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# Career Technical Education in Health

## An Overview of Student Success at California's Community Colleges

### Technical Appendices

#### CONTENTS

Appendix A: Data Sources and Sample Construction	2
Appendix B: Analysis of Degree Completion	11
Appendix C: Analysis of Wage Returns and Industry	18

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# Appendix A: Data Sources and Sample Construction

## Student-level Data

The data used in this report come from the California Community College Chancellor's Office Management Information System (COMIS). Specifically, we use a longitudinal dataset of students enrolled in every college in the California Community College system. This dataset includes detailed information on student characteristics, including demographics, measures of economic and academic disadvantage, and disability, along with course enrollment, financial aid receipt, and award completion.

Additionally, the system has information on each course (title, credit status, transfer status, basic skills status, subject, etc.). The course-level data also includes information that identifies courses as occupational and classifies all courses with a Taxonomy of Program (TOP) code. The TOP system of numerical codes is used at the state level to collect and report information on programs and courses, in different colleges throughout the state that have similar outcomes. The TOP was designed to aggregate information about programs and all courses and awards are coded with a 6-digit TOP code.

The analysis of labor market returns relies on administrative wage data from the state's Unemployment Insurance (UI) system collected by the California Employment Development Department and merged with student records from the COMIS data files. Data from the UI system include quarterly wage records and industrial sector of employment defined by 6-digit NAICS codes. Only jobs that are covered by UI are included in these official wage data; that excludes self-employed, contract, seasonal, and informal work, as well as military employment. We have information on wage data from the first quarter of 2000 through the fourth quarter of 2014. Students with employment in a covered industry in California have a record that includes the total of wages earned in the quarter for each covered industry in which any wages were earned.

## Identifying CTE degree-seeking students in health programs

The basic criteria for being included in our sample required that a student have enrollment records sometime during the primary study time period, which includes school years 1999/2000 through 2008/2009 and also have an SSN recorded for their student ID. Unique student identifiers are not maintained across the entire community college system, only within individual colleges. Fortunately, the COMIS data provides a pseudo-SSN (scrambled and de-identified) that can be used to link students across multiple colleges so that we can track enrollment across the entire system. Because we are interested in student pathways to degree completion, we want to ensure that we capture students who may take courses at multiple community college campuses to achieve their goals. Thus we exclude students who do not have a valid SSN match. For our sample period, this exclusion criteria results in about 12% of records with any enrollment in our time period of interest being dropped from our sample.

In order to examine successful pathways of community college students in health CTE programs, we must identify those students who appear to begin a program or have an intention of completing a health degree, but who we do not observe earning an award. Because CCC students generally do not declare a program of study when they enroll, we need a method for identifying these students using their observed course enrollments.

The COMIS data has a coding system to identify occupational courses. The Student Accountability Model or SAM codes designate courses as occupational or non-occupational as determined by the campus/district. The variable has five levels including 1) Apprenticeship (very few), 2) Advanced occupational, 3) Clearly occupational, 4) Possibly occupational, and 5) Not occupational. Following the Chancellor's Office criteria,

we define CTE courses as those with the first three SAM codes (apprenticeship, advanced occupational, and clearly occupational.)

Our analytic sample is constructed using enrollment in a health occupational course to initially identify CTE students and then uses course enrollment in specific programs (defined by 6-digit TOP codes) to identify students seeking degrees in health programs. Specifically, the sample includes students who enrolled in their first observed health occupational course sometime between Fall Term 1999 and Summer Term 2009 and subsequent (or concurrent) to the first observed SAM course, earned at least 8 units in a specific health program (based on 6-digit TOP codes – all 8 units are within a single 6-digit TOP code) within a three year period of taking the first health vocational course.

To assign students to health programs, we use the 6-digit TOP code that the student completed the maximum number of health units in during the three year window from entrance into the sample. In the case of students who complete the exact same number of maximum units in multiple health TOP codes within the three year window, the first instance of completing the max units from SAM entrance is used to assign their health program and their primary college.

