**The Effect of Minimum Nurse Staffing Requirements on Staff Levels and Quality of Care in Nursing Homes**

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The following memo describes the effects of the minimum nurse staffing law that was brought into effect in 2000 for all nursing homes in California. The new policy mandated that nursing homes must provide a daily minimum of 3.2 hours of nursing care per resident. This memo will first address whether this new requirement was effective in raising levels of nurse staff. Second, this memo will consider whether increasing nurse staffing translates to improved quality of care.

**Background: Changes between 1996 and 2004**

The minimum staffing law was approved in 1999 and became effective at the start of 2000. A comparison of the nurse staffing levels before and after the policy was implemented shows an overall increase. It should be noted that all the changes described in this section are based on a simple comparison and do not account for state-wide time trends.

In the short-term, between 1998 and 2000, the policy compliance rate increased significantly from 29% to 40%. The increase in compliance was even higher in the long-term (2004) reaching 71%. There was a significant short-term and long-term increase in the number of hours per resident day (HPRD) provided by non-supervisory (NS) nurses (see Table 1). However, it appears that mostly nurse aides, as opposed to licensed nurses, are contributing this increase. The staff levels of nurse aides increased, relative to 1998, by 0.11 and 0.34 HPRD in the short- and long-term respectively. By comparison, the increase in licensed nurse staffing, though statistically significant, was small in magnitude at only 0.02 and 0.07 in the short- and long-term respectively.

To measure the quality of care, this memo considers the number of total of deficiency citations (TDCs) and the rate of pressure sores seen in a nursing home. Interestingly, the short term shows a significant increase in the number of TDCs. However, the change is small in magnitude, and in the long-term, the TDCs decrease by 1.7. For the rates of pressure sores, there appears to be no significant change from the 1998 rates.

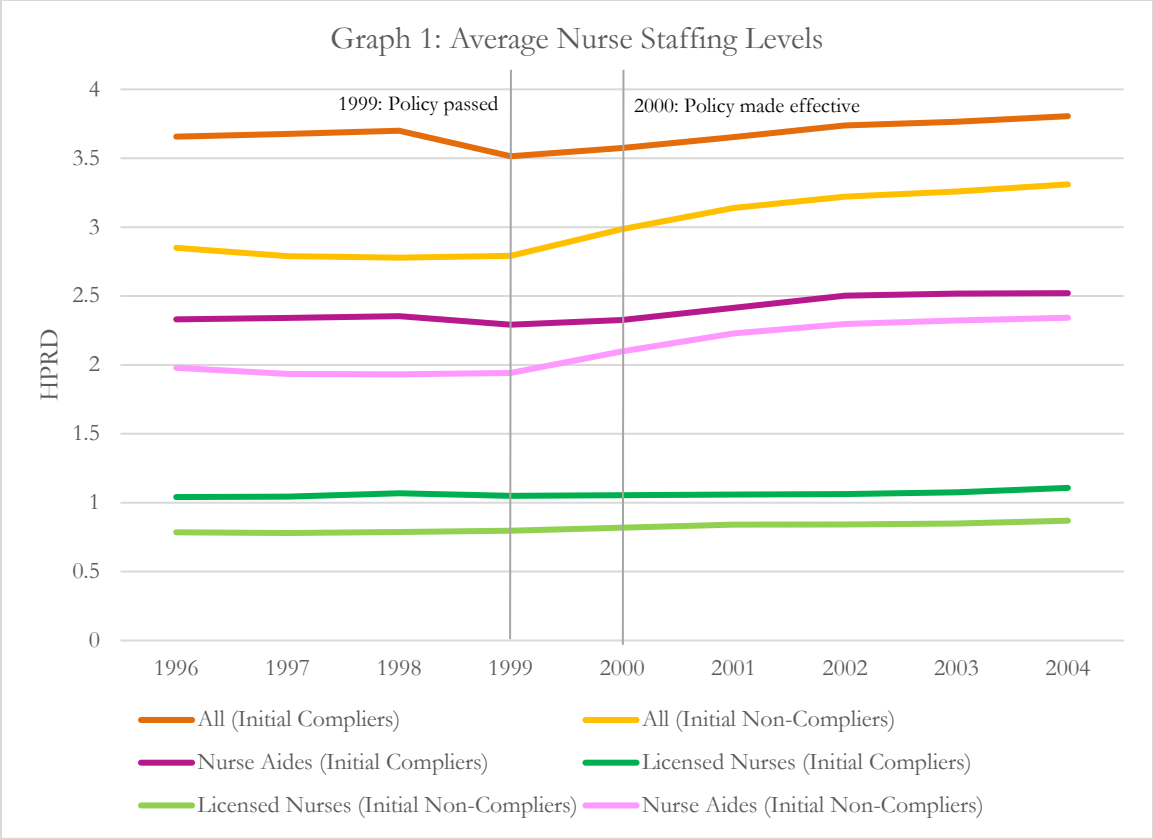
Table 1: Short-term and long-term changes in compliance, staffing, and quality measures

