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ABSTRACT

We examine the effect of HIV/AIDS infection risks on the earnings of registered nurses (RNs) and other health care workers by combining data on metropolitan statistical area (MSA) AIDS prevalence rates with annual 1987 –2001 Current Population Survey (CPS) and quadrennial 1988 –2000 National Sample Survey of Registered Nurses (SRN) data. Holding constant wages of control groups that are likely not exposed to AIDS risks and group-specific MSA fixed effects, a 10 percent increase in the AIDS rate raises RN earnings by about 0.8 percent in post-1992 samples, when AIDS rates were falling but a more comprehensive categorization of AIDS was used by the CDC. AIDS wage differentials are much larger for RNs and non-nursing health practitioners than for other nursing and health care workers, suggesting that this differential represents compensation paid for job-related exposure to potentially HIV-infected blood.

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I. Introduction

The labor market for health care workers has changed substantially over the past two decades. Medicare prospective payment system adoption, managed care evolution, hospital industry consolidation and rapid technological change all had considerable effects on the health care employment environment.[1] During that time, acquired immunodeficiency syndrome (AIDS) emerged as a top public health issue, as health practitioners and researchers scrambled to first understand the nature of the disease and then devise methods to reduce both its transmission and lethality. AIDS has had a profound effect on the health care sector, as funds have been poured into research for effective treatments and a vaccine while clinicians and administrators have struggled to contain costs of patient care while finding ways to finance it. Despite this, the impact of AIDS on health care labor markets has received scant attention from economists.

AIDS occurs through infection with human immunodeficiency virus (HIV), which is transmitted by blood-to-blood and sexual contact. HIV causes AIDS by destroying CD4+ T blood cells that are crucial to immune system functioning, though people infected with HIV can carry the virus for years before the immune system is sufficiently damaged for AIDS to develop. An HIV-infected person is diagnosed with AIDS after developing one of the CDC-defined AIDS indicator illnesses or on the basis of CD4+ counts.

The first U.S. AIDS case was reported in June 1981. The number of reported AIDS cases increased each subsequent year, partially because of expansions in case definitions in 1985, 1987 and 1993, until peaking at 104,759 in 1993. Reported cases declined each year thereafter until reaching a low of 40,307 in 2000, as awareness about how to avoid contracting HIV grew and increasingly effective treatment delayed progression of HIV infection to AIDS, and then rose

[1] For a discussion of these issues, see Buerhaus and Staiger (1996), Gaynor and Haas-Wilson (1999), Schumacher (2001) and Spetz (1999).

again to 41,334 in 2001 and 42,651 in 2002. Of the 830,274 people in the U.S. diagnosed with AIDS through 2002, 483,615 have died (CDC, various years).

Since HIV is transmitted through blood and other bodily fluids, including those surrounding the brain, spinal cord, bone joints, and unborn babies, health care workers who provide patient care risk contracting HIV from infected patients. Workers presumably require monetary compensation for the potential risk of contracting HIV and the burden of increased precautions required to avoid this risk, relative to similar jobs that do not involve HIV/AIDS risk. In particular, the theory of compensating wage differentials holds that jobs having relatively unpleasant characteristics must offer higher wages than otherwise similar jobs in order to attract workers, with the equilibrium wage premium being just enough to compensate workers for having to deal with the unpleasantness. A health care example of this is the finding of Schumacher and Hirsch (1997) that wages for registered nurses (RNs) employed in hospitals are 20 percent higher than are those of comparable RNs employed elsewhere. The authors attribute about half of this differential to the less desirable working conditions of hospitals relative to other settings in which RNs work.

Through the end of 2000, 57 health care workers, including 24 nurses, were known to have acquired HIV following occupational exposure, and 25 of them had developed AIDS. All but seven of these workers were exposed to HIV-infected blood. Another 138 cases of HIV infection or AIDS are documented as having occurred among health care workers, 35 of whom were nurses, who reported no other risk factors and a history of occupational exposure to blood, body fluids, or HIV-infected laboratory material (CDC 2001). Even though such incidents represent an extremely small fraction of the nursing and overall health care workforces, the threat of HIV infection is of great concern to potentially exposed workers because the

consequences are so severe (Boland 1990). In addition, workers might bear some of the time and inconvenience costs associated with infection prevention.

Some effects of AIDS on nurses have been studied in the nursing trade literature (e.g. Boland 1990, Cole and Slocumb 1993, Worthington 2001). However, only one study has examined the potential impact of AIDS on health care labor markets. Using 1987–1993 Current Population Survey (CPS) data on earnings of nurses in 43 metropolitan statistical areas (MSAs), Faucher (1996) finds that AIDS prevalence at the MSA level is positively associated with RN wages. This is the relationship predicted by compensating wage differential theory: as AIDS rates rise, so does the chance that a nurse will encounter a patient with AIDS, and hence the risk of HIV/AIDS transmission. Estimates imply that AIDS raised RN wages by three to four percent and reduced hours worked by over one percent. These results persist when MSA fixed effects are included in the regressions.

