



MLDS CENTER

Maryland Longitudinal
Data System

Better Data • Informed Choices • Improved Results

December
2018

The Effects of Completing a Health CTE Program on College and Workforce Outcomes

Submitted by:

Maryland Longitudinal Data System Center

Ross Goldstein, Executive Director
Angela K. Henneberger, Ph.D., Principal Investigator
& Director of Research

Authored by:

B. Heath Witzen, M.A.¹

¹ University of Maryland, College Park

Maryland Longitudinal Data System Center

550 West Baltimore Street

Baltimore, MD 21201

410-706-2085

mlds.center@maryland.gov

<http://mldscenter.maryland.gov/>

Ross Goldstein

Executive Director

James D. Fielder, Jr., Ph.D.

Secretary of Higher Education,

Chair, MLDS Governing Board

Larry Hogan

Governor

© Maryland Longitudinal Data System Center 2018

Suggested Citation

Witzen, B.H. (2018). *The Effects of Completing a Health CTE Program on College and Workforce Outcomes*. Baltimore, MD: Maryland Longitudinal Data System Center.

Acknowledgement

This report was prepared by the Research Branch of the Maryland Longitudinal Data System Center (MLDSC). The Research Branch would like to thank the entire staff of the MLDSC for their assistance with this report. This research was completed in response to a request by the Maryland Health CTE working group.

If you have questions regarding this publication, please contact mlds.center@maryland.gov.

Table of Contents

Executive Summary	v
Introduction	1
Background	1
Research Question	2
Method	3
Data and sample selection	3
Measures	3
Analyses	4
Findings	
Summary statistics	5
Effects on college enrollment and enrollment in health majors	6
Effects on degree completion and completion in health majors	8
Effects on MD workforce wages and employment in a health field	9
Summary of Findings	10
Discussion	10
Conclusion	11
References	12

This page intentionally left blank

Executive Summary

Career and Technical Education (CTE) provides students with specialized instruction designed to culminate in an industry-recognized credential or open a pathway to higher education. These programs may be particularly important in the health care sector, which often requires specialized instruction and has a large existing demand for qualified workers. While CTE programs in general have been found to have mixed effects on postsecondary enrollment, degree completion, and workforce wages, studies that have examined students who completed health-related CTE programs have found positive effects on these outcomes. This report contributes to this literature by using data from the Maryland Longitudinal Data System (MLDS) to examine the effect of completing a health-related CTE program on college enrollment, enrollment in a health-related major, degree completion, workforce wages, and the likelihood that a completer is employed in the health-care sector. Findings indicate that relative to similar students who do not complete a health CTE, completers are more likely to enroll in college immediately after high school, with some substitution from four-year to two-year enrollment that extends to degree receipt. CTE completion is also associated with a higher likelihood of completing a degree in a health-related major, being employed in a health-related field 6 years after high school, and higher workforce wages. This report discusses policy directions and implications for future research on health-related CTE.

This page intentionally left blank

Introduction

The United States faces a shortage of available health care workers. This shortage expanded after the passage of the Affordable Care Act (ACA) in 2010, as the ACA has contributed to a significant increase in the demand for health care. As a result, the number of health care sites have since increased and existing sites have extended practicing hours and added staff, placing increased strain on an industry that was already battling staffing shortages (Wishner and Burton, 2017). One potential mechanism for increasing the amount of labor in the health industry is through Career and Technical Education (CTE) programs, which provide specialized instruction that prepares students for a career with an industry-approved credential or a pathway towards a postsecondary degree. Recent reauthorization of the Carl D. Perkins Career and Technical Education Act represents a substantial commitment of government resources to CTE programs, which include Health Sciences pathways to prepare students for careers in the health care industry.

This study uses data from the Maryland Longitudinal Data System (MLDS) to examine the effect that completing a health-related CTE program has on a student's enrollment in postsecondary education, degree receipt, and workforce wages. Additionally, it examines whether Health CTE programs are effective at attracting students to the health care industry, by estimating the effect that completion has on a student enrolling in or completing a degree in a health-related major, and the effect on the likelihood of working in the health care industry six years after high school graduation. This study employs a propensity-score matching empirical strategy, which matches Health CTE completers with similar students who did not complete a Health CTE program. This method controls for observable differences between Health CTE completers and non-completers to eliminate the bias caused by systematic differences between the two groups.

