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# DOES LICENSING IMPROVE THE QUALITY OF SERVICE: THE CASE OF DENTISTS

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 14 <b>CRC-405</b>	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) 6 <b>Does Licensing Improve the Quality of Service: The Case of Dentists,</b>		5. TYPE OF REPORT & PERIOD COVERED
7. AUTHOR(s) 10 <b>Arlene/Holen, Paul/Feldman, James/Jondrow</b>		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS <b>Center for Naval Analyses 2000 N. Beauregard Street Alexandria, Virginia 22311</b>		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS <b>Div. of Special Projects, Federal Trade Commission, 6th &amp; Pennsylvania Ave., N.W. Washington, D.C. 20580</b>		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 11
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE <b>November 1979</b>
		13. NUMBER OF PAGES <b>21</b>
		15. SECURITY CLASS. (of this report) <b>Unclassified</b> 12
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report)		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES <b>This material is based upon research supported by the Federal Trade Commission under Contract L0186. Any opinions, findings, and conclusions and recommendations expressed in this publication are those of the Public Research Institute and do not necessarily reflect the views of the Federal Trade Commission.</b>		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) <b>dentistry, job analysis, licenses, requirements</b>		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) <b>In 1970, about 500 occupations were licensed by one or more states in the U. S. and over 2000 were regulated at the local level. The fact that licensing is so widespread suggests that it must provide some benefits to the public, perhaps by eliminating from the market some low quality services that most consumers feel they would only have bought by mistake. It may also result in higher prices, however, without improving the quality of services available.</b>		

DD FORM 1473 EDITION OF 1 NOV 65 IS OBSOLETE  
1 JAN 73 S/N 0102-LF-014-6601

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

1108 938

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20 This paper presents results of a study of how the licensing of dentists affects the quality of services and the dental health of the public. Using state cross-section data, indicators of the stringency of licensing were related to two measures of the quality of service (malpractice premiums and the fraction of dentists who continued their education after having been licensed) and to an index of dental health (constructed from data derived from dental examinations administered to Navy recruits drawn from 41 states).

The results show that greater stringency of licensing does have some benefits: it is associated with higher quality of service and with a better state of dental health in the recruit population. Although the results suggest that more stringent licensing can improve quality in a single state, they cannot be extrapolated to suggest that national licensing standards would have salutary effects. Since the study does not consider the costs involved in licensing, it can only be considered the first step in a benefit-cost analysis. It does not, in itself constitute an evaluation of licensing. Nevertheless, a benefit cost analysis must take account of the possibility that licensing improves the quality of service.



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"Dentistry was left to barbers and to roving bands of charlatans who practiced their so-called skills at market places and fairs."

Columbia Encyclopedia

"It is one of the finest problems of legislation -- what the state ought to take upon itself to direct by the public wisdom, and what it ought to leave, with as little interference as possible, to individual discretion."

Edmund Burke  
Thoughts on Scarcity, 1795

INTRODUCTION

Anyone observing the growth of government in the United States since 1795 might be tempted to judge that, over the years, Americans have resolved Burke's "finest problem" by opting for greater direction of private actions by the public wisdom and leaving less for individual discretion. Times change, however, and so does public opinion. Judging from the recent outpouring of complaints about the size of government and the extent of its interference in private decisions, it appears that Burke's problem has, once again, become a live issue.

In this paper we consider the question of whether or not government should interfere in the practice of skilled professions, and, if interference is called for, the form that it should take. The question arises at all, because some professions involve the delivery of services so complex, and requiring so much specialized knowledge, that buyers are generally unable to judge the qualifications of the practitioner or the quality of the services rendered. The lack of information provides an opportunity for poorly qualified practitioners to offer themselves to the buyer and, possibly, to do physical or financial injury to him. In law, states have generally relied upon buyers to protect themselves - caveat emptor. In some markets, however, the state has chosen to interpose itself between buyer and seller. Generally, the chosen method of interposition is to require that an individual be licensed by the state before offering services to the public.