Our paper examines the effects of AIDS rates on the wages of health care workers over the 1987–2001 period. Like Faucher (1996), our main analysis combines MSA-level AIDS prevalence data with annual CPS data.[2] Because the CDC changed the definition of AIDS in 1993 to encompass cases that previously would not have been categorized as AIDS, we separately analyze the 1987–1992 and 1993–2001 periods. This coincidentally divides the data into distinct eras of rising and declining AIDS rates, as well as rapidly rising followed by relatively flat RN real wages. We estimate AIDS wage differentials for three different categories of health care workers – RNs, licensed practical nurses (LPNs) and nursing aides, and remaining workers in the health care industry – focusing on the differential wage impact of AIDS for workers employed within and outside of the health care sector and allowing health care wages to

[2] Ideally we would use prevalence rates for HIV rather than AIDS. However, HIV prevalence data are not available for most of the period, and in any case are likely to be incomplete since many HIV-infected people do not realize they have HIV until AIDS develops.

vary by MSA.

Our results show a large AIDS-related wage differential for RNs. Specifically, we find that a 10 percent increase in the local MSA AIDS rate raises the wage for RNs, relative to that for comparable non-health care workers, by nearly one percent. The analogous effect is only slightly smaller for non-nursing health care practitioners but is much smaller and insignificant for remaining health care workers, consistent with the relative exposure each group likely has to HIV/AIDS.

To further investigate whether RNs receive an AIDS wage premium, we examine data from the quadrennial 1988–2000 National Sample Survey of Registered Nurses (SRN). By definition there are no non-RN control groups in the SRN, and the 1993 AIDS definition change dictates that we divide the data into pre- and post-1993 samples each containing only two years of data. In order to both compare the RN wage premium to that potentially received by similar workers from outside of health care and account for potential MSA-specific effects, therefore, our specification includes the average CPS wage for college educated non-health care workers in the MSA of residence and survey year as an additional explanatory variable. Results are quite similar to those for RNs from the CPS.

The paper proceeds as follows. In the next section we lay out our methodology for estimating the compensating wage differential associated with AIDS risks. We then describe the CPS and AIDS data in Section III, present our main results in Section IV, discuss the SRN data and results in Section V, and conclude in Section VI.

II. Methodology

In order to estimate the impact of AIDS risks on the earnings differential between

workers within and outside the health care sector, the effect of AIDS needs to be isolated from effects of other factors that are correlated with AIDS rates and also influence earnings. Our basic regression specification thus allows both the wage effects of AIDS and wage trends to vary across sectors. For instance, when the health care group of interest is RNs, we construct a sample that includes not only RNs but also workers employed in sectors other than health care who are comparable to RNs (in terms of educational attainment), and estimate the equation

$$(1) \qquad \ln W_i = X_i\alpha + \beta_1 AIDS_m + \beta_2 (AIDS_m \times RN_i) + \beta_3 RN_i + YEAR_t\delta + (YEAR_t \times RN_i)\gamma + \varepsilon_i .$$

In equation 1, $\ln W_i$ is the log of the hourly wage for worker *i*, X_i is a vector of human capital and other individual characteristics that affect earnings, $AIDS_m$ represents the AIDS rate in MSA *m*, RN_i is an indicator that worker *i* is an RN, $YEAR_t$ is a vector of year indicators, "×" represents an interaction between two variables, ε_i is an error term that is uncorrelated with the vector of explanatory variables, and vectors α, δ, and γ along with scalars β_1, β_2, and β_3 are parameters to be estimated. The coefficient of interest is β_2, which indicates the effect of AIDS on wages of RNs net of AIDS wage effects that are not sector specific. These latter effects, captured by β_1, include factors correlated with AIDS rates that are also correlated with wages, perhaps such as the crime rate, city size, or demand for AIDS-related services. Alternatively, there could be an overall compensating differential to everyone in communities that have higher AIDS rates. Other fixed wage differences between RNs and non-health care workers are captured by β_3, and sector differences over time in wage movements are captured by δ and γ.

A weakness of equation 1 is that wage variations across MSAs that result from differences in other factors not controlled for in the equation but are correlated with cross-MSA differences in AIDS rates are incorrectly attributed to AIDS rate variations. A more complete

specification allows both average wages and the wage differential between RNs and other workers to vary by MSA:

$$\ln W_i = X\alpha + \beta_1 AIDS_m + \beta_2 (AIDS_m \times RN_i) + \beta_3 RN_i + YEAR_t\delta + (YEAR_t \times RN_i)\gamma + MSA_m\phi + (MSA_m \times RN_i)\lambda + \varepsilon_i \quad (2)$$

In equation 2, β_2 is again the coefficient of interest, but MSA indicators explicitly capture MSA-specific wage effects that do not vary across time, while interactions between the MSA and RN indicators control for time-invariant MSA-specific differentials between the wages of RNs and non-health care workers.

We estimate equations 1 and 2 separately for three groups of health care workers: RNs, a combined group of LPNs and nursing aides, and health care workers not included in the first two groups. All regressions are estimated by OLS, with standard errors adjusted for both clustering by MSA and heteroskedasticity of unknown form.

III. CDC & CPS Data

Our AIDS rate information comes from the CDC, which publishes annual data on AIDS cases reported to them for all MSAs with populations of 500,000 or more. For consolidated MSAs that consist of several primary MSAs (e.g. New York, Los Angeles, Chicago), rates are reported for all primary MSAs within the consolidated MSA that meet the population criterion. Rates are available for 107 MSAs during the sample period, which is restricted to 1987–2001 by two facets of the AIDS data: the CDC changed its definition of what constituted an AIDS case in 1987, making previous reported rates non-comparable, and MSA-level data were available only through 2001 when we conducted the analysis.