Background

There has been substantial research on vocational and CTE programs, though much of the existing estimated effects on post-high school outcomes are mixed. Earlier research on vocational education found that students who take vocational courses receive higher earnings but are less likely to complete a college degree (Bishop and Mane, 2005; Meer, 2007). More recent evidence has found mixed results and evidence that outcomes can depend on the type of CTE coursework completed, as concluded by a 2014 product of the U.S. Department of Education (U.S. Department of Education, 2014). This report commissioned quasi-experimental studies in several U.S. cities to examine the effects of CTE coursework. For example, study results from San Diego (Betts et al., 2014) and Philadelphia (Furstenberg and Neumark, 2005) found positive effects of CTE on postsecondary enrollment or aspirations of enrollment, while the study in Florida found no effect on college going for CTE students (Jacobson and Mokher, 2014). Even more recently, Kreisman and Stange (2017) found positive effects of advanced CTE coursework on earnings after high school. Kreisman and Stange also found that there is some

substitution between four- and two-year college enrollment, though they did not find that this extends to college degrees.

Several studies have separately examined the effects of CTE programs by the type of program completed and have found substantial variation in the estimates by program type, and some have specifically estimated the effect for health-related CTE programs. The U.S. Ed study found that 81% of health sciences CTE completers were enrolled in a postsecondary program two years after graduation, and 19% were within health-related majors. Forty percent of Health CTE completers obtained a degree in a health-related field within 8 years after high school graduation (U.S. Department of Education, 2014). Other research has found that health-related CTE programs at the community college level have demonstrated considerable positive labor market returns, especially when compared to other types of CTE programs (Stevens et al, 2018).

The Current Study

To estimate the effect of Health CTE completion on postsecondary and workforce outcomes in Maryland, this study used a propensity-score matching technique (PSM) (Rosenbaum and Rubin, 1983) to match Health CTE completers with similar students who did not complete a Health CTE program based on observable demographic, test score, and school district characteristics. The paired students were then used to estimate the effect of a Health CTE on a variety of post-high school outcomes, including college enrollment in years 1 and 4 after high school graduation, degree completion at postsecondary institutions, and workforce wages six years after high school graduation. Additionally, this study examined whether Health CTE completion led to an increase in the likelihood of enrolling in or completing a degree in a health-related major as well as employment in the health care industry six years after high school graduation.

This study adds to the existing literature on the effect of Health CTE program completion on postsecondary and workforce outcomes. Previous literature has found mixed effects of CTE completion on postsecondary outcomes, indicating that providing additional estimates can contribute to the existing body of work. Additionally, the previous literature has found differential results by the type of CTE program completed, and those that have examined Health CTE programs have generally found positive effects. This study provides an additional estimate of the effect of Health CTE programs. Previous reviews of the CTE literature have called for more quasi-experimental evidence on the effect of CTE programs (Ahn, 2017), and the PSM technique used in this study obtains such an estimate.

Research Question

What is the long-term effect of completing a Health CTE program in high school?

This research was requested by the Maryland Health CTE working group. This report responds to the Maryland Longitudinal Data System Center (MLDSC) Research Agenda Question:

What are the workforce outcomes for Maryland high school students who complete Career Technical Education coursework, who either enter the workforce directly or also obtain postsecondary education or training?

Method

Data and sample selection

The data used for this report are from the Maryland Longitudinal Data System (MLDS), which contains linked longitudinal data from three State agencies¹. The Maryland State Department of Education (MSDE) provides data for public PreK-12 students and schools. The Maryland Higher Education Commission (MHEC) provides data for Maryland public and private college students and colleges. The Department of Labor Licensing and Regulation (DLLR) provides Unemployment Insurance (UI) wage records. A wage record is present for all workers in jobs for which their employer must participate in filing quarterly UI records. The federal government (including the military), certain non-profit and religious organizations, and private contractors (self-employed individuals) do not participate in quarterly UI filing.

For this report, data were used from students who completed high school at Maryland public high schools in the 2009-2010 academic year², to ensure a follow up period of 6 academic years in which to view postsecondary enrollment, degree completion, and workforce wages. The total number of high school completers in the sample is 59,474 students.

Measures

Health CTE Completion. To estimate the effect of completing a Health CTE program in high school, an indicator for whether a student completed a CTE program was created from the student's high school completion record and the Classification of Instructional Programs (CIP) code of the CTE program completed. Students who completed a CTE program with a CIP code in the 51 category (Health Professions and Related Programs) were labeled to have completed a Health CTE program. The total number of high school completers who completed a Health CTE program was 867. Throughout the remainder of the report, "non-completers" will be used to refer to those who do not complete a Health CTE program, which may include students who have taken or completed the CTE coursework for other CTE programs.