Table A1 provides the distribution of CTE students across health programs for our sample. The first column shows our full sample of students who completed 8 or more units in a health program. The second column makes adjustments to our 8+ sample to account for the fact that some colleges do not report a certain type of credential – local certificates – which are common for certain short-term health programs. We provide more detail on how we make this adjustment in the section below. And the final column shows the distribution across programs if we lower our criteria for sample entrance to be the completion of 6 or more units in a single health program. There are some differences across the samples – most notably, the share of the sample that is in Emergency Medical Services drops considerably when we adjust for the non-reporting of local certificates. The same is true, but to a lesser degree, for other programs that tend to offer short-term certificates including medical assisting, certified nursing assistant, and pharmacy technology among others.

**TABLE A1**

CTE intending student sample entering health program school years 2000–2009

Program of student's maximum units earned	8+ unit sample	8+ unit sample, adjust for non-report of local certificates	6+ unit sample
Health Occupations, General	2057	2057	4816
Medical Laboratory Technology	158	158	184
Phlebotomy	167	125	430
Physician Assistant	487	487	493
Medical Assisting	4500	3605	6699
Clinical Medical Assisting	857	609	1084
Administrative Medical Assisting	1548	1197	2150
Hospital Central Service Technician	145	145	145
Respiratory Care/Therapy	3219	3219	3384
Polysomnography	107	107	108
Electro Neurodiagnostic Technology	86	86	92
Cardiovascular Technician	712	712	757
Orthopedic Assistant	148	148	149

Program of student's maximum units earned	8+ unit sample	8+ unit sample, adjust for non-report of local certificates	6+ unit sample
Electrocardiography	239	239	275
Surgical Technician	393	393	522
Occupational Therapy Technology	513	513	531
Optical Technology	46	46	46
Speech/Language Pathology and Audiology	1106	1106	1438
Pharmacy Technology	2271	1226	2552
Physical Therapist Assistant	724	724	755
Health Information Technology	2902	2264	3593
Health Information Coding	1042	845	1274
Radiologic Technology	4489	4489	4816
Radiation Therapy Technician	185	185	232
Diagnostic Medical Sonography	438	438	448
Athletic Training and Sports Medicine	409	409	835
Nursing	4430	4430	4922
Registered Nursing	37684	37684	40109
Licensed Vocational Nursing	7832	7832	9104
Certified Nurse Assistant	3367	2637	8475
Home Health Aide	258	250	992
Psychiatric Technician	4191	4191	4285
Dental Assistant	4801	4801	4933
Dental Hygienist	2300	2300	2318
Dental Laboratory Technician	744	744	779
Emergency Medical Services	16053	8942	39448
Paramedic	3099	2351	4240
Mortuary Science	725	725	745
Health Professions, Transfer Core Curriculum	2352	2352	3211
Community Health Care Worker	215	215	265
Massage Therapy	510	510	620
Kinesiology	127	127	198
Other Health Occupations	2097	2097	2926
<b>Total Sample Size</b>	<b>119768</b>	<b>107755</b>	<b>165420</b>

SOURCE: Authors' calculations from COMIS data.

NOTE: Program codes are based on 6-digit TOP codes. Any programs with fewer than 10 observations have been removed from the table.

## Adjusting for non-reporting of local certificates

Local certificates are short-term degrees that require the completion of between 6 and 17 units. These certificates are developed by individual community colleges and districts and are not approved by the Chancellor's office. Colleges are not required to report their local certificates to the Chancellor's office, although some colleges do and thus are captured in the data files we use, but others do not. This complicates our ability to generate completion rates for certain programs that confer short-term degrees that may be local certificates.

To address this issue, we first identify colleges that appear to report their local certificates based on the share of their short-term certificates that are coded as local certificates. Then among those colleges that are flagged as reporting local certificates, we identify programs as short-certificate programs based on the share of students completing short-term awards relative to all completed awards. If a program has the majority of students completing a short-term award in at least 3 colleges that report local certificates then we flag that program as being a short-term certificate program. Using this method, we identified eight health CTE programs that are likely short-term certificate programs that may not have all completed degrees reported because they can be local certificates. These programs include Medical Assisting (general, clinical, and administrative), Emergency Medical Services, Paramedic, Health IT/Coding, Certified Nursing Assistant, Pharmacy Technician, Home Health Aide, and Phlebotomy. When we analyze completion rates for these programs, we only include students who attended colleges that were identified as reporting local certificates.