As a means of protecting buyers, licensing has both advantages and disadvantages. The major advantage, at least in theory, is that truly unqualified individuals are legally excluded from the market. There are other ways to help buyers discriminate against unqualified suppliers, such as providing them with detailed information about suppliers, but licensing has become the most common. In practice, a license is granted, not to a person known to be qualified, but to one who has met specified educational (and other) requirements and passed a test. Even if the test is accurate, continuing proofs of qualification are not generally required. One whose skills have decayed over time, or one who managed to meet the licensing requirements by careful preparation for the test, might have failed if tested later.

Tests, of course, are not necessarily accurate indicators of whether or not a practitioner would be effective in providing service. Some people are good at assimilating "book knowledge," but are bad at applying it; others are just the opposite. Moreover, tests may focus on skills or knowledge that are not important in dealing with practical problems. Thus, the fact that a license has been granted is not a guarantee to the public that services offered in the market will meet minimal standards of quality.

Another drawback of licensing is that it can preclude services that informed consumers would want -- services below society's standards of quality but worth more to some buyers than their cost. The result would be that licensing not only raises the average quality of service, but, also raises the price.

Whatever its drawbacks, licensing of occupations is widespread in the United States. In 1970, about 500 separate occupations were licensed by one or more states: 2000 more were regulated at the local level [2].

This paper examines the licensing of one profession - dentistry - and measures the extent to which licensing improves the quality of care.

Dentistry was one of the first professions (along with law, medicine, and pharmacy) for which licenses were required in the U.S. License requirements were first imposed in a few states in the late 1800's: By 1900, most states had followed suit. Currently, all states

require that dentists be licensed; fifteen states require licenses for the practice of specialties within dentistry [1].

That restrictions on who can practice dentistry are so common could indicate that licensing has substantial redeeming features, but this is not very strong evidence. Our goal is to see if there is firmer evidence. We do not, however, perform a benefit-cost analysis; benefits are not put in dollar terms and, while costs are discussed, they are not examined empirically. Our primary aim is to see if there is evidence that licensing improves the quality of dental service. It could be otherwise. Attempts to regulate are not always effective and controlling the quality of service requires more than simply establishing a regulatory body and charging it with responsibility to protect the public interest.

To determine whether regulation affects quality, we make use of a natural experiment: licensing criteria for dentists vary substantially from state to state. Some involve tests of skills used in everyday practice; others involve more complex skills that are rarely, if ever, used. The practical effect of this variation is that some states are more restrictive than others in granting licenses. If more restrictive tests truly reflect higher entry standards, and if higher entry standards ensure that practitioners will perform better, there ought to be some measurable differences among states in the quality of services available in the market and in the dental health of the population.<sup>1</sup>

Our tests for the effect of licensing involve the statistical analysis of these differences. Variations in licensing stringency, measured in several ways, are correlated with variations in the quality of service and dental health, also measured in several ways. To summarize the general conclusion drawn from the analysis, we find some evidence that licensing standards lead to higher quality service and to better dental health. The remainder of the paper describes the basic analytic approach; the data, our measures of licensing

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<sup>1</sup>For a more extensive description of the dental market and the statistical analysis of the effects of dental licensing see [3].

stringency and the quality of dental service; the statistical procedures applied, and the conclusions.

#### THE ANALYTIC APPROACH

The desirability of licensing cannot be proven simply by reference to the consumer's inability to judge the quality of service. Suppose, for example, that there are two types of practitioners -- one of high quality, one of lower quality -- and that the function of licensing is to eliminate the latter. To evaluate this licensing scheme one would need to know several things: the cost of identifying the high quality practitioners, the value to consumers of shifting their consumption to the higher quality practitioner (or no practitioner at all if they decided not to pay the higher price); and the cost of finding or training practitioners of the higher quality. A full analysis would then compare costs and benefits.

As stated earlier, we have not attempted a complete evaluation of licensing. Our study focuses on the limited issue of whether current regulatory procedures for dentists actually shift consumption from a lower quality service to a higher quality service. This is clearly only a modest part of the overall evaluation. We are not dealing with the question of whether the shift is worth making, but only whether licensing does, in fact, result in a shift.