Outcomes. The main student outcomes of the study are enrollment in postsecondary education, degree receipt, and workforce wages. To analyze the first outcome, a history of postsecondary enrollment was constructed for each high school completer. An indicator for enrollment in postsecondary education was created if the student was enrolled in the fall semester of an academic year that was X years after high school graduation. The level of institution ("2-year" or "4-year") and CIP codeⁱ pertaining to the student's major at the time of

¹ For more information on the sources and data elements included in the MLDS, see <https://mldscenter.maryland.gov/>.

² This measure includes high school completers of all types and only excludes non-completers.

enrollment was also included. A similar indicator was created for graduation, which equals to 1 if a student receives a degree within 6 academic years after high school completion, and the CIP code of the student's degree was also included. Each of these measures include enrollment and degree completion at any institution. Students are linked to the National Student Clearinghouse³, which contains enrollment and degree completion data on students at a U.S. institution of higher learning.

Workforce data were used to create measures of wages within an academic year. To align with academic years, wage years were coded such that quarters roughly match the academic year, thus earnings in the 2015-2016 academic year are from quarter 3, 2015 through quarter 2, 2016. Any missing quarters were coded as zero for a student, meaning that the workforce wages measures is the sum of all observed wages (including zeros) for the academic year approximation. This study focuses on workforce wages 6 years after high school graduation. The North American Industry Classification Code (NAICS) of the organization for which the student had the largest wages was used to determine the industry of employment for a student. If a graduate worked at a firm in the "Health Care and Social Assistance" NAICS group, s/he was classified as working in a health care field. It is important to note that the NAICS code indicates the industry of the *employer*, and not necessarily an indicator that the student is employed in a healthcare occupation.

Matching variables. Demographic and high school test score variables were included to match Health CTE completers to non-completers, which includes students who did not complete a CTE program as well as those who completed other types of CTE programs. These included a student's race, gender, and ethnicity, as well as an indicator for whether a student received special education. A student's free and reduced price meal (FARMS) eligibility was also included as a measure of socioeconomic status. Several measures of academic ability were also included. The first was an indicator of having a 3.0 GPA from the student's high school completion record. The second was the student's highest score on the Maryland High School Assessment (HSA) tests in English and Algebra. One limitation of the HSA data for earlier cohorts in the MLDS is that HSA records are not available for students who took the exam before the 2007-2008 year (the year that the MLDS data begin). However, an indicator for having completed an HSA test in English or Algebra provided some information, as higher achieving students are more likely to take the exams earlier in their high school career. Lastly, the distance between the student's high school and the nearest 2-year and 4-year institutions were included as a measure of geographical difference between Health CTE completers and non-completers.

Analyses

To limit the observable differences between Health CTE completers and non-completers, a propensity-score matching method was utilized. A logistic regression was used to estimate a student's probability of completing a Health CTE program based on the observable characteristics described in the previous section. A student's propensity score, or probability of

³ For more information on the National Student Clearinghouse, please visit www.studentclearinghouse.org

completing a Health CTE program based on observable characteristics, was used to match Health CTE completers with non-completers. A nearest-neighbor matching method was utilized with each Health CTE completer matched to one non-completer without replacement. The matched data result in a total matched sample of 1,734 students (867 Health CTE completers and 867 non-completers). After obtaining the matched sample, simple linear regressions were run by regressing the dependent variable on an indicator for completing the Health CTE program and the control variables used in estimating the propensity score. In the case of a binary dependent variable, this method is a Linear Probability Model.

Findings

Summary Statistics of Sample

Table 1 displays the means of the demographic characteristics used in the matching process for Health CTE completers and non-completers. The first two columns show the means for the unmatched sample, which includes all students who completed a Maryland high school education in the 2009-2010 academic year. The second column shows the same means for the samples after the propensity score matching process was conducted.