## Common Variable Definitions

We use a number of variables—some of which we construct and others that are defined and created by the CCCCCO—to assess the socioeconomic and course-taking characteristics of health CTE students. Definitions are provided for in Table A2.

**TABLE A2**

Definition of key variables used in analysis of student outcomes

Variable name	Definition
Disabled	Derived data element constructed by CCCCCO, indicates whether a student was ever reported with a primary disability during their academic career. Primary disabilities include mobility, visual, hearing, or speech impairment; intellectual, learning, or mental health disability; brain injury, ADHD, autism spectrum or other.
Limited English Proficiency	Derived data element constructed by CCCCCO, indicates a student was either enrolled at some time in their academic career in a basic skills English as Second Language (ESL) course or was identified as needing ESL services.
Academically Disadvantaged	Derived data element constructed by CCCCCO, indicates student had enrollment or been flagged as needing basic skills instruction or was reported on academic probation or dismissal at least once in their academic career.
Low-income	Identified as receiving CalWORKs assistance or a Pell Grant at least one term during their academic career.
Economically Disadvantaged	Composite variable indicating whether student had ever been identified as receiving CalWORKs or other cash assistance (SSI or GA), received Pell Grants, or been categorized as economically disadvantaged for the purposes of colleges receiving VTEA funds.
Momentum indicator	Student was flagged as completing at least 30 units prior to entering the health CTE program.
Persistence indicator	Student completed units in at least three consecutive primary (Fall or Spring) school terms.
Financial aid	Student received some type of financial aid during the three year period after they entered the health CTE program. Includes fee waivers, grants, loans, work study, or scholarships.
GPA a in 3 year prior to 1 <sup>st</sup> health degree	Average GPA across all terms in the three years prior to earning 1 <sup>st</sup> health degree.
Ever took full-time course load after 1 <sup>st</sup> health degree	Completed at least 12 semester units in at least one term after completion of the first health degree

SOURCE: California Community College Chancellor's Office Management Information Systems Data Mart, Data Element Dictionary. Accessible at <http://extranet.cccco.edu/Divisions/TechResearchInfoSys/MIS/DED.aspx>

## Sample Characteristics

As described in the previous section, the COMIS data includes detailed information on all students— demographic characteristics, academic and economic disadvantage, course-taking behavior – to better understand which students enter health CTE programs and how certain student characteristics correlate with successful completion of a degree. Table A3 provides sample characteristics for our entire sample of 8+ units and 6+ units. Tables A4, A5 and A6 provide these characteristics across different sub-groups, including race-ethnic groups, students identified as economically disadvantaged, and students enrolled in programs of different length based on the level of the award earned (associate, long-term, and short-term programs.)

**TABLE A3**  
Sample characteristics of health CTE intending students

	8+ Unit Sample	6+ Unit Sample	8+ Unit Sample (Excluding Registered Nursing)
Student age (at program entrance)			
Mean age	29.1	28.4	28.8
Age 15 to 24	42.9%	47.1%	46.7%
Age 24 to 30	18.4%	17.5%	16.6%
Age 30 and older	38.7%	35.4%	36.7%
Female	71.3%	65.8%	65.7%
Citizen	85.4%	87.1%	86.7%
Race/Ethnicity			
White	44.9%	46.8%	45.8%
Latino	22.8%	22.7%	23.9%
African American	7.3%	7.2%	7.3%
Asian and Pacific Islander	22.0%	19.9%	19.7%
Other	3.1%	3.5%	3.3%
Education level (at program entrance)			
No High School Degree	4.3%	4.2%	4.6%
High school diploma	57.3%	59.6%	59.8%
GED or equivalent	11.3%	10.6%	11.0%
Associate degree	7.5%	6.7%	6.5%
Bachelor degree or higher	12.9%	12.4%	11.4%
Unknown/not reported	6.7%	6.5%	6.7%
Markers of Disadvantage			
Disabled	7.9%	7.4%	8.1%
Limited English proficient	7.3%	6.7%	7.9%
Academically disadvantaged (CCCCO definition)	58.6%	57.6%	60.2%
Economically disadvantaged (broad definition)	68.0%	64.8%	66.8%
Ever received CalWