper by the third author (Flamm 2002, 2005; Shermer 2004). Similar considerations indicate that the STEP study design (Study of the Therapeutic Effects of Intercessory Prayer; Benson et al. 2006) implies that in the absence of SP and IP, there will be only a limited effect of standard care, and that a design accounting for SP would require far more subjects. The same problems afflict the recently published MANTRA II study, whose findings were entirely negative (*Monitoring and Actualisation of Noetic Trainings*; Krucoff et al. 2005).

One way to salvage IP studies from these problems is to postulate a threshold effect—that only prayer above a certain level, regardless of whether it comes from designated intercessors or others, has an effect. According to this explanation, the amount of SP is unimportant, because the addition of IP causes the treatment group to cross a critical threshold, leading to a significant effect. However, the *variation* in SP received by different subjects becomes a significant complicating factor in this scenario, resulting in considerable overlap between the two groups with respect to the exposure to prayer.

Figures 1C and 1D illustrate this problem. The dotted line represents the hypothetical threshold above which prayer has an effect. In Figure 1C, there are some treatment group subjects who nonetheless fall below the critical threshold. There also are some control subjects who receive prayer in excess of this threshold. In 1D, variation around the mean is

¹Supporting statistical analyses are available from the authors.

substantially greater. As the curves overlap to a greater and greater degree, the treatment and control groups become more and more similar, and the difference between the two groups in the percentage of subjects who exceed the critical threshold, whatever it is, diminishes substantially. This makes it more and more difficult to detect an outcome difference between the treatment and control groups.

Qualitative Dimensions of Prayer

These considerations assume that there are no qualitative differences between IP and SP. Several IP studies employ fundamentalist Christian intercessors (Byrd 1988; Cha, Wirth, and Lobo 2001). If, hypothetically, only evangelical Christian prayer were effective, then the doubling of the pregnancy rate in the IVF study would make sense. SP (assuming it is not from evangelical Christians—a big assumption) would have no particular effect, and therefore the success rate in the control group is due only to IVF treatment. Astonishingly, an editorial accompanying the MANTRA II study suggested precisely this possibility (*Lancet* 2005). Of course, such a position must be clearly articulated, allowing readers to consider its broader theological implications.

These problems reflect a more general failure to establish the construct validity of the primary independent variable of IP studies: prayer (Chibnall, Jeral, and Cerullo 2001). We have no idea how to quantify it or specify its dimensions. We are unable to determine the degree of exposure to prayer and therefore cannot draw firm conclusions about its effects. Even though IP studies appear to conform to the RCT framework, these problems make interpretation of their findings difficult at best.

Issues Concerning Outcome Variables

In addition to problems associated with the treatment variable, IP studies have problems with outcome variables. IP studies typically consider a great many of these variables, for example, 29 by Byrd (1988), 40 by Harris et al. (1999), and 36 by Dusek et al. (2002). Without an underlying theory, a matter discussed below, IP studies do not specify which of these many outcome variables should be influenced by prayer (Chibnall, Jeral, and Cerullo 2001). Why, in the Byrd study, should the effect be seen in heart failure but not cardiac arrhythmias? Why should the effect of prayer in heart failure that Byrd reported not be replicated by Harris et al.? These studies exemplify the “sharpshooter’s fallacy,” in which the sharpshooter empties a six-gun into the side of the barn and *then* draws the bull’s-eye (Park 2000).

This failure to limit outcome variables is accompanied by a failure to control for multiple comparisons, increasing the likelihood of falsely rejecting the null hypothesis and accepting outcomes that are the product of chance alone. In the Byrd study (1988), six of the 29 different outcome variables were significant at the 0.05 level. When the appropriate adjustments are made, the “significant” findings in IP studies disappear (Sloan, Bagiella, and Powell 1999); this may explain why two studies with similar protocols had conflicting results (Bolton 2001).

Problems Concerning Mechanisms of Effect

What mechanism could explain how the prayers of some people influence medical outcomes in others at a great distance? Although Levin (1996) offers a series of candidates, two have received the most attention: divine intervention and distant effects.