There are several differences between the Health CTE completers and non-completers in the full sample (See Table 1). The largest difference is the gender balance. Only 16% of Health CTE completers are male, while the proportion is 50% among all non-completers. This gap is important in the context of enrollment in higher education as female students are more likely to enroll in postsecondary education than male students (NCES, 2017). Health CTE completers are slightly less likely to be black (31% versus 35%) and Hispanic of any race (7% versus 8%), and slightly more likely to be Asian (7% versus 6%). Health CTE completers are also less likely to have a special education status (5% versus 9%) and slightly more likely to be eligible for free or reduced-price meals (FARMS; 28% versus 26%). Health CTE completers are more likely to have an English HSA score and less likely to have an Algebra HSA score in the MLDS, indicating that completers may take these exams later in their high school career than non-completers. The distance between a completer's high school and the nearest 2-year institution is not different between CTE Health completers and non-completers, but the Health CTE completers are slightly further from 4-year institutions, on average, than non-completers.

Columns (3) and (4) in Table 1 show that the propensity score matching process is successful at creating a balanced sample on observed characteristics. After matching, the differences between Health CTE completers and non-completers are 1 percentage points or less for most outcomes. A X^2 test of the differences between the Health CTE completers and non-completers fails to reject the null that the demographic characteristics of the matched sample are the same.

Table 1. Demographic and Test Score Means of the Unmatched and Matched Samples

Variable	Unmatched		Matched	
	Health CTE	No Health CTE	Health CTE	No Health CTE
Male	16%	50%	16%	16%
Hispanic	7%	8%	7%	8%
Black	31%	35%	31%	30%
Asian	7%	6%	7%	7%
3.0 GPA	44%	35%	44%	43%
Special Education	5%	9%	5%	6%
FARMS	28%	26%	28%	27%
Has HSA English	96%	93%	96%	96%
Has HSA Algebra	22%	27%	22%	23%
HSA English Score	400	386	400	398
Distance to nearest 2-year (mi)	7.4	7.365	7.4	7.452
Distance to nearest 4-year (mi)	14.22	12.584	14.22	14.429
N	867	58,607	867	867

Effects of Health CTE Completion on College Enrollment and Enrollment in Health Majors

First, the differences in college enrollment between Health CTE completers and non-completers are examined in Table 2. Columns (1)-(3) show the effect of completing a Health CTE on the probability of enrollment for any level of institution, a 2-year institution, and a 4-year institution, respectively, in the first year after high school completion. Columns (4)-(6) provide similar estimates, but focus on the fourth year after high school graduation. The estimated regression coefficients have the interpretation as percentage point effects, indicating the change in the likelihood of each outcome. Standard errors are provided in parentheses to illustrate the precision of the estimated coefficient, and the levels of statistical significance relative to a null hypothesis of no effect are indicated by stars. The number of observations are given in the row labeled N, and the means of the dependent variables are included in the row above N to provide context for the estimated coefficients.

Health CTE completers are 7.8 percentage points more likely to be enrolled in any institution immediately after high school graduation, compared to non-Health CTE completers. This difference is statistically significant ($p < .01$). Column (2) indicates that most of this effect is driven by an increased probability of enrolling at a 2-year institution (14.6 percentage points). Some tradeoff between 2-year and 4-year schools are present in the first years, as Health CTE completers are 6.7 percentage points less likely to enroll at a four-year institution.

Four years after high school graduation, Health CTE completers are not significantly more or less likely to be enrolled at any institution. However, this effect appears to be driven by a continued tradeoff between two-year and four-year enrollments. Four years later, Health CTE

completers are 9.9 percentage points more likely to be enrolled in a 2-year institution, but 10.5 percentage points less likely to be enrolled in a 4-year institution.

Table 2. College Enrollment

	One year later			Four years later		
	Any Enr. (1)	2-Year (2)	4-Year (3)	Any Enr. (4)	2-Year (5)	4-Year (6)
Health CTE	0.078*** (0.02)	0.146*** (0.02)	-0.067*** (0.02)	-0.006 (0.02)	0.099*** (0.02)	-0.105*** (0.02)
Dep. Mean	0.71	0.37	0.34	0.57	0.19	0.38
N	1,734	1,734	1,734	1,734	1,734	1,734
R ²	0.158	0.072	0.261	0.215	0.048	0.294