| | Average in 1998 | Average in 2000 | Short-Term Change (2000) |
|---|---|---|---|
| Overall Compliance (%) | 28.6% | 39.9% | 11.3%*** |
| Non-Supervisory Nurse HPRD | 3.0 | 3.2 | 0.11*** |
| Licensed Nurse HPRD | 0.9 | 0.9 | 0.02*** |
| Nurse Aide HPRD | 2.1 | 2.2 | 0.11*** |
| Total Deficiency Citations | 11.8 | 12.4 | 0.60*** |
| Pressure Sore Rate | 0.1 | 0.1 | 0 |
| | | | |
| | Average in 1998 | Average in 2004 | Long-Term Change (2004) |
| Overall Compliance (%) | 28.6% | 70.6% | 42.1%*** |
| Non-Supervisory Nurse HPRD | 3.0 | 3.5 | 0.41*** |
| Licensed Nurse HPRD | 0.9 | 0.9 | 0.07*** |
| Nurse Aide HPRD | 2.1 | 2.4 | 0.34*** |
| Total Deficiency Citations | 11.8 | 10.1 | -1.74*** |
| Pressure Sore Rate | 0.1 | 0.1 | 0 |

*** significant at the 0.01 significant level

**I. The law raised overall nurse staffing levels, primarily through an increase in nurse aide hours**

The effects of the law are estimated by comparing nursing homes that were below the 3.2 HPRD requirement in 1997-98 ("initial non-compliers") to those that met the requirement in the same time period ("initial compliers"). Presumably, the initial non-compliers were most affected by the law from 2000 onwards as it compelled them to raise staff levels, while the initial compliers remained largely unaffected as the law required no action from them. Therefore, assuming that the two groups behave similarly prior to 1999-2000, the difference in their behavior after this point can show the effect of enacting the law. Graph 1 shows that before the law was implemented, the compliers and non-compliers showed a similar trend in their staffing levels, particularly for nurse aides and licensed nurses.




The results, given in Table 2, estimate the effects of the policy on staffing levels for initially non-compliant homes. In other words, they describe how much higher the staffing levels are relative to a scenario in which the policy had not been adopted. By 2001 (or the "short-term"), the policy raised the overall staffing level (i.e. all NS nurses) by 0.16 HPRD or 5.5 percentage points (pp). The long-term effect, observed from 2000 to 2004, is even higher at 0.31 HPRD (or 10.8pp). Closer examination of these trends shows that the increase in nurse aides outweighs that of licensed nurses. While the short- and long-term effects of the policy on licensed nurses' HPRD were 2.7pp and 5.2pp respectively, the effects for nurse aides was nearly double that level at 5.6pp and 9.4pp respectively.

Table 2: Short-term and long-term effects of the policy on staffing levels (in HPRD)

| | Short-Term Effect on HPRD | Long-Term Effect on HPRD |
|---|---|---|
| All (Non-Supervisory Nurses) | 0.16*** | 0.31*** |
| Licensed Nurses | 0.03** | 0.04*** |
| Nurse Aides | 0.11*** | 0.18*** |

| | Short-Term Effect on HPRD (percentage points) | Long-Term Effect on HPRD (percentage points) |
|---|---|---|
| All (Non-Supervisory Nurses) | 5.5 pp*** | 10.8 pp*** |
| Licensed Nurses | 2.7 pp*** | 5.2 pp*** |
| Nurse Aides | 5.6 pp*** | 9.4 pp*** |