The problems of divine intervention as a scientific explanation are obvious. The existence of God can be neither proved nor disproved by scientific method. Ascribing the effects of IP to

God is vacuous, since any outcome, positive or negative, can be ascribed to God's will. As the recent court decision in the Dover, Pennsylvania, trial about teaching intelligent design in high school science classes made clear, supernatural explanations are not acceptable in science.

"Distant healing" posits a "non-local" effect: the cognitive activities of some people influence the physical health of others (Targ 1997). Supporters of distant healing make both weak and strong claims. The weak version holds that we must accept the findings of IP studies, even if we don't understand the underlying mechanisms. This situation is similar, they assert, to the case of scurvy and its treatment by consumption of citrus fruit long before we understood the role of vitamin C. The IP findings are so strong, proponents believe, that we must accept them now and incorporate them into medical practice: "We need not wait until all the answers are in before employing prayer adjunctively" (Dossey 2000). Likewise, Harris et al. (1999) recommend distant prayer as an "effective adjunct to standard medical care."

The strong claim raises considerably greater problems. Proponents of IP often frame this work as consistent with new trends in the philosophy of consciousness and quantum mechanics. For example, Krucoff et al. (2005) report that quantum physics may provide a mechanism for the effects of distant prayer, even though their study found no effect whatsoever of prayer. Dossey (2000) writes that "while it is true that there is no generally accepted theory for the remote actions of consciousness, many mathematicians, physicists, and biological and cognitive scientists are currently offering hypotheses about how these events may happen," and that "there is considerable evidence that neither telepathy nor psychokinesis is nonsense." That is, not only can consciousness have effects on physical processes, but it can exert them on distant objects. Some critics have described these attempts at explanation as "quantum quackery" (Shermer 2004). If accepted, the distant healing literature requires that we abandon our understanding of ourselves and the universe, something we should not do in the absence of truly compelling evidence. In fact, such compelling evidence does not exist.

Philosophers have long considered the problem of how consciousness, with no physical properties, could arise from a physical substrate, the brain. In this sense, consciousness is "non-local," dependent upon but apparently not residing in the brain. But asserting this is considerably different from claiming that consciousness can influence physical or biological phenomena, even those close by, let alone those at a distance. Nothing in current views of consciousness supports such an assertion.

Current quantum mechanics also considers non-local effects. Under certain experimental conditions, the spin of two photons deriving from the same excited atom is consistently related even if the photons exist at a distance from each other. Thus, the effect is "non-local." But the photons are related merely in a correlational and not causal way. So while quantum physics posits the existence of non-local effects, they cannot be the basis of health outcomes seen as *causally* linked to distant prayer.

Of the four forces known in nature, none can account for IP effects. Strong and weak nuclear forces operate only at the subatomic level. Gravitational force acts at a distance but only in proportion to the masses involved. The mass of the brain, indeed of an entire group of intercessors, is so trivially small that no effect of gravity could account for these findings. Electromagnetic energy associated with brain activity possibly could account for such findings, but the electrical activity of the brain, measured at the surface of the skull, is only about 10-4V, and the brain's magnetic field is much smaller still. Neither can be detected at

a distance of even a few meters. Proponents of IP must explain how their findings can be reconciled with these facts or why the facts do not apply.

Revolutionary Science?

In the eyes of IP proponents, their work represents a scientific revolution, especially in the inability of contemporary science to embrace it and the scorn IP researchers receive from the scientific establishment (Dossey 2000). Of course, science progresses by the accumulation of data that force us to abandon established views in favor of others more consistent with the data. This is how successive views of the universe, from the Ptolemaic to the Copernican to the Newtonian, evolved. However, although innumerable claims of revolutionary scientific discoveries have been made throughout history, only in a very few cases have the data lived up to those claims.

Moreover, there is a critical distinction between revolutionary science of the past and IP research. Past revolutions transformed our understanding through the formulation of a theory that allowed for a different and more thorough explanation of observed phenomena than was previously possible. Darwin's work, for example, provided a comprehensive transformation of our understanding of how living creatures evolve, not merely an isolated finding that appeared to conflict with prevailing views. Newtonian celestial mechanics and Einstein's relativity also were theories that accounted for previously inexplicable phenomena. Theories permit such a new understanding and, as a result, the prediction of specific, testable, and potentially disconfirming events.