A third aspect of the AIDS data forces us to split the samples into two between 1992 & 1993: in 1993 the CDC again changed its definition of AIDS. Before 1993, the definition

included only AIDS opportunistic illnesses. However, because most HIV-infected people become severely immunosuppressed (low CD4+ count) before the onset of such illnesses, in 1993 the definition was expanded to include a laboratory measure of immunosuppression along with three additional clinical conditions (pulmonary tuberculosis, recurrent pneumonia, and invasive cervical cancer) (CDC 1995). Consequently, the number of AIDS cases reported in the U.S. jumped from 47,293 in 1992 (after increases of less than five percent the previous two years) to 104,759 in 1993. Besides rendering pre- and post-1993 data non-comparable, a potentially important effect of this change is that it makes the AIDS rate a better proxy for the probability of HIV infection. This suggests that the compensating wage differentials observed in the post-1993 period will be larger, and more reflective of the actual compensation that health care workers receive for AIDS risk, than those observed in the pre-1993 samples.

Table 1 lists summary statistics for the AIDS data by year at the MSA level (using CPS sample weights). The 1993 definition expansion is evident from the more than twofold increase in cases between 1992 and 1993. After almost doubling from 1987–1992, the mean rate fell threefold during 1993–2001, with most of the decline occurring by 1998. The sizable standard deviations indicate that rates vary widely across MSAs.

AIDS rates are matched by MSA to individual responses from the 1987–2001 monthly Outgoing Rotation Group files of the CPS, which provides large samples of workers both within and outside of the health care industry. The CPS identifies location of residence for 202 MSAs with populations of at least 100,000. In each year, our samples include respondents living in MSAs for which the CPS contains at least seven workers of each type and the CDC reports AIDS data.[3] Health care workers are classified into three categories: RNs, LPNs and nursing

[3] Our results are similar when we require the CPS to contain at least 20 workers of each type in the MSA that year in order to include the MSA/year in the sample.

aides, and other health care workers. Our control group typically consists of workers who are not employed in the health care sector and have educational attainment similar to that of the comparison group, which we define as at least 16 years of school for RNs and 12–15 years for the other two health care groups. Physicians are omitted because the CPS top-codes income, meaning that actual wages are likely to exceed observed wages for most physicians.

Hourly earnings are defined as usual weekly earnings divided by usual hours worked per week and converted to 2001 dollars using the CPI for all urban consumers. For the small percentage of workers in the sample who are above the earnings top code ($999 in 1987–88, $1,923 in 1989–97 and $2,885 in 1998–2001), we assign the mean above the cap, which is calculated using the assumption that the upper tail of the earnings distribution follows a Pareto distribution.[4] A small number of workers with implicit hourly wages of less than $3 and greater than $150 are omitted. Individual characteristics included as explanatory variables are: years of schooling and years of experience, both in quadratic form; indicators for health care group, gender, race/ethnicity (African American, Hispanic, and white), marital status (currently and previously married), part-time status, union status, public employment and year; and interactions between health care group and year and between both years of experience terms and gender.

Table 2 displays descriptive characteristics by group over the period and is useful for understanding our group selections. Hourly wages are substantially higher for RNs and lower for LPNs/aides than for the other two groups. The same holds for schooling. RNs are also more likely to be female, in a union, employed part time or in a hospital, and married. Sample sizes are smaller for RNs and LPNs/aides (the main reason for combining LPNs and aides into a single group) than for other health care workers.

[4] Hirsch and Macpherson (2002, p. 6) provide estimates of gender-specific means above the cap for 1973–2001. For observations with non-positive usual hours worked per week or "variable hours" (after 1994), we use hours worked the previous week. Absent information on hours worked, observations are dropped.

To illustrate relative wage movements for the different groups of workers during the period, we construct an adjusted wage index for each group. A separate log wage equation, with the same set of explanatory variables as listed earlier, is estimated for each group. Indexes are calculated from the year indicator coefficients, with the value set to 100 in 1987 (the omitted first year of the series). Figure 1 displays these indexes. The 1987–1993 period was one of rapidly rising RN wages: an RN earned almost 15 percent more in 1993 than did an RN with identical observed characteristics in 1987. Wage growth for the other groups during this period was slower, and wages actually declined for non-health workers. During 1993-2001, wages of health care workers first fell and then rose. Since 1993, RN wage growth has been similar to that of wages for college educated females working outside of nursing.

IV. CPS Results

a. 1993–2001

Table 3 displays estimation results for the 1993–2001 CPS samples. The columns without primes (') show estimates of equation 1, which omits MSA indicators and interactions between MSA and health care group indicators, while those with primes show estimates of equation 2, which contains MSA indicators and interactions. The first line shows the coefficient on the logged AIDS rate, which is the estimated average impact of AIDS on wages of control group workers. The second line shows the coefficient on the interaction between the logged AIDS rate and the health care group indicator, which is the estimated average additional impact of AIDS on health care workers beyond any impact on control group workers, i.e. the compensating wage differential for health care workers because of AIDS risks, and is therefore the line upon which we focus.