Note: Standard errors in parentheses **p< .05, ***p<0.01

Table 3 shows a similar sets of comparisons as Table 2, however, the dependent variable used is whether or not a student was enrolled in an institution of a given type *and* enrolled in a Health major. Health CTE students are 17.1 percentage points more likely to be enrolled and enrolled in a health major than non-completers. This is driven by an increased probability of being enrolled in a 2-year program and a health major (12.2 percentage points) and a positive effect on being enrolled in a 4-year program and in a health major (4.9 percentage points). The difference between the positive results at four year institutions in Table 3 and the results of Table 2, indicate that Health CTE completion may affect two margins. Health CTE completion might drive some students to alter which type of institution in which they enroll in the first year, however, CTE completers who do enroll in 4-year institutions are more likely to enroll in Health majors. A similar effect among the two margins can be seen in Columns (4)-(6) of Table 3, where four years after high school graduation, Health CTE completers are more likely to be enrolled and in a health major (12.7 percentage points) with a 8 percentage points effect for enrolled in a health major at a 2-year institution and a 4.7 percentage points effect for being enrolled in a health major at a 4-year institution.

Table 3. College Enrollment in Health Majors

	One year later + Health Major			Four years later + Health Major		
	Any Enr. (7)	2-Year (8)	4-Year (9)	Any Enr. (10)	2-Year (11)	4-Year (12)
Health CTE	0.171*** (0.02)	0.122*** (0.01)	0.049*** (0.01)	0.127*** (0.01)	0.080*** (0.01)	0.047*** (0.01)
Dep. Mean	0.12	0.08	0.04	0.1	0.07	0.04
N	1,734	1,734	1,734	1,734	1,734	1,734
R ²	0.083	0.076	0.05	0.065	0.047	0.046

Note: Standard errors in parentheses **p< .05, ***p<0.01

Effects of Health CTE Completion on Degree and Certificate Completion and Completion in Health Majors

Table 4 displays the estimated differences between Health CTE completers and non-completers in terms of degree and certificate receipt, as well as degree and certificate receipt in health majors. Columns (1)-(3) present the percentage point effect on receiving a degree or certificate of the indicated level, and Columns (4)-(6) present the same information, but for receiving the degree *in a health major*. Each degree estimate is for receiving a degree within 6 years after high school graduation.

The results are largely consistent with the enrollment effects found in Tables 2 and 3. There appears to be a substitution effect for Health CTE completers in the types of degrees received, as they are 6.6 percentage points more likely to receive an associate's degree but 9 percentage points *less* likely to receive a bachelor's degree. There is little difference in the propensity to receive a certificate.

When looking at the probability of receiving a degree *and* having that degree be in a health major, the effects mirror the positive effects of the enrollment tables. Students are 4.9 percentage points more likely to receive an associate's degree in a health major and 6.4 percentage points more likely to receive a bachelor's degree in a health major. Students are also 1.6 percentage points more likely to receive a certificate in a health field. This table indicates that the enrollment margins and major choice margins may both be affected by the completion of a Health CTE program. Health CTE completion may shift some students between bachelor's and associate's degrees within 6 years after high school graduation. However, students who would otherwise complete a bachelor's degree appear to be more likely to complete a bachelor's degree in a health major upon completion of a Health CTE program in high school.

Table 4. College Degrees/Certificates and Degree in Health Majors

	Degree/Certificate			Degree/Certificate + Health Major		
	Associate's (1)	Bachelor's (2)	Certificate (3)	Associate's (4)	Bachelor's (5)	Certificate (6)
Health CTE	0.066*** (0.017)	-0.090*** (0.019)	0.011 (0.008)	0.049*** (0.01)	0.064*** (0.01)	0.016*** (0.006)
Dep. Mean	0.15	0.34	0.03	0.05	0.05	0.01
Observations	1,734	1,734	1,734	1,734	1,734	1,734
R2	0.064	0.299	0.019	0.051	0.064	0.022

Note: Standard errors in parentheses **p< .05, ***p<0.01

Effects of Health CTE Completion on Maryland Workforce Wages and Employment in a Health Field

Lastly, this study examined the effect of completing a Health CTE program in high school on employment and workforce wages within 6 years of high school graduation. Table 5, presents the results of these tests. Column (1) shows the effect on the probability of receiving wages from an employer located in Maryland. Column (2) shows the effect on the probability of receiving wages from an employer located in Maryland and that the employer has a Health NAICS code. This indicates that the employer is in the health industry, not necessarily that the student is employed in a health occupation, but can, however, provide information about how CTE programs affect students’ entrance into the healthcare industry. Column (3) shows the effect on wages, but only for students who have wages in the 6th year after high school graduation, limiting the sample to only these students.