*** significant at 0.01 significance level; ** at 0.05 significance level

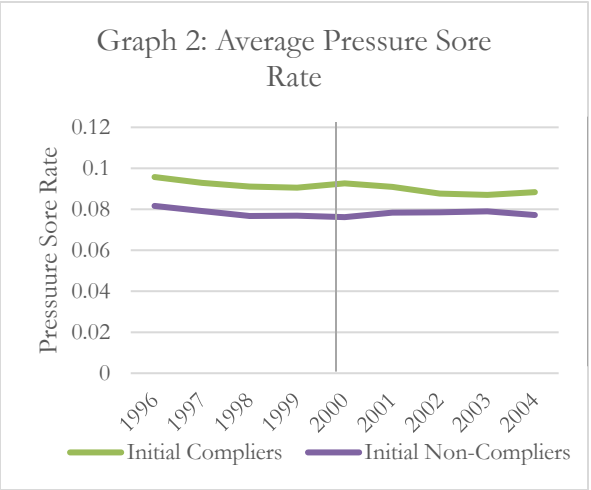
Nurse aides, compared to licensed nurses, receive less formal training, but perform the majority of the daily patient care responsibilities. In this context, it is important to understand how their increased participation given their limited training affects the quality of care provided in nursing homes.

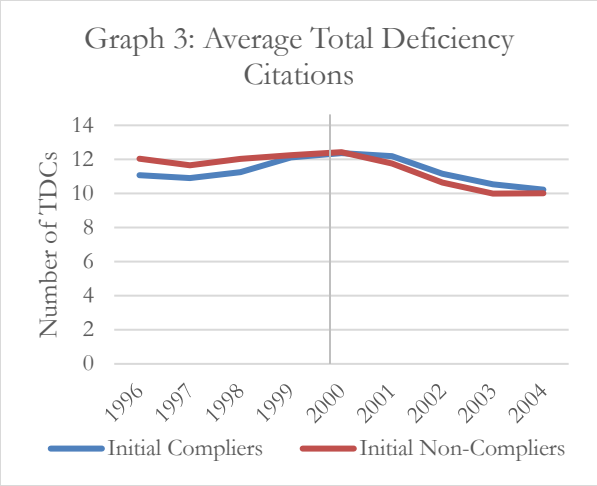
**II. The law had little to no effect on the quality of care provided in nursing homes**

To describe how the policy affects nursing home quality, the analysis presented below uses the change in staffing levels from before and after 1999 to estimate the change in the quality of care. In order to isolate the effects of the policy, the change in staffing levels mentioned above must reflect the changes that are motivated by the policy alone. This is an important consideration because many other factors may influence changes in staffing level such as the county demographics or the local budget. The analysis therefore introduces a measure of how far below an initially non-compliant nursing home was from the 3.2 HPRD requirement in 1997-98. This measure is used to estimate how much staffing levels would change *in response to the policy*.[1] Finally, this isolated change in staffing is used to estimate the change in nursing quality.

Based on the analysis described above, it appears that a change in overall staffing levels caused by the policy has little to no effect measures of quality. There were no significant changes seen for pressure sore rates between 1998 and 2004. Even a simple comparison of

[1] From a technical standpoint, this measure is referred to as an "instrumental variable." The author of this memo considers this instrument to be appropriate because (1) the change in staffing level is conceptually linked to the shortfall of the staffing level from the given requirement; and (2) there is no clear reason to believe that this shortfall affects nursing home quality in any way other than through its effect on the increase in staffing; however, this point may be subject to further debate.




the initially compliant and non-compliant nursing homes (Graph 2) shows a fairly level rate over the years. For TDCs, significant improvement was observed only for changes in 2000 and 2001. That is, the policy-driven changes in staffing levels seen from 1998 to 2000, and 1998 to 2001, resulted in a significant decrease in TDCs by 1.7 and 2.2 units respectively.[2] However, in effect, these results are fairly small in magnitude because, as noted in Section I, the policy is induced a 0.31 increase in NS nurse HPRD. Therefore, the overall policy effect on TDCs would be a decrease of only 0.5 and 0.7 for 2000 and 2001 respectively. This is seen in Graph 3, which shows a small decline in TDC, particularly in 2000-2001.

**Conclusion**

The data related to the 1999-2000 California minimum nurse staffing law indicate that minimum staffing ratios raise the levels of nurse staff, particularly nurse aides, but have no effect on the quality of care, with the exception of a small short-term improvement in TDCs. However, a different composition of the nurse staff may lead to different results. Further research is required to assess whether amending federal law to raise the minimum staffing level for licensed nurses would have a stronger effect on quality outcomes. It must also be noted that these results are most applicable to the state of California in the early 2000s and may not be generalizable to states with different healthcare regulations that may affect quality outcomes in conjunction with the minimum nurse staffing requirement.