Specifications 1 and 2 estimate AIDS wage effects for RNs. Columns 1 and 1' compare RNs with non-health care workers who have completed at least 16 years of schooling, i.e. are college graduates.[5] The estimated AIDS wage differential in column 1' is 70 percent larger than that in column 1 and is statistically significant, implying that a 10 percent AIDS rate increase raises RN wages by 0.8 percent relative to wages of comparable workers outside the health care sector. Columns 2 and 2' compare RNs with health care workers who are not RNs, LPNs or nursing aides. The estimated AIDS wage differential is again positive and significant and, regardless of whether MSA indicators and interactions are included, is about two-thirds the size of the column 1' differential. These results suggest that RNs earn a wage premium because they risk infection with HIV/AIDS as part of their jobs, and that this premium is relative not only to wages of workers outside of health care but also, albeit with slightly smaller magnitude, to wages of other health care workers who likely have less exposure to HIV/AIDS than do RNs.

Specification 3 compares the LPN/nursing aide group to workers outside the health care sector who have 12–15 years of schooling, a restriction imposed here and in remaining specifications in order to make more comparable the average educational attainment between the health care and control groups. The AIDS wage differential is paradoxically negative and significant when MSA indicators and interactions are omitted, but adding these indicators and interactions renders the differential insignificant. The absence of an AIDS-related wage premium for LPNs and nursing aides is not surprising, to the extent that these types of nurses have substantially less exposure to blood and other potentially HIV-infected bodily fluids than do RNs because of restrictions on the types of procedures that LPNs and aides are allowed to perform (e.g. in some states LPNs cannot draw blood).

The remaining three specifications compare other health care workers to the group of

[5] Further restricting this group to females yields similar results.

workers from outside health care. Columns 4 and 4' include all health care workers who are not RNs, LPNs, and nursing aides. The estimated AIDS wage differential for this group is only slightly more than one-quarter the size of that for RNs in specification 1, and becomes only marginally significant when MSA indicators and interactions are added. We further divide the other health care group, based on occupation, into practitioners and non-practitioners in order to isolate workers who are likely to have direct contact with patients and examine whether AIDS wage premiums are larger for this group, as our compensating wage differential explanation for these premiums would suggest. Indeed, the estimated differential for practitioners in column 5' is significant and twice as large as that for non-practitioners in column 6', though it is only about one-half the magnitude of that for RNs.

In Table 3 we thus observe AIDS wage differentials that are large for RNs, smaller for non-nursing health care practitioners, and insignificantly different from zero for other nurses and non-nursing non-practitioners. It appears, then, that the size of the AIDS wage differential diminishes along with on-the-job exposure to HIV/AIDS infection risks, taking into account the extent to which each group has patient contact and is allowed or required to engage in procedures that involve exposure to potentially HIV-infected bodily fluid as part of their work duties. This pattern suggests that the AIDS wage differential is in fact compensation for infection risk.

A large proportion of interaction between health care workers and AIDS patients occurs in hospitals. Since RNs are more likely to work in hospitals than are other health care workers, while LPNs and nursing aides are less likely to do so (Table 2), a potential alternative explanation for the estimated AIDS wage differentials is that they simply reflect the extent to which each group works in hospitals. In results not shown, we split the samples into those employed in hospitals and elsewhere. For RNs, the AIDS wage differential is quite similar to

that shown in column 1' of Table 3 in both the hospital and non-hospital samples. Likewise, the differential for other healthcare workers is largely unchanged, whereas the differential for the LPN/aides group is virtually zero both in and out of hospitals. Although the lack of importance of working in a hospital may seem surprising at first, many RNs who work outside of hospitals are employed in places such as surgery centers where they have comparable exposure to potential HIV/AIDS infection.

This suggests that the significant AIDS wage differential for RNs relative to LPNs and aides is a consequence not of differences in employment setting, but rather of differences in job attributes, particularly in the amount contact with needles, blood and other potentially infected bodily fluid. Additionally, RNs generally have more education and skills than LPNs and aides, and therefore might possess greater job mobility. With a wider employment opportunity set, RNs would require compensation to work in environments with greater risk of HIV/AIDS infection to a greater extent than would LPNs and aides.

To check the robustness of the estimated AIDS wage differential for RNs to possible alternative explanations, we ran two modified versions of the column 1' specification. To address the possibility that the differential is being driven by a strong positive correlation between AIDS rates and nursing wages in a few large metropolitan areas with particularly high AIDS rates and wages, we added the triple interaction term between the AIDS rate, the RN indicator and an indicator that the AIDS rate in the MSA is in the top 10 percentile of rates for that year. However, the estimated AIDS wage differential is unchanged and the additional interaction term is insignificant. Another data artifact that could drive the results is the inflation of AIDS cases in 1993, and possibly subsequent years to a lesser degree, when the newly expanded case definition added to AIDS counts not only people truly making the transition to

AIDS in 1993, but also those who were not previously considered to have AIDS but would have been by the new definition if that definition had been used earlier. Splitting the 1993–2001 sample into early and later periods, though, yields results that are quite similar to those shown, suggesting that the wage effect is relatively constant over this period despite any impact of the 1993 case definition change.

The addition of MSA indicators has a large effect on the estimated AIDS wage differential, particularly for RNs and other health care practitioners. One possible explanation is the relationship between market size and earnings. Hirsch and Schumacher (1995) find an inverse relationship between relative nursing wages and market size (contrary to the monopsony hypothesis), potentially attributable to a correlation between market size and unmeasured worker and job quality attributes. Because AIDS rates increase with market size, if unmeasured quality rises more slowly with respect to market size for RNs and other health care practitioners than for others, when MSA indicators are not included the coefficient on the interaction between the AIDS rate and RN/practitioner group indicators will include a negative component along with any actual AIDS wage differential. Since this is a geographic phenomenon that does not vary across time, MSA indicators absorb these unmeasured differences so that the interaction between the AIDS rate and RN/practitioner indicators reflects the actual AIDS wage differential.