It is not always straightforward to show that a particular regulation has some effect. For example, Stigler and Friedlander [6] find no evidence that regulators actually affect the prices charged by electric utilities. In a more general vein, Stigler argues that economists have provided almost no evidence that regulation makes any difference; that with respect to regulation, "economists have refused to either leave the problem alone or to work on it" [5, p. 14]. This study is intended to provide some of the desired evidence.

#### Inference from Cross-State Variation

To estimate the effects of licensing, we make use of variation among states in the stringency of licensing. Our data are purely cross-sections of states and of individuals. The nature of the data limits the kinds of conclusions that can be drawn from the analysis. For example, using state cross-section data means that we

can only make inferences about the effects of state policies on licensing, but not the effects of national policies.

To illustrate the types of information available from state data, consider, again, the example of dentists at two skill levels, and assume that licensing eliminates the less skilled. In states with such restrictive licensing, those consumers who had chosen the less skilled practitioners will have to make a choice between foregoing services altogether and shifting to higher quality services. Almost certainly, some will make the shift and, in those states: the initial effect of licensing will be to increase the demand for the more skilled practitioners.

The subsequent effects will depend on how the state's supply of dental services responds to this increased demand. For instance, if supply is completely unresponsive, the increase in demand will result in the price of the higher quality services being bid up. If the supply is responsive (possibly because less skilled dentists can be upgraded), the price for a given quality of service will not rise much (at least over the long run), and the increase in demand will be realized primarily as an increase in the quantity of higher quality services.

Statistical analysis of state cross-section data on the price, quantity, and quality of service, allows us to estimate how much the relevant variables change because of variations in licensing -- and, thus, how much the quality of dental service in a single state would be increased by stricter licensing if all other states maintained their existing standards. It is important to note, however, that state cross-section analysis can not be used to estimate the results of changing licensing standards in many states at one time, or to estimate the effects of imposing uniform national licensing standards. The reason is that, cross-section data allow estimation of the consumer demand for services and how the supply of highly skilled dentists to a state would change if the price of services rose (or fell). The supply to a state is not the same as the supply to the nation. The supply of dentists for a single state can be very flexible; a rise in the price within a state can draw dentists from other states where prices have not risen. If the price of high quality services were to rise everywhere in the nation because of the imposition of national standards -- or

even in more than a few states at once -- the main source of increased supply would have to be newly trained or upgraded dentists rather than dentists migrating from other areas. The resulting price rise will be greater, and the increase in quantity smaller, than would be suggested by cross-section data.

#### The Measurement of Quality

One of the first steps in the statistical analysis of how licensing affects the quality of dental services is to measure quality, a term that is not well defined. What does it mean for dental service? One possible meaning refers to the dentist rather than his service: whether he has good credentials, whether he is careful, hard working, and up-to-date. Another meaning is that quality refers to the results of the service: whether dental problems are detected early, whether fillings last, whether serious mistakes are avoided.

More precisely, quality can be defined in terms of the effect of the service on the consumer's utility, or equivalently, the effect on the amount he would pay for different amounts of service. It is tempting to define a higher quality product as one of which the informed consumer would consume more (at a given price). However a higher quality product might be so much better that less services are required. For example, an inferior dentist may require five attempts to fix a bad tooth while a better dentist will require only one. (For further examples, see Oi [4, p.11].) Instead, a higher quality product could be defined as one for which consumers would always be willing to pay a higher price (for any given quantity) since this is a measure of the consumer's total satisfaction with the product.

Unfortunately, to use this more precise definition in an empirical study of licensing would require estimation of a price-quantity relationship (a demand curve) that is unobservable, namely, the one that would result from complete information on the part of the consumer. Given that no direct measure exists, we construct a variety of indirect measures, none of these is perfect, but all should show a consistent pattern if licensing truly affects quality.

We have developed three measures of the quality of dental service in a particular state:

1. the fee that dentists must pay for malpractice insurance,
2. the proportion of dentists who continue their formal education after beginning practice,
3. the fraction of dental disease which is treated.

The first measure, the malpractice insurance rate, reflects the likelihood that the average dentist in a state will make a serious mistake for which he would be sued.