Column (1) indicates that Health CTE completers are 9.6 percentage points more likely than other high school graduates to have wages from a Maryland firm 6 years after high school graduation. Health CTE completers are also 19.7 percentage points more likely to have both wages within Maryland and for those wages to be from a company in with a Health NAICS code. Among students who have Maryland wages, Health CTE completers receive about \$1,926 additional in annual income from wages than high school graduates that did not complete a Health CTE program.

Table 5. Workforce Wages and Employment in a Health Field in the 6th Academic Year after High School Graduation

	Any MD Wages? (1)	MD Wages + Health Field (2)	Annual Wages if MD Wages Present (3)
Health CTE	0.096*** (0.021)	0.197*** (0.019)	1,925.927** (897)
Dep. Mean	0.71	0.23	\$21,804.65
Observations	1,734	1,734	1,237
R2	0.048	0.101	0.072

Note: Standard errors in parentheses *p<.1, **p<.05, ***p<0.01

Summary of Findings

In this report, a propensity-score matching approach was used to examine the effect of completing a Health career and technical education (CTE) program in high school on college enrollment, degree completion, and workforce participation and wages six years after high school graduation. Health CTE completers were more likely to initially enroll in postsecondary education after high school graduation with a positive effect on attending a 2-year institution. Both one year and four years after high school graduation, there appears to be a significant substitution effect away from 4-year institutions towards 2-year institutions for Health CTE completers. The results also indicate that Health CTE completion may increase the propensity to enroll in a health major. The enrollment effects translate into degree effects, as Health CTE completion appears to have a switching effect between bachelor's and associate's degree. However, CTE completion also appears to induce students to complete a bachelor's in a health major who would have otherwise completed a bachelor's in another major. Six years after high school graduation, Health CTE completers are also more likely to receive wages in Maryland, be employed in a health-related industry in Maryland, and receive higher wages than students who do not complete a Health CTE program in high school.

Discussion

The results of this study are consistent with several pieces of the existing literature. The increases in workforce wages are consistent with work such as Bishop and Mane (2005), Meer (2007), and Kreisman and Stange (2017) who found that vocational and CTE programs increased wages after high school graduation. The increase in the propensity to enroll in any postsecondary education echoes the findings of Furstenberg and Neumark (2005) and Betts et al. (2014) and the increased likelihood of enrolling in a health related major is consistent with the findings of the U.S. Department of Education (2014), which found that health science CTE

completers were particularly likely to enroll in health majors and graduate with health-related degrees at the postsecondary level. The substitution from four-year programs to two-year programs is also consistent with some of the findings of Kreisman and Stange (2017). This study adds to this literature a documented increase in the likelihood of working in the health care industry 6 years after high school graduation.

This study uses a PSM technique to match Health CTE completing students with non-completers. To do this, the study uses available demographic, test score, and school-level data to match students, however, it is limited to reducing the differences between the two groups on observable variables only. The necessary assumption underlying the PSM approach is that, conditional on the variables used to create the propensity score, Health CTE completers and non-completers do not differ in systematic ways. Possible violations of this assumption would lead to bias in the estimated effects of Health CTE completion. For example, students may decide to enter a Health CTE program based on their own knowledge about their skill or interest in the healthcare sector. If this is the case, then the estimates will overstate the effect of the Health CTE program. Additionally, previous literature has shown how students can make postsecondary decisions based on other cognitive and socioemotional abilities, as demonstrated by Prada and Urzúa (2017), some of which, like mechanical ability, are not generally captured by test scores or other variables in the MLDS.

There are also several limitations specific to the estimated wage effects. One limitation is the ability to only observe the wages of students who remain in Maryland. This study finds that Health CTE completers are more likely to be employed in Maryland 6 years after high school. If variables that influence a student's decision to remain in Maryland are also related to their potential wages, and these differ systematically by Health CTE completers and non-completers, then this could lead to bias in the estimates of the effect on early career wages. This study also uses the NAICS code to characterize employment a healthcare field. The NAICS code characterizes the industry of the employer but does not reflect the occupation of the employed individual, and therefore is a noisy measure of whether a CTE completer becomes a health care professional.