In each specification, the estimated overall AIDS effect is positive, large and significant without MSA indicators and interactions, but becomes small and insignificant when these indicators and interactions are added. A likely reason is that larger cities have both higher costs of living and higher AIDS rates, creating a spurious positive correlation between AIDS rates and wages in the absence of MSA indicators. Since this correlation persists over time, i.e. is again a phenomenon created purely by geographic variation, it is absorbed by the MSA indicators when

they are added to the model.

b. 1987–1992

Table 4 shows estimated AIDS wage differentials for the same specifications as in Table 3, but using 1987–1992 data in which AIDS counts are determined by the 1987 CDC definition that encompasses substantially fewer cases than does the 1993 definition. The RN differential in column 1' is only half the size of the analogous differential in Table 3 and is no longer significant. Similarly, the differentials for RNs in column 2' and other health practitioners in 5' are much smaller than in Table 3 and have also become insignificant. For no group does there appear to be a significant AIDS wage differential during 1987–1992.

A possible explanation is that wages took awhile to adjust to HIV/AIDS risks and did not fully do so until the later period. However, such slow wage adjustment seems unlikely given that the earlier period involved much more uncertainty regarding the ways in which HIV could be contracted. In particular, many thought HIV could be transmitted much more easily than is actually the case, so that if anything a larger differential might be expected in the earlier period.

The likely reason the differential is instead smaller, and for most specifications non-existent, is the AIDS definition itself. Based on the time trend in cases in CPS MSAs (as shown in Table 2) and in the U.S. as a whole (as described earlier), roughly twice as many cases were reported using the new definition in 1993 as would have been reported if the 1987 definition had still been used. Perhaps as important is that these newly counted cases were primarily less severe than those previously counted in that they represented severely immunosuppression that occurred before the onset of AIDS opportunistic illnesses. Thus it seems that differences in measured AIDS rates across locations and time did not reflect true differences in HIV/AIDS risks before 1993 because the 1987 AIDS definition failed to capture many types of AIDS cases

that involved risks of HIV infection. Presumably this is because HIV infection risks are what truly matter, and the 1987 definition excluded many pre-symptomatic cases from the AIDS count that involved HIV risks for workers who cared for patients with HIV.

V. SRN – Data and Results

Although the pattern of results observed in the CPS data seems plausible, replication of this pattern in different data would provide some assurance that our hypothesized explanations are accurate. In an attempt to do so, we turn to the National Sample Survey of Registered Nurses (SRN), a voluntary survey of roughly 30,000 licensed RNs conducted every four years by the Bureau of Health Professions. To match the time periods analyzed in the CPS, we form a pre-1993 sample by pooling the 1988 and 1992 SRN and a post-1993 sample by pooling the 1996 and 2000 SRN.

Because the SRN samples only RNs, we can neither analyze other nursing or health care workers nor include a control group in the sample. As an alternative method of estimating the AIDS wage differential, therefore, we include as an explanatory variable the average log wage for the CPS non-health care college educated group (the same control group as used in columns 1 and 1' of Tables 3 and 4), specific to MSA and year. We thus estimate the wage equation

$$\ln W_i = X_i\alpha + \beta_1 AIDS_m + YEAR_t\delta + (\overline{NH \ln W}_i)\gamma + \varepsilon_i, \quad (3)$$

where $(\overline{NH \ln W}_i)$ is the average log wage of the non-health care control group in the RN's MSA for the year of observation. Since the estimated β_1 indicates the effect of AIDS on RN wages while holding wages of comparable workers from outside health care constant, it effectively serves as an estimate of the AIDS wage differential. Inclusion of the non-health average wage also controls for city-specific differences in cost of living and other determinants of overall wage levels, though in an alternative

specification we also include MSA indicators. Other explanatory variables in the SRN regressions include indicators for nine age categories (eight five-year groups between 25 and 64 along with age 65+, with under 25 years old as the omitted group: more specific age information is unavailable), being currently and previously married, having children younger than six and any children but none younger than six in the house, eight Census divisions and one of the two years.

Table 5 displays the SRN results. For the 1988–1992 sample, the positive AIDS effect estimated in column 1 diminishes in magnitude by 60 percent once the control wage variable is added in column 2, and becomes insignificant once MSA indicators are added in column 3. In contrast, the estimated AIDS effect for the 1996–2000 sample is twice as large in column 4 as for the earlier sample in column 1, and declines in magnitude only slightly when the control wage variable is added in column 5. The effect size falls by more than half when MSA indicators are added in column 6, but remains positive and nearly significant.