The second measure of quality, the tendency of the dentist to continue his education, is a characteristic of the dentist, not the service he provides. The presumptions are (1) that the extra education expands the dentist's skills, and (2) that it is the more motivated and skillful dentists who choose to further their education.

The third measure, the incidence of untreated disease, is a measure of dental service. However, it is a measure not only of how well the typical dentist discharges his services, but also of how much dental service consumers use. It describes both the quality of service offered and the quantity consumed. The extra information on quantity is useful because it bears on an expected undesirable side effect of licensing: if licensing raises the price of dental services and if this higher price reduces demand, then dental health may suffer because of decreased quantity, even if the quality has improved. Following this argument, we might find that licensing had a positive effect on our pure measures of quality, but a negative effect on dental health.

#### The Measurement of Licensing Stringency

To determine how licensing affects quality, we require a measure of the different licensing standards adopted by each state. Again, no single measure is perfect, but several measures can be constructed that reflect variations in stringency. Table 1 shows six such measures and how these differ among the states. The

TABLE 1  
DENTAL LICENSING VARIABLES, BY STATE, 1969

State	Fail Rate (%)	Reciprocity	Simultaneous Exam	Gold Foil Requirement	Recognizes National Board Exam	Licensing Exam Fee (\$)
Alabama	5	No	No	No	Yes	50
Alaska	56	Yes	No	Yes	Yes	25
Arizona	45	No	No	Yes	Yes	75
Arkansas	8	No	No	No	Yes	50
California	26	No	No	Yes	Yes	50
Colorado	17	No	No	Yes	Yes	50
Connecticut	6	No	No	No	Yes	50
Delaware	0	No	No	Yes	No	50
Dist. of Col.	5	No	Yes	No	Yes	40
Florida	35	No	No	Yes	No	50
Georgia	14	No	No	No	Yes	50
Hawaii	25	No	No	Yes	Yes	50
Idaho	22	No	No	Yes	Yes	75
Illinois	16	No	No	Yes	Yes	50
Indiana	2	Yes	No	Yes	Yes	25
Iowa	1	No	No	Yes	Yes	50
Kansas	0	Yes	Yes	Yes	Yes	55
Kentucky	2	Yes	No	Yes	Yes	50
Louisiana	0	No	No	No	Yes	50
Maine	4	No	Yes	Yes	Yes	50
Maryland	1	No	Yes	Yes	Yes	30
Massachusetts	5	No	Yes	Yes	Yes	40
Michigan	4	No	No	No	Yes	35
Minnesota	0	No	No	Yes	Yes	25
Mississippi	0	No	No	No	Yes	50
Missouri	3	Yes	Yes	Yes	Yes	40
Montana	18	No	No	Yes	No	25
Nebraska	0	No	No	Yes	Yes	50
Nevada	57	No	No	Yes	Yes	100
New Hampshire	3	Yes	Yes	Yes	Yes	50
New Jersey	19	No	No	No	Yes	50
New Mexico	26	No	No	Yes	No	50
New York	14	No	Yes	No	Yes	40
North Carolina	8	No	No	No	Yes	30
North Dakota	33	Yes	No	Yes	Yes	50
Ohio	6	Yes	No	No	Yes	50
Oklahoma	6	Yes	Yes	No	Yes	50
Oregon	17	No	No	Yes	Yes	50
Pennsylvania	0	Yes	Yes	No	Yes	25
Rhode Island	0	No	No	No	Yes	50
South Carolina	12	No	No	No	Yes	50
South Dakota	0	Yes	No	Yes	Yes	50
Tennessee	3	No	No	No	Yes	50
Texas	7	No	No	No	Yes	50
Utah	5	No	No	Yes	Yes	25
Vermont	14	No	No	Yes	Yes	25
Virginia	6	No	No	No	Yes	50
Washington	21	No	No	No	Yes	25
West Virginia	4	Yes	Yes	No	Yes	35
Wisconsin	5	No	No	No	Yes	25
Wyoming	29	No	No	Yes	Yes	50

TABLE 1 (continued)

Sources: Fail rate: percent of state licensing examinations resulting in failure. Facts About States for the Dentist Seeking a Location, 1971 (American Dental Association), p. 20, col. 5.