Nothing in the IP literature comes remotely close to such an achievement. Not only has no comprehensive theory emerged, but, on the contrary, the proponents of IP and distant healing cannot even specify which outcome variables will be influenced by prayer.

Conclusions and Recommendations

Most of the scientific community may dismiss unilaterally the idea that distant IP can influence health. But in an era in which the most fundamental scientific theories about the evolutionary origins of life and the universe are under attack, such cavalier disregard can only allow beliefs in the effects of IP to persist. IP studies must be held to the standards of science: as long as investigators cannot control and measure exposure to prayer and identify specific outcome variables, these studies cannot be conclusive and should not be undertaken.

If they are conducted nonetheless, reviewers must evaluate their merits in light of the absence of these essential characteristics. Perhaps if the field develops and more precise hypotheses are tested and supported, a comprehensive theory will emerge. When this happens, we may indeed be on the threshold of the scientific revolution that IP proponents claim. But to truly achieve the status of revolutionary science, hypotheses about IP must derive from a theory that identifies the underlying mechanisms and allows for specific, testable, and falsifiable predictions. Based on the considerations raised in this paper, we think this is highly unlikely to occur.

References

- Aviles JM, et al. Intercessory prayer and cardiovascular disease progression in a coronary care unit population: A randomized controlled trial. *Mayo Clin Proc.* 2001; 76(12):1192–98. [PubMed: 11761499]
- Benson H, et al. Study of the Therapeutic Effects of Intercessory Prayer (STEP) in cardiac bypass patients: A multicenter randomized trial of uncertainty and certainty of receiving intercessory prayer. *Am Heart J.* 2006; 151(4):934–42. [PubMed: 16569567]

- Bolton B. Intercessory prayer. *Ann Intern Med.* 2001; 135(12):1094. [PubMed: 11747401]
- Byrd RC. Positive therapeutic effects of intercessory prayer in a coronary care unit population. *South Med J.* 1988; 81:826–29. [PubMed: 3393937]
- Cha KY, Worth DP, Lobo RA. Does prayer influence the success of in vitro fertilization-embryo transfer? Report of a masked, randomized trial. *J Reprod Med.* 2001; 46(9):781–87. [PubMed: 11584476]
- Chibnall JT, Jeral JM, Cerullo MA. Experiments on distant intercessory prayer: God, science, and the lesson of Massah. *Arch Intern Med.* 2001; 161(21):2529–36. [PubMed: 11718583]
- Dossey L. Prayer and medical science: A commentary on the prayer study by Harris et al. and a response to critics. *Arch Intern Med.* 2000; 160(12):1735–37. [PubMed: 10871965]
- Dusek JA, et al. Study of the Therapeutic Effects of Intercessory Prayer (STEP): Study design and research methods. *Am Heart J.* 2002; 143(4):577–84. [PubMed: 11923793]
- Flamm BL. Faith healing by prayer: Review of Cha KY, Wirth DP, and Lobo RA. Does prayer influence the success of in vitro fertilization transfer? *Sci Rev Alternative Med.* 2002; 6:47–50.
- Flamm BL. Prayer and the success of IVF. *J Reprod Med.* 2005; 50(1):71. [PubMed: 15730180]
- Galton F. Statistical inquiries into the efficacy of prayer. *Fortnightly Rev.* 1872; 12:125–35.
- Harris WS, et al. A randomized, controlled trial of the effects of remote, intercessory prayer on outcomes in patients admitted to the coronary care unit. *Arch Intern Med.* 1999; 159:2273–78. [PubMed: 10547166]
- Helm HM, et al. Does private religion activity prolong survival? A six-year follow-up study of 3,851 older adults. *J Gerontol.* 2000; 55A:M400–M406.
- Hummer RA, et al. Religious involvement and U.S. adult mortality. *Demography.* 1999; 36:273–85. [PubMed: 10332617]
- Krucoff MW, et al. Music, imagery, touch, and prayer as adjuncts to interventional cardiac care: The Monitoring and Actualisation of Noetic Trainings (MANTRA) II randomised study. *Lancet.* 2005; 366(9481):211–7. [PubMed: 16023511]
- Lancet. Mantra II: Measuring the unmeasurable?. 2005; 366(9481):178.
- Levin J. How prayer heals: A theoretical model. *Alternative Therapies.* 1996; 2(1):66–73.
- Matthews DA, Marlowe SM, MacNutt FS. Effects of intercessory prayer on patients with rheumatoid arthritis. *South Med J.* 2000; 93(12):1177–86. [PubMed: 11142453]
- Pandian Z, et al. In vitro fertilisation for unexplained subfertility. *Cochrane Database of Systematic Reviews.* 2005:2.
- Park, RL. Voodoo science. New York: Oxford Univ. Press; 2000.
- Sandweiss DA. P value out of control. *Arch Intern Med.* 2000; 160(12):1872. author reply 1877–78. [PubMed: 10871988]
- Shermer M. Flying carpets and scientific prayers: Scientific experiments claiming that distant intercessory prayer produces salubrious effects are deeply flawed. *Sci Am.* 2004; 291(5):34. [PubMed: 15521144]
- Sicher F, et al. A randomized double blind study of the effect of distant healing in a population with advanced AIDS. Report of a small scale study. *West J Med.* 1998; 169(6):356–63. [PubMed: 9866433]
- Sloan RP, Bagiella E, Powell T. Religion, spirituality, and medicine. *Lancet.* 1999; 353:664–67. [PubMed: 10030348]
- Targ E. Evaluating distant healing: A research review. *Alternative Therapies.* 1997; 3:74–78.
- Van der Does W. A randomized, controlled trial of prayer? *Arch Intern Med.* 2000; 160(12):1871–72. author reply, 1877–78.s. [PubMed: 10871987]