The SRN results thus are broadly consistent with those for RNs in the CPS: an AIDS wage differential exists but it is much smaller using the 1987 AIDS definition in pre-1993 data than using the 1993 definition in post-1993 data. In particular, the estimates from the models that include the control wage but not MSA indicators, i.e. those in columns 2 and 5 of Table 5, are quite similar to those in columns 1' of Tables 4 and 3, respectively. The estimates in both Tables 3 and 5 indicate an AIDS wage differential of 0.8 percent for a 10 percent increase in the AIDS rate. Analogously, both the Table 4 and 5 estimates reveal a substantially smaller effect in the earlier period: the CPS estimate is larger but only the SRN estimate is significant. Even the column 3 and 6 estimates in Table 5 parallel the CPS results, though with only two years of data, separated by four years, in each SRN sample, and the control wage variable already accounting for cross-MSA wage differences, including MSA indicators might be asking too much of the

data. Overall, the appearance of the same AIDS wage differential pattern for the two time periods in two independent data sets provides strong support for our hypotheses of a compensating wage differential for AIDS risks that is more difficult to observe with the 1987 AIDS definition than with the more expansive 1993 definition.

VI. Conclusion

Our study tests the hypothesis that health labor markets compensate workers who face risks of infection with HIV/AIDS as part of their jobs by examining the differential effect of local AIDS prevalence on the earnings of workers within and outside the health care sector. We find strong evidence that this type of compensating wage differential exists when AIDS is defined to include cases of severe immunosupression that occur before the onset of AIDS opportunistic illnesses. Specifically, our estimates indicate that in data using the 1993 definition of AIDS, a 10 percent increase in the AIDS rate in the metropolitan area of residence leads to an increase in RN wages of slightly less than one percent relative to wages of college educated non-health care workers. This effect is substantially larger than that found for other health care workers in the same period, with the exception of non-nursing health care practitioners, and for RNs and other health care practitioners during the pre-1993 period. The relative on-the-job exposure that each health care group has to potential HIV infection suggests that these AIDS wage effects represent compensating differentials paid to RNs and other health care practitioners because they care for HIV/AIDS patients as part of their jobs. Presumably this additional compensation is primarily to offset the risk of HIV/AIDS infection, but could also be necessary, for example, because of the psychologically difficulty of working with patients such as those with late-stage AIDS who are likely to die while under the care of the worker.

AIDS rates fell steadily after 1993. Based on our results, this decline implies a diminishing compensating AIDS wage differential over the period that partially explains the convergence between wages for RNs and college educated non-health female workers, and between other health and non-health workers, that is observed in Figure 1.

These results are interesting for at least two reasons. One is that they represent a tangible example of a compensating wage differential that had not previously been considered by economists. The other is that they represent additional evidence of behavioral responses to AIDS risks, in that these compensating differentials would not exist if they were not necessary to induce RNs into local markets. Policies that lower the prevalence of HIV and AIDS, therefore, carry the additional benefit of reducing the wage necessary to attract individuals into RN and other health practitioner jobs. The findings here suggest that AIDS rate reductions would provide substantial savings to society in the form of reduced RN compensation. For example, a 10 percent AIDS rate decline would induce a 0.8 percent decline in wages, or about $0.20 per hour at the average 2002 wage. With over two million RNs employed in the U.S., this comes to a savings of $400,000 per hour, which translates to $800 million per year for full time work.

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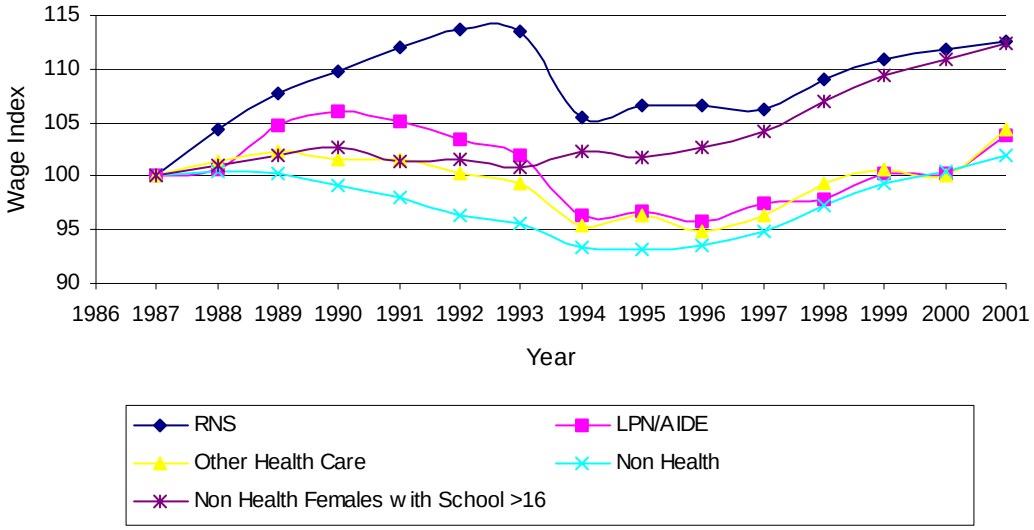
Figure 1
Adjusted Wage Indexes: 1987-2001



Data are from the 1987–2001 Current Population Survey monthly Outgoing Rotation Group files. Each index is constructed from a separate regression that controls for years of schooling, years of experience in quadratic form, and indicators for gender, race/ethnicity (African American, Hispanic, and white), marital status (currently and previously married), part-time status, union status, public employment, year, and interactions between the two experience terms and gender. Indexes are created by converting the year dummy coefficients (which are in log wage terms) to percentages and multiplying by 100.