Reciprocity: whether the state has reciprocity arrangements with any other state. Facts, 1969; p. 19.

Simultaneous examination: whether the state participates in a simultaneous examination arrangement. Dr. Donald W. Johnson, Division of Dentistry (U.S. Dept. of H.E.W.).

Gold foil requirement: whether the clinical examination includes some class of gold foil restoration. Facts, 1969; pp. 15-18.

Recognizes National Board Examination: whether the state recognizes the certificate of the National Board of Dental Examiners. Facts, 1969; p. 13, col. 4.

Licensing examination fee: Facts, 1969; p. 14, col. 1.

first is the failure rate: the fraction of examinations on which the applicant received a failing grade.<sup>1</sup>

We also consider more specific measures of stringency: the licensing fee; whether the state automatically accepts dentists licensed in certain other states (reciprocity); whether the state participates in simultaneous examination arrangements; whether the state recognizes the national examination administered by the National Board of Dental Examiners; and whether the gold foil restoration is a part of the examination.

The licensing fee itself is modest, rarely exceeding \$50. Hence, the fee itself cannot be considered a serious restriction on entry. However, the fees may reflect the intricacy of the examination, for they are set, in part, to cover the costs of preparing and giving the tests. The gold foil requirement is of special interest as a measure of stringency. This requirement is widely considered to be arbitrary; most dentists rarely perform it in practice. Still, the ability to perform this technique may well be correlated with skills that are important in practice.

The different measures of stringency are, in a way, different measures of the same thing. Therefore, we would not expect them to have strong, separate effects on quality. Even if it is true that licensing improves quality, it is only necessary that all the measures taken together have an effect, not that each has an effect in addition to the others. In fact, it turned out in the statistical work that the fail rate alone was an adequate measure of stringency; adding other measures did little to improve the accuracy of the results.

#### EVIDENCE FROM STATE DATA

To determine whether more stringent licensing leads to higher quality service, we compared the experience of states with differing degrees of licensing stringency. The idea is that if licensing stringency can raise quality, then states in which it is more difficult to

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<sup>1</sup>This measure must be distinguished from the fraction of applicants who fail (on which we have no data) since the same applicant may take a test several times.

obtain a license should have a higher quality service. Of course, inference can be made only if a correction is made for other factors that can affect the quality of service. These corrections will be discussed below. Even when the corrections are made, comparisons across states can only serve as a check on the central hypothesis -- that more stringent licensing leads to higher quality. There could always be other interpretations for any observed relations between stringency and quality.

To make a cross-state comparison we require numerical measures of quality, licensing stringency and other state characteristics. In the statistical analysis, we use the malpractice premium for dentists as an indicator of one dimension of quality, the chance that dental work will result in a severe problem. The malpractice premiums are levels recommended for a given level of coverage. The recommendations, based on actuarial data, are made by Insurance Services Office, a trade organization that analyzes claims experience for the insurance industry. Actual rates may differ from these recommended rates because, in some instances, state insurance regulatory agencies require that rates be determined on other criteria. We consider the recommended rates to be a more accurate reflection of the likelihood of a claim than the rates actually charged.

The stringency of licensing was measured by the results of the licensing tests. The exact measure was the fraction of tests that were failed. This fraction, the fail rate, ranges from 0 in a number of states (Delaware, Kansas, Louisiana, Minnesota, Mississippi, Nebraska, Pennsylvania and Rhode Island) to 57 percent in Nevada, 56 percent in Alaska, 45 percent in Arizona, and 35 percent in Florida. It seems to be much harder to get a license in some states than others, which should provide the type of natural experiment needed for statistical analysis.

Even if states with high fail rates have low malpractice premiums, the fail rate is not the only factor determining malpractice costs. Other likely factors include: the cost of living (which helps determine the size of court settlements), the tendency of residents toward litigation, the rules of evidence followed in court (for example, whether community or national standards are followed) and any other state characteristics that lead to frequent or sizeable court awards.