[2] The effects, quantified as 1.7 TDCs and 2.2 TDCs, are significant at the 0.1 and 0.05 levels respectively.

```
1   **************
2   *Final - code
3   **************
4
5   *Nivedita Vatsa (nkv4)
6
7   clear
8   set matsize 11000
9   set more off
10
11  *set working directory
12  cd "U:\Final"
13  use ca_minstaff.dta, replace
14
15  *generating a variable for whether firm is compliant with 3.2 HPRD
16  gen comply = (hprd_ns>3.2)
17  gen in_effect = (year>=2000)
18
19
20  ******************************
21  *SECTION I: EXPLORE THE DATA
22  ******************************
23
24  *Just a quick comparison (not used in memo)
25
26
27  *Nurse staffing -- overall increase
28  ttest hprd_ns, by (in_effect) unequal level(95)
29  ttest hprd_na, by (in_effect) unequal level(95)
30  ttest hprd_lic, by (in_effect) unequal level(95)
31
32  *Compliance -- overall increase
33  ttest comply, by (in_effect) unequal level(95)
34
35  *Quality -- overall improvement
36  ttest totdef, by (in_effect) unequal level(95)
37  ttest psore_rate, by (in_effect) unequal level(95)
38
39  *-x-x-x-x
40
41  *reshape
42  drop in_effect
43  reshape wide occup-comply, i(fac_id) j(year)
44
45
46  *(i) Nurse staffing levels per resident per day
47  preserve
48  collapse hprd_ns* hprd_na* hprd_lic*
49  save "average_staffing.dta",replace
50  restore
51
52  *(a) compare the 1999, 2000, & 2004 NS nurse levels to the 1998 levels
53  ttest hprd_ns1998 == hprd_ns1999, level(95)
54  ttest hprd_ns1998 == hprd_ns2000, level(95)
55  ttest hprd_ns1999 == hprd_ns2000, level(95)
56  ttest hprd_ns1998 == hprd_ns2004, level(95)
57
58      *The 1999 levels are not significantly higher than 1998,
59      *But, the 2000 levels are significantly higher than
60      *the 1998 or 1999 levels. This makes sense since the law
61      *came into effect only in 2000. Also, 2004 levels are higher
62
63  *(b) doing the same for nurse aides
64  ttest hprd_na1998 == hprd_na1999, level(95)
65  ttest hprd_na1998 == hprd_na2000, level(95)
66  ttest hprd_na1999 == hprd_na2000, level(95)
67  ttest hprd_na1998 == hprd_na2004, level(95)
68      *No signficant change in 1999. Significant increase by 2000
69      *and 2004.
70
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*(c) doing the same for licensed nurses
ttest hprd_lic1998 == hprd_lic1999, level(95)
ttest hprd_lic1998 == hprd_lic2000, level(95)
ttest hprd_lic1999 == hprd_lic2000, level(95)
ttest hprd_lic1998 == hprd_lic2004, level(95)
    *No signficant change in 1999. Significant increase by 2000
    *and 2004.


*(d) EXTRA (not used): computed the t-tests for only the firms who were initially below
*the 3.2 HPRD level to see whether the already compliant firms were
*distorting the difference

*oddly, the results show that the intitially non-compliant
*firms had either a decrease or no change in their staffing levels

ttest hprd_ns1998 == hprd_ns1999 if below97981996==0, level(95)
ttest hprd_ns1998 == hprd_ns2000 if below97981996==0, level(95)
ttest hprd_ns1999 == hprd_ns2000 if below97981996==0, level(95)
    *Reject null hypothesis that 1998 levels < 1999 or 2000 levels

ttest hprd_na1998 == hprd_na1999 if below97981996==0, level(95)
ttest hprd_na1998 == hprd_na2000 if below97981996==0, level(95)
ttest hprd_na1999 == hprd_na2000 if below97981996==0, level(95)
    *Signficant decrease in 1999. Significant increase by 2000
    *relative to 1999.

ttest hprd_lic1998 == hprd_lic1999 if below97981996==0, level(95)
ttest hprd_lic1998 == hprd_lic2000 if below97981996==0, level(95)
ttest hprd_lic1999 == hprd_lic2000 if below97981996==0, level(95)
      *Signficant decrease in 1999. But no significant change
      *by 2000.

*(e) EXTRA (not used): repeating for the firms who were initially above
*the 3.2 HPRD level to see whether the policy affected their
*staffing levels

*oddly, the results show that the intitially non-compliant
*firms had either a decrease or no change in their staffing levels