Conclusion

This report examined the effect that completing a Health CTE program has on postsecondary enrollment, degree completion, and workforce outcomes. Using a propensity-score matching technique, Health CTE completers were compared with similar non-completers on a variety of college and workforce outcomes. The analyses indicated that Health CTE completers were more likely to enroll in a postsecondary institution immediately after high school, but that Health CTE completion was also associated with a substitution from four-year program enrollment to two-year program enrollment. Health CTE completion also appears to be associated with a switch from bachelor's degree receipt to associate's degree receipt. Additionally, Health CTE completers were more likely to pursue health-related majors and graduate with degrees in health-related majors, and the results indicate that Health CTE completion might cause changes in major choice among students who would have otherwise enrolled in other majors. Health CTE completers were also found to be more likely to be

employed in the health care industry six years after high school completion and earn higher wages relative to non-completers. These results suggest that Health CTE programs may change students' postsecondary enrollment decisions, with some substitution away from four-year programs to two-year programs, but are successful at attracting students towards health care majors and the health care industry.

References

- Ahn, J. (2017). Technical Working Group on Career and Technical Education Meeting. Meeting Summary (Washington, DC, September 22, 2017). *Institute of Education Sciences*.
- Betts, J. R., Zau, A., McAdams, J., & Dotter, D. (2014). Career and technical education in San Diego: A statistical analysis of course availability, students' course-taking patterns, and relationships with high school and postsecondary outcomes. *San Diego Education Research Alliance*.
- Bishop, J. H., & Mane, F. (2005). Raising academic standards and vocational concentrators: Are they better off or worse off?. *Education Economics*, 13(2), 171-187.
- Furstenberg Jr, F. F., & Neumark, D. (2005). *School-to-career and Post-secondary Education: Evidence from the Philadelphia Educational Longitudinal Study* (No. w11260). National Bureau of Economic Research.
- Jacobson, L., & Mokher, C. (2014). Florida Study of Career and Technical Education. Final Report. *CNA Corporation*.
- Kreisman, D., & Stange, K. (2017). Vocational and Career Tech Education in American High Schools: The Value of Depth Over Breadth. *Education Finance and Policy*, 1-72.
- Meer, J. (2007). Evidence on the returns to secondary vocational education. *Economics of education review*, 26(5), 559-573.
- Prada, M. F., & Urzúa, S. (2017). One size does not fit all: Multiple dimensions of ability, college attendance, and earnings. *Journal of Labor Economics*, 35(4), 953-991.
- Rosenbaum, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70(1), 41-55.
- Stevens, A. H., Kurlaender, M., & Grosz, M. (2018). Career technical education and labor market outcomes: Evidence from California community colleges. *Journal of Human Resources*, 1015-7449R2.
- United States. Department of Education. Office of Planning, Evaluation, and Policy Development. (2014). National Assessment of Career and Technical Education.
- Wishner, J. B., & Burton, R. A. (2017). How Have Providers Responded to the Increased Demand for Health Care Under the Affordable Care Act?.

ⁱ When a Maryland college or university seeks to offer an academic program, the Maryland Higher Education Commission (MHEC) assigns a Higher Education General Information Survey (HEGIS) code and Classification of Instructional Programs (CIP) code upon approval or recommendation to implement the program. Six digit HEGIS codes are assigned based upon program, degree level and degree type. Typically, HEGIS codes in the range of 01 to 23 indicates a program offered at the baccalaureate level or higher, 49 indicates a transfer degree program offered at community colleges, 50 to 56 indicates a career degree program offered at community colleges, and 90 indicates an undeclared program.

MHEC data collections include HEGIS code to identify the program of enrollment and graduation for degree-seeking students rather than CIP code. The MLDSC maps HEGIS to CIP to align to MHEC's academic program inventory, which contains both the HEGIS and CIP for each approved program.

Due to the limitations of the HEGIS coding scheme, a HEGIS code may not always uniquely identify a program as the code does not always distinguish between variations in curriculum across institutions or within the same institution. For example, HEGIS code 089901 identifies Agricultural Education at one college and Health Professions Education at another. Depending on the CIP code assigned in the academic program inventory, it may not be possible to identify this variation in the MLDSC data.

Additionally, academic programs may have areas of concentrations. MHEC does not collect college enrollment and graduation information on areas of concentrations. Instead, MHEC collects information solely on the parent program. For example, the HEGIS code 491001 identifies all Arts & Sciences Transfer enrollments and degrees at the same institution even though individual students may complete an area of concentration in either: art, biology, business, chemistry, English, physics or any of 14 possible concentrations.

The HEGIS code structure may limit uniquely identifying the program of study and may result in understating or overstating the number of enrollments and graduates for any one program across the State.