To summarize these characteristics, we included as a determinant of the dental malpractice premium the premium for physicians in the same state. The idea is that the physicians' premium will be influenced by all the same factors that influence the dental premium, hence, including the physicians' premium helps to ensure that the estimated effect of licensing stringency on the dental malpractice premium will not include the effects of these other factors. What we are trying to guard against is a case in which a high fail rate seems to lead to a low dental malpractice premium, but only because states with high fail rates have other characteristics which lead to a low dental premium. In table 2, these recommended premiums for dentists are compared to premiums for physicians in general practice.

The addition of the physicians' premium as a determinant of the dental premium complicates comparison of the experience of different states. We seek to compare the dental malpractice premium in states with differing licensing stringency and differing physicians' premiums, and infer the effect of each characteristic.<sup>1</sup>

To make this comparison we used a statistical technique, multiple regression analysis. This technique involves finding the mathematical formula which best explains differences in dental premiums between states in terms of state characteristics. In this case the characteristics are the dental fail rate and the physicians' malpractice premium.

The regression allows estimation of coefficients, which describe how much each of the characteristics affects the dental malpractice premium. It also gives us an estimate of the statistical significance of each coefficient (which is a measure of how likely it is that the coefficient differs from zero simply by mistake), and how much of the variation in dental premiums is associated with all the characteristics in the formula. The regression analysis was based on 49 observations (all the states except Alaska, for which data were missing). The results are presented below with indicators of statistical significance (t values) given in parentheses under the coefficients:

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<sup>1</sup>For more detail on the statistical analysis see [3].

TABLE 2  
ANNUAL MALPRACTICE INSURANCE PREMIUMS, BY STATE, 1970  
(\$)

State	Dentists	Physicians, general practitioners
Alabama	25	49
Alaska	missing	missing
Arizona	45	146
Arkansas	25	89
California	150	278
Colorado	45	126
Connecticut	36	84
Delaware	45	62
Dist. of Col.	50	73
Florida	40	165
Georgia	40	66
Hawaii	35	72
Idaho	25	57
Illinois	45	71
Indiana	25	62
Iowa	60	62
Kansas	45	57
Kentucky	30	72
Louisiana	40	67
Maine	25	44
Maryland	68	56
Massachusetts	43	48
Michigan	30	153
Minnesota	25	77
Mississippi	20	40
Missouri	40	64
Montana	25	109
Nebraska	25	51
Nevada	30	146
New Hampshire	25	25
New Jersey	39	130
New Mexico	40	104
New York	72	180
North Carolina	15	35
North Dakota	15	40
Ohio	80	102
Oklahoma	48	99
Oregon	35	79
Pennsylvania	60	69
Rhode Island	34	37
South Carolina	30	31
South Dakota	15	42
Tennessee	25	57
Texas	30	60
Utah	25	92
Vermont	35	38
Virginia	30	54
Washington	50	98
West Virginia	20	57
Wisconsin	25	65
Wyoming	16	40

Source: Dr. Graham Boyd, Insurance Services Office.

Equation 1

$$\begin{aligned} \text{Dental malpractice} &= 13.31 - .52(\text{fail rate premium}) \\ &\quad (-2.63) \\ &\quad + .38(\text{physician malpractice premium}) \\ &\quad (7.09) \end{aligned}$$

$$R^2 = .5$$

The formula describes the best prediction that can be formed of the dental malpractice premium given the fail rate and the physician malpractice premium. The regression provides us with coefficients for the fail rate and physician malpractice premium (-.52 and +.38) and indicators of the statistical significance of the coefficients: the t values (-2.63 and 7.09 respectively). For the sample sizes we deal with in this report, absolute value of t greater than about 2 indicates that the coefficient is statistically significant -- that is the indicated result most likely did not occur by chance.

Finally, the regression analysis provided us with a measure ( $R^2$ ) of how much of the variation in dental premiums among the states is accounted for by the formula. In this analysis,  $R^2$  was .5; this means that half of the observed variation in dental malpractice premiums can be explained by the state's fail rate and the premiums for physician's malpractice insurance.