ttest hprd_ns1998 == hprd_ns1999 if below97981996==1, level(95)
ttest hprd_ns1998 == hprd_ns2000 if below97981996==1, level(95)
ttest hprd_ns1999 == hprd_ns2000 if below97981996==1, level(95)
    *Significant increase in NS levels by 2000

ttest hprd_na1998 == hprd_na1999 if below97981996==1, level(95)
ttest hprd_na1998 == hprd_na2000 if below97981996==1, level(95)
ttest hprd_na1999 == hprd_na2000 if below97981996==1, level(95)
    *Significant increase in NS levels by 2000

ttest hprd_lic1998 == hprd_lic1999 if below97981996==1, level(95)
ttest hprd_lic1998 == hprd_lic2000 if below97981996==1, level(95)
ttest hprd_lic1999 == hprd_lic2000 if below97981996==1, level(95)
      *Significant increase from 1998 to 1999, and the from
      *1999 to 2000.

*(ii) The fraction of firms in compliance with the 3.2 HPRD standard
preserve
collapse (mean) comply*
save "average_compliance.dta",replace
restore

*checking for differences
ttest comply1998 == comply2000,level(95)
ttest comply1999 == comply2000,level(95)
ttest comply1998 == comply2004,level(95)
    *significant increase by 2000 and 2004

*(iii) Measures of quality care before and after implementation of the staffing law in CA:
preserve
```

```
141   collapse psore_rate* totdef*
142   save "average_quality.dta",replace
143   restore
144
145   *(a) total deficiency citations (TDCs)
146   ttest totdef1998==totdef2000, level(95)
147   ttest totdef1999==totdef2000, level(95)
148   ttest totdef1998==totdef2004, level(95)
149       *we see a decrease by 2000, but interestingly,
150       *there's an increase in TDCs by 2004
151
152   *(b) pressure sore rate
153   ttest psore_rate1998==psore_rate2000, level(95)
154   ttest psore_rate1999==psore_rate2000, level(95)
155   ttest psore_rate1998==psore_rate2004, level(95)
156       *no significant change
157
158   *comparing these measures by compliers and non-compliers
159   gen initial_noncomply = (ahprd9798_q101996<8)
160
161   preserve
162   collapse (mean) hprd_ns* hprd_na* hprd_lic*, by(initial_noncomply)
163   save "average_staffing_groups.dta", replace
164   restore
165
166   preserve
167   collapse (mean) totdef* psore_rate* , by(initial_noncomply)
168   save "average_quality_groups.dta", replace
169   restore
170
171   ********************************
172   *SECTION II: Regression Analysis
173   ********************************
174
175   ******************************************
176   *(A) Do they comply with the law after 2000?
177        *i.e. what happens to staff levels?
178   ******************************************
179
180   use ca_minstaff.dta, replace
181
182   gen comply = (hprd_ns>3.2)
183   gen initial_noncomply = (ahprd9798_q10<8)
184
185   gen in_effect = (year>=2000)
186   gen DID = in_effect*initial_noncomply
187
188   gen year2001 = (year==2001)
189   gen DID2001 = year2001*initial_noncomply
190
191   gen ln_hprd_ns = log(hprd_ns)
192   gen ln_hprd_na = log(hprd_na)
193   gen ln_hprd_lic = log(hprd_lic)
194
195   *Difference-in-differences
196
197   *DiD between initial compliers and non-compliers
198   *(I checked and found no significant difference in the DID
199   *coefficient after including and removing the covariates for
200   *occupation rate, county, and year one by one).
201
202   *(i) Non-supervisory nurses
203
204   *post period is 2000 onwards
205   xi: regress hprd_ns in_effect initial_noncomply DID occup i.county i.year, robust cluster(
      county)
206   xi: regress ln_hprd_ns in_effect initial_noncomply DID occup i.county i.year, robust cluster
      (county)
207
208   *post period is only 2001
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```
xi: regress ln_hprd_ns year2001 initial_noncomply DID2001 occup i.county i.year, robust cluster(county)
xi: regress hprd_ns year2001 initial_noncomply DID2001 occup i.year i.county, robust cluster (county)

*(ii) Nurse aides

*year 2000 onwards
xi: regress ln_hprd_na in_effect initial_noncomply DID occup i.county i.year, robust cluster (county)