Table 1
Mean Annual MSA AIDS Cases and Rates

Year	Cases	Rate
1987	502	12.8
	(818)	(12.2)
1988	604	17.2
	(1146)	(17.0)
1989	612	18.0
	(1020)	(15.7)
1990	907	23.1
	(1614)	(23.4)
1991	910	23.4
	(1553)	(21.9)
1992	966	23.3
	(1623)	(20.3)
1993	2018	51.8
	(3124)	(42.1)
1994	1738	40.8
	(3025)	(37.9)
1995	1462	35.8
	(2402)	(29.8)
1996	1250	31.3
	(2137)	(25.9)
1997	1085	26.9
	(1997)	(24.1)
1998	837	21.1
	(1487)	(18.2)
1999	801	19.9
	(1286)	(16.0)
2000	730	17.7
	(1125)	(13.2)
2001	693	17.4
	(1185)	(14.1)

Data are from annual CDC *HIV/AIDS Surveillance Reports*. The AIDS rate represents reported AIDS cases per 100,000 MSA residents. Means are weighted by the CPS data used in the subsequent analysis. Standard deviations are in parentheses.

Table 2
CPS Descriptive Characteristics by Group and Period

	RNs		LPNs and Aides		Other Health Care		Non-Health Care	
	1987–1992	**1993–2001**	**1987–1992**	**1993–2001**	**1987–1992**	**1993–2001**	**1987–1992**	**1993–2001**
Real hourly wage (in 2001 $)	22.35 (7.26)	22.81 (7.98)	11.31 (5.34)	11.06 (6.19)	16.86 (11.99)	17.76 (13.79)	16.88 (11.82)	17.15 (12.63)
MSA AIDS rate	19.77 (19.80)	29.63 (30.22)	21.37 (21.41)	36.12 (37.70)	20.85 (20.21)	32.22 (32.21)	19.55 (18.68)	29.85 (29.31)
Female	.950 (.281)	.935 (.246)	.910 (.286)	.902 (.297)	.739 (.439)	.738 (440)	.452 (.498)	.455 (.498)
Union member	.194 (.395)	.193 (.395	.189 (.391)	.190 (.393)	.090 (.286)	.082 (.273)	.189 (.391)	.173 (.379)
Years of schooling	15.33 (1.53)	15.22 (1.52)	12.22 (1.96)	12.52 (1.88)	13.75 (2.65)	14.16 (2.69)	13.24 (2.76)	13.55 (2.70)
African American	.072 (.259)	.094 (.291)	.351 (.477)	.352 (.478)	.141 (.348)	.132 (.339)	.108 (.310)	.107 (.309)
Hispanic	.026 (.156)	.032 (.175)	.080 (.268)	.107 (.308)	.075 (.261)	.089 (.284)	.092 (.286)	.120 (.324)
White	.822 (.383)	.794 (.405)	.524 (.499)	.485 (.500)	.745 (.436)	.736 (.441)	.751 (.433)	.716 (.451)
Currently married	.652 (.477)	.659 (.474)	.486 (.500)	.462 (.499)	.567 (.496)	.573 (.495)	.583 (.493)	.582 (.493)
Previously married	.171 (.376)	.190 (.392)	.281 (.450)	.285 (.451)	.191 (.393)	.198 (.399)	.153 (.360)	.161 (.368)
Works part-time	.303 (.459)	.295 (.456)	.249 (.433)	.262 (.441)	.166 (.372)	.156 (.363)	.141 (.348)	.138 (.345)
Works in the public sector	.162 (.368)	.143 (.350)	.142 (.349)	.123 (.328)	.125 (.330)	.090 (.287)	.173 (.379)	.172 (.378)
Works in a hospital	.739 (.439)	.669 (.471)	.336 (.472)	.254 (.435)	.409 (.492)	.370 (.483)	.000	.000
Sample size	7,650	10,473	6,365	8,699	21,514	29,987	394,709	511,021

Data are from the 1987–2001 Current Population Survey monthly Outgoing Rotation Group files. LPNs are licensed practical nurses, other health care workers are workers in the health care sector who are not RNs, LPNs or nursing aides, and non-health care workers are workers not employed in the health care sector.

Table 3
The Effect of AIDS on the Wage Differential between Health Care and Non-Health Care Workers: 1993–2001 CPS Data

	RN v. Non-health care (schooling ≥ 16 years)		RN v. Other health care		LPN v. Non-health care (12–15 years schooling)	
	1	1’	2	2’	3	3’
Log (AIDS rate)	.072	-.016	.058	-.012	.043	.004
	(.013)	(.009)	(.011)	(.009)	(.010)	(.008)
Log (AIDS rate) × group interaction	.047	.080	.054	.055	-.029	-.010
	(.007)	(.038)	(.006)	(.005)	(.007)	(.016)
MSA indicators	No	Yes	No	Yes	No	Yes
MSA × group interactions	No	Yes	No	Yes	No	Yes

	Other health care v. Non-health care (12–15 years schooling)		OHC practitioners v. Non-health care (12–15 years schooling)		OHC non-practitioners vs. Non-health care (12–15 years schooling)	
	4	4’	5	5’	6	6’
Log (AIDS rate)	.058	-.001	.061	-.004	.061	-.003
	(.011)	(.007)	(.011)	(.009)	(.012)	(.009)
Log (AIDS rate) × group interaction	.022	.025	-.018	.042	.019	.021
	(.002)	(.015)	(.009)	(.022)	(.003)	(.016)
MSA indicators	No	Yes	No	Yes	No	Yes
MSA × group interactions	No	Yes	No	Yes	No	Yes

Standard errors adjusted for heteroskedasticity of unknown form and clustering by MSA are in parentheses. MSA indicators and interactions between MSA and health care group indicators are omitted from regressions 1–6 but included in regressions 1’–6’. Regressions 1 and 1’ restrict the non-health care comparison group to those with at least 16 years of schooling. Regressions 5 and 5’ (6 and 6’) include only those other health care workers who are (not) in practitioner occupations. Other explanatory variables in these regressions include years of schooling, years of experience in quadratic form, and indicators for health care group, gender, race/ethnicity (African American, Hispanic, and white), marital status (currently and previously married), part-time status, union status, public employment, year, and interactions between health care group and year and both experience terms and gender.