In considering the statistical results, note the importance of the physicians' premium, with a coefficient of .38; states which differ in their physician malpractice premium by \$100 will (on the average) differ by \$38 in their dental malpractice premiums (provided the fail rate is the same). Besides being substantial, the coefficient on the physician premium is also statistically significant, with a t value of 7.09.

The importance of the physician premium suggests that the likelihood of making a costly error is not the only determinant of the dentist premium; this means that the dentist premium is not a pure measure of quality. For example, the state with the highest physician premium (California), also has the highest dentist premium. Perhaps this is picking up the same tendencies which have since resulted in highly publicized settlements and malpractice fees.

Let us look now at the relationship of central interest, that between licensing stringency and the dental malpractice premium. The coefficient on the fail rate suggests that stringent licensing is associated with lower malpractice premiums. The coefficient (-.52) gives an indication of the magnitude of the effect. An increase in the fail rate from 15 percent to 35 percent (well within the observed range of variation) would reduce the predicted malpractice premium by \$10 -- say from \$60 per year to \$50. It is hard to say if this decrease is "large" or "small". In an absolute sense, \$10 per dentist does not seem a major improvement, but then, reducing the malpractice premium is not the primary goal of dental licensing. The goal is to raise the quality of dental services of which the malpractice premium is an indicator.

One thing the results do suggest is that licensing has some of the intended effect. This is not to say that the benefits of the program outweigh the costs, but that licensing does something: it pushes quality in the desired direction. Dental licensing seems not to be a case in which regulators find they cannot achieve their limited objectives. In the same vein, the estimated effect suggests that the standards used for licensing are meaningful. One can hypothesize a case in which licensing standards have little to do with dental skill. Indeed, some licensing standards call for skills in archaic procedures, for instance the gold foil test. Nevertheless, the standards do seem to raise quality.

We have considered a cross-state comparison based on one measure of quality, the dental malpractice premium. Consider now results based on a second measure of quality, the tendency of dentists to continue their education. The exact variable to be explained is the fraction of dentists in a state reporting to interviewers that they took continuing education courses. Interviews were conducted over an extended period, 1966-1969. This variable is considered a measure of quality in the sense that it provides some information on the quality of the dentist himself. Continuing one's education suggests not only that the dentist is keeping up with current techniques -- or otherwise expanding his abilities -- but also that his professional interest continues to be strong even after his initial training. Continuing education was not required for licensing in any state during the survey period. Since then, it has

been adopted in several states as a relicensing requirement.

We want to test whether states with more stringent licensing seem to have a higher proportion of dentists continuing their education. We make this test using a regression whose dependent variable is the fraction of dentists reporting continuing education courses. The sole explanatory variable is the fail rate, averaged over the period 1960-1966. We tested to see if further explanatory variables were needed, but these did not add significantly to the ability to explain continuing education, either singly or as a group. Nor did the inclusion of additional variables alter the significance of the fail rate. These variables included the median age of dentists in the state, the availability of continuing education courses (measured as the number of dental students per practicing dentist), and measures of licensing stringency other than the fail rate.<sup>1</sup>

The results of the statistical analysis are presented in equation 2. The analysis is based on 49 observations, one for each state except Georgia, where data were missing. The number in parentheses is a t value.

Equation 2: The Effect of Licensing on Continuing Education

Fraction of dentists continuing their education =  $38.7 + .58(\text{fail rate})$   
(6.1)

$R^2 = .43$

The results suggest that the fail rate is a significant determinant of the tendency toward continuing education. The coefficient on the fail rate (.58) indicates that an increase of the fail rate from, say, 15 percent to 35 percent would (on the average) raise the fraction of dentists continuing their education by 11.6 percent, say from 40 percent to 51.6 percent. The t value (6.1) is far above the level required for statistical significance, which indicates that the observed effect of fail rates on continuing education is unlikely to be a chance occurrence.

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<sup>1</sup>For further detail see [3, p. 22].

## EVIDENCE FROM INDIVIDUAL DATA

In the preceding section, we used state data to make two tests of the hypothesis that more stringent licensing leads to higher quality service. Both tests seemed to indicate that there is a positive relation between licensing and quality.