xi: regress hprd_na in_effect initial_noncomply DID occup i.county i.year, robust cluster( county)

*only 2001
xi: regress ln_hprd_na year2001 initial_noncomply DID2001 occup i.county i.year, robust cluster(county)
xi: regress hprd_na year2001 initial_noncomply DID2001 occup i.county i.year, robust cluster (county)

*(iii) Licensed nurses

*year 2000 onwards
xi: regress ln_hprd_lic in_effect initial_noncomply DID occup i.county i.year, robust cluster(county)
xi: regress hprd_lic in_effect initial_noncomply DID occup i.county i.year, robust cluster( county)

*only 2001
xi: regress ln_hprd_lic year2001 initial_noncomply DID2001 occup i.county i.year, robust cluster(county)
xi: regress hprd_lic year2001 initial_noncomply DID2001 occup i.county i.year, robust cluster(county)

************************************************
*(B) Does an increase in staffing improve quality?
************************************************

*(note: I don't use logs of the outcome because there are many values for
*quality that are equalto zero)

*Quick naive comparison (not used in memo)
regress totdef hprd_ns occup _Iyear_* _Icounty_*,robust
regress totdef hprd_ns occup _Iyear_* _Icounty_* if year>=1999,robust
    *negative significant effect

regress psore_rate hprd_ns occup  _Iyear_* _Icounty_*,robust
regress psore_rate hprd_ns occup  _Iyear_* _Icounty_* if year>=1999,robust
    *oddly, there's a positive significant effect

*Instrumental variables (used in memo)

*Using the change in staffing levels as a predictor of the change in
*quality. If the policy were effective, a greater (+ve) change in
*staffing would lead to a greater improvement in quality (-ve effect).

*The changes in staffing levels are predicted (first stage) by
*how far below the home is from the 3.2 requirement. Since the
*changes in staffing can be motivated by many factors that you can't
*control for such as budget, demographic changes, etc., the best
*way to capture the change in staffing motived by the POLICY ONLY
*is to use how much the home falls short of the requirement (or
*how much improvement is needed).

*Using changes in variables instead of absolute measures because
*you're interested in how the initial non-compliers (who showed
*most change) reacted to the policy change. So the shortfall will
*be better correlated with the subsequent increase -- this also makes
*it better for the "relevance condition" for IV using "below9798."

preserve
```

```
269
270   *reshaping again
271   drop in_effect DID* year2001 ln_hprd_* _Iyear_*
272   reshape wide occup-comply, i(fac_id) j(year)
273   rename(gap97981996)(gap9798_all)
274   drop gap97981* gap97982*
275
276   *"change" variables - change from 1998 to 200x
277   forvalues i = 0(1)4{
278   gen change_hprd_ns980`i' = hprd_ns200`i' - hprd_ns1998
279   gen change_totdef_980`i' = totdef200`i'-totdef1998
280   gen change_psore_rate_980`i' = psore_rate200`i'-psore_rate1998
281   gen change_occup_980`i' = occup200`i'-occup1998
282   }
283
284   *regression - 2000
285   ivregress 2sls change_totdef_9800 change_occup_9800 _Icounty_* (change_hprd_ns9800=
      gap9798_all), first robust
286       *significant & -ve (beta = -1.65 and p-value = 0.076)
287   ivregress 2sls change_psore_rate_9800 change_occup_9800 _Icounty_* (change_hprd_ns9800=
      gap9798_all), first robust
288       *insignificant
289
290   *regression - 2001
291   ivregress 2sls change_totdef_9801 change_occup_9801 _Icounty_* (change_hprd_ns9801=
      gap9798_all), first robust
292       *significant & -ve (beta = -2.19 and p-value = 0.022)
293   ivregress 2sls change_psore_rate_9801 change_occup_9801 _Icounty_* (change_hprd_ns9801=
      gap9798_all), first robust
294       *insignificant
295
296   *regression - 2002
297   ivregress 2sls change_totdef_9802 change_occup_9802 _Icounty_* (change_hprd_ns9802=
      gap9798_all), first robust
298       *insignificant
299   ivregress 2sls change_psore_rate_9802 change_occup_9802 _Icounty_* (change_hprd_ns9802=