Table 4
The Effect of AIDS on the Wage Differential between Health Care and Non-Health Care Workers: 1987–1992 CPS Data

	RN v. Non-health care (schooling ≥ 16 years)		RN v. Other health care		LPN v. Non-health care (12–15 years schooling)	
	1	1’	2	2’	3	3’
Log (AIDS rate)	.088	.014	.093	.014	.079	.022
	(.012)	(.012)	(.011)	(.013)	(.010)	(.015)
Log (AIDS rate) × group interaction	.011	.040	.030	.013	-.049	-.031
	(.012)	(.029)	(.011)	(.013)	(.006)	(.026)
MSA indicators	No	Yes	No	Yes	No	Yes
MSA × group interactions	No	Yes	No	Yes	No	Yes

	Other health care v. Non-health care (12–15 years schooling)		OHC practitioners v. Non-health care (12–15 years schooling)		OHC non-practitioners vs. Non-health care (12–15 years schooling)	
	4	4’	5	5’	6	6’
Log (AIDS rate)	.086	.019	.022	.022	.087	.020
	(.011)	(.014)	(.013)	(.013)	(.011)	(.015)
Log (AIDS rate) × group interaction	.024	.008	-.024	.000	.027	.015
	(.004)	(.013)	(.018)	(.018)	(.005)	(.014)
MSA indicators	No	Yes	No	Yes	No	Yes
MSA × group interactions	No	Yes	No	Yes	No	Yes

Standard errors adjusted for heteroskedasticity of unknown form and clustering by MSA are in parentheses. MSA indicators and interactions between MSA and health care group indicators are omitted from regressions 1–6 but included in regressions 1’–6’. Regressions 1 and 1’ restrict the non-health care comparison group to those with at least 16 years of schooling. Regressions 5 and 5’ (6 and 6’) include only those other health care workers who are (not) in practitioner occupations. Other explanatory variables in these regressions include years of schooling, years of experience in quadratic form, and indicators for health care group, gender, race/ethnicity (African American, Hispanic, and white), marital status (currently and previously married), part-time status, union status, public employment, year, and interactions between health care group and year and both experience terms and gender.

Table 5
The Effect of AIDS on the Wages of Registered Nurses: SRN Data

	1988 and 1992 surveys			1996 and 2000 surveys		
	1	2	3	4	5	6
Log (AIDS rate)	.052	.022	-.016	.095	.075	.031
	(.008)	(.008)	(.016)	(.017)	(.018)	(.020)
Associate Degree	-.025	-.026	-.026	-.034	-.035	-.040
	(.006)	(.006)	(.007)	(.008)	(.008)	(.007)
Bachelors Degree	.033	.031	.030	.040	.036	.029
	(.006)	(.005)	(.005)	(.009)	(.009)	(.008)
Graduate Degree	-.028	-.033	-.048	.103	.096	.079
	(.080)	(.081)	(.082)	(.091)	(.092)	(.091)
Part-Time	.016	.012	.013	.056	.051	.048
	(.008)	(.008)	(.008)	(.009)	(.009)	(.009)
Female	-.064	-.066	-.065	-.017	-.019	-.021
	(.011)	(.011)	(.011)	(.013)	(.013)	(.013)
White	-.024	-.021	-.008	-.050	-.049	-.028
	(.010)	(.008)	(.009)	(.010)	(.011)	(.009)
Hospital	.124	.124	.124	.093	.093	.090
	(.008)	(.008)	(.008)	(.007)	(.008)	(.008)
Nursing Home	-.052	-.053	-.050	-.021	-.023	-.022
	(.012)	(.011)	(.011)	(.012)	(0.11)	(.011)
Temp Agency	.059	.064	.064	.030	.028	.033
	(.026)	(.025)	(.026)	(.028)	(.028)	(.029)
Control Wage	--	.420	.222	--	.302	.009
		(.043)	(.063)		(.070)	(.075)
MSA indicators	No	No	Yes	No	No	Yes

Standard errors adjusted for heteroskedasticity of unknown form and clustering by MSA are in parentheses. The control wage is the average wage of college-educated workers in the MSA and year, imputed from the CPS using the column 1' specification of Tables 3 and 4. Columns 1 and 4 include neither the control wage nor MSA indicators, columns 2 and 5 include the control wage but not MSA indicators, and columns 3 and 6 include both the control wage and MSA indicators. Other explanatory variables in these regressions include indicators for nine age categories (eight five-year groups between 25 and 64 along with age 65+, with less than 25 as the omitted group), being currently and previously married, having children younger than six and any children but none younger than six in the house, eight Census divisions and one of the two years.