In this section we consider a different source of evidence about the relation between the quality of dental service and the stringency of licensing -- data on individuals. The individuals studied are 477 naval recruits screened in 1968 at the Naval Training Center in San Diego. The recruits came from 41 states with a wide variety of licensing procedures. The survey provides detailed information on each recruit: age, education, home state, and indicators of his dental health.

The information on dental health allows us to form a more inclusive measure of the quality of dental service than was used before. In the previous analysis, we considered measures that indicated the competence of the dentist but not his availability. For example, licensing could ensure that only dentists of very high quality could practice, but might so limit their availability that little attention was given to each patient, or it could result in many patients being priced out of the market. Dental health could actually suffer from the high standards of quality.

With these data on the dental health of Navy recruits we can find out whether a higher quality of service is being bought at the expense of dental health. The first requirement is a measure of the dental health of each recruit in the sample. We constructed an inverse indicator which we called the index of dental neglect. The index was the amount of untreated or currently existing disease relative to the total amount of dental disease experienced by the individual over his lifetime. This was calculated as the ratio of decayed teeth to the sum of decayed, missing and filled teeth.

We performed another regression analysis to estimate the effect of licensing on dental neglect. In this analysis, we took into account characteristics of the individual and of his home state. The individual characteristics were age and education. The state characteristics, in addition to the fail rate, were public

dental care expenditures per capita and income per capita.

The regression equation estimating the effect of dental neglect on dental health is presented below. The regression is based on 477 observations, each representing information on an individual recruit. Numbers in parentheses are t values.

Equation 3: The Effect of Licensing on Dental Neglect

$$\begin{aligned} \text{Index of} &= .94 - .002(\text{state fail rate}) \\ \text{dental} & \quad (1.79) \\ \text{neglect} & \\ \text{for} & + .01(\text{age of recruit}) \\ \text{recruit} & \quad (.93) \\ & - .06(\text{education of recruit}) \\ & \quad (.49) \\ & + .00003(\text{per capita income of state}) \\ & \quad (-3.63) \\ & - .04(\text{state per capita expenditures for dental care}) \\ & \quad (-1.24) \end{aligned}$$

$$R^2 = .05$$

The average fail rate (1960-1966) has a negative coefficient. To indicate the general magnitude of effect, an increase in the fail rate from 15 percent to 35 percent would, on the average, reduce dental neglect by 4 percentage points, say from 10 percent to 6 percent. The t value, 1.79, suggests that the effect is not very likely to occur by chance, but it does not achieve the level usually required for statistical significance. Still, we certainly find no support for the possibility that licensing reduces dental health, while we do find some support, though not conclusive, that the fail rate improves dental health.

The  $R^2$ , .05, is somewhat lower than those reported earlier for state data. The low  $R^2$  is, however, typical of regressions based on individual data, since individuals differ in so many ways.

## SUMMARY AND CONCLUSION

We have investigated whether licensing stringency improves the quality of dental service. Using different indicators of the quality of services within individual states, we examined three ways in which licensing stringency might be associated with increased quality. Each of the three tests added evidence that stringency does improve quality. Licensing does seem to do something.

We do not interpret our results to mean that licensing is desirable. We set out to see if there was some effect, not to perform a complete analysis of dollar benefits and cost. The limited scope of the analysis lends extra force to the usual statement that further research is needed. In this case, the further research would involve not only the estimation of costs but the conversion of estimates of benefits such as ours from measures of quality to dollars. The estimation of costs would require estimating whether dentists of high quality can be trained at a reasonable cost. Since this analysis is based on comparisons across states, we can estimate whether stringent licensing leads to high quality, but not how great would be the improvement from tightened national standards.

What our results do suggest is that licensing should not be interpreted as a purely arbitrary limitation on supply, a barrier without benefits. Instead, licensing has some benefits, and, we conjecture, some costs. A complete analysis would go far beyond what we have presented here, but should take account of our basic result: that licensing seems to accomplish a major objective; it does seem to improve quality.

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