      gap9798_all), first robust
300       *insignificant
301
302   *regression - 2003
303   ivregress 2sls change_totdef_9803 change_occup_9803 _Icounty_* (change_hprd_ns9803=
      gap9798_all), first robust
304       *insignificant
305   ivregress 2sls change_psore_rate_9803 change_occup_9803 _Icounty_* (change_hprd_ns9803=
      gap9798_all), first robust
306       *insignificant
307
308   *regression - 2004
309   ivregress 2sls change_totdef_9804 change_occup_9804 _Icounty_* (change_hprd_ns9804=
      gap9798_all), first robust
310       *insignificant
311   ivregress 2sls change_psore_rate_9804 change_occup_9804 _Icounty_* (change_hprd_ns9804=
      gap9798_all), first robust
312       *insignificant
313
314   restore
315
316   *SANITY CHECK: Trying difference-in-differences
317   *(not discussed in detail in memo because the IV answers whether the
318   *the benefits of nurse staff are exaggereated and seems to follow the
319   *suggested tips more closely).
320
321   *year 2000 onwards
322   regress totdef in_effect initial_noncomply DID occup i.county i.year, robust cluster(county)
323       *no significant effect
324
325   *only 2001
326   regress totdef year2001 initial_noncomply DID2001 occup i.county, robust cluster(county)
327       *significant negative effect, but very small in magnitude
328       *beta = -0.6657044 ; p-value = 0.085
```

```
329       *it's also close the effect found for IV
330
331   *year 2000 onwards
332   regress psore_rate in_effect initial_noncomply DID occup i.county i.year, robust cluster(
      county)
333       *no significant effect
334
335   *only 2001
336   regress psore_rate year2001 initial_noncomply DID2001 occup i.county, robust cluster(county)
337       *no significant effect
338
339   *do-file ends here
340
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396   /*
397   *TRYING CATEGORICAL INSTRUMENTS
```

```
rename(ahprd97981996)(ahprd9798_all)
drop ahprd97981* ahprd97982*
ivregress 2sls change_totdef_9801 occup2001 _Icounty_* (change_hprd_ns9801=ahprd9798_all), first robust
ivregress 2sls change_psore_rate_9801 occup2001 _Icounty_* (change_hprd_ns9801=ahprd9798_all), first robust

rename(below97981996)(below9798_all)
drop below97981* below9798
ivregress 2sls change_totdef_9801 occup2001 _Icounty_* (change_hprd_ns9801=below9798_all), first robust
ivregress 2sls change_psore_rate_9801 occup2001 _Icounty_* (change_hprd_ns9801=below9798_all), first robust
*/


/*
*another IV
**just use all change variables
ivregress 2sls totdef2002 (hprd_ns2002=gap9798_all), first robust
ivregress 2sls psore_rate2002 (hprd_ns2002=gap9798_all), first robust

ivregress 2sls totdef2003 (hprd_ns2003=gap9798_all), first robust
ivregress 2sls psore_rate2003 (hprd_ns2003=gap9798_all), first robust

ivregress 2sls totdef2004 (hprd_ns2004=gap9798_all), first robust
ivregress 2sls psore_rate2004 (hprd_ns2004=gap9798_all), first robust

/*
*one more IV
gen change_hprd_ns_9802 = hprd_ns2002-hprd_ns1998
ivregress 2sls totdef2002 (change_hprd_ns_9802=gap9798_all), first robust
ivregress 2sls psore_rate2002 (change_hprd_ns_9802=gap9798_all), first robust

gen change_hprd_ns_9803 = hprd_ns2003-hprd_ns1998
ivregress 2sls totdef2003 (change_hprd_ns_9803=gap9798_all), first robust
ivregress 2sls psore_rate2003 (change_hprd_ns_9803=gap9798_all), first robust

gen change_hprd_ns_9804 = hprd_ns2004-hprd_ns1998
ivregress 2sls totdef2004 (change_hprd_ns_9804=gap9798_all), first robust
ivregress 2sls psore_rate2004 (change_hprd_ns_9804=gap9798_all), first robust
*/

/*
*Other instruments

ivregress 2sls totdef (hprd_ns=below9798), first robust
ivregress 2sls psore_rate (hprd_ns=below9798) if year>2000, first robust

ivregress 2sls totdef (hprd_ns=ahprd9798_q10), first robust
ivregress 2sls psore_rate (hprd_ns=ahprd9798_q10) if year>2000, first robust
*/

/*
*IV - absolute (long)
ivregress 2sls totdef (hprd_ns=gap9798), first robust
ivregress 2sls psore_rate (hprd_ns=gap9798), first robust
*/
```