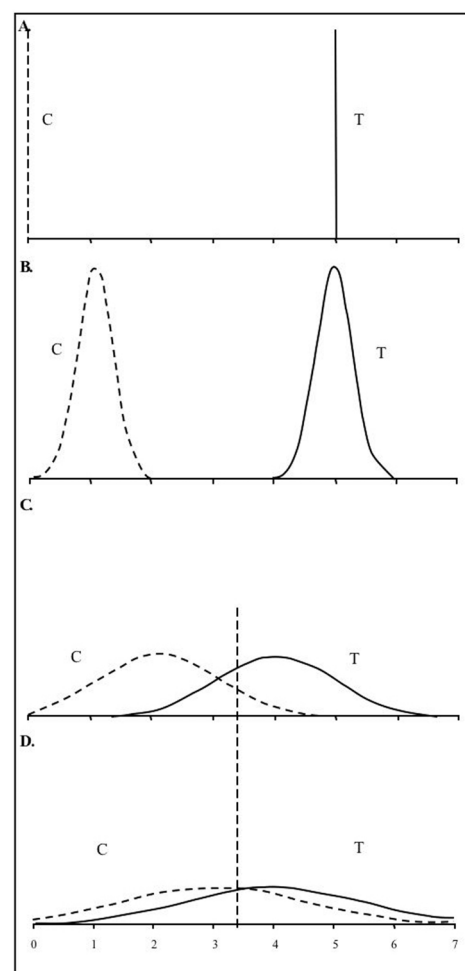


Figure 1. Distribution of Treatment Exposure under Four Different Study Conditions

A. The treatment group receives a new synthetic drug; the control group receives placebo.

B. The treatment group receives a nutritional supplement as part of the treatment plus whatever is contained in the ordinary diet; the control group receives whatever is contained in the ordinary diet.

C. The treatment group receives intercessory prayer plus an equal amount of supplementary prayer; the control group receives only supplementary prayer.

D. The treatment group receives intercessory prayer plus considerably more supplementary prayer; the control group receives only supplementary prayer. When a threshold model is postulated, the dotted vertical line represents a hypothetical threshold for an amount of prayer above which there will be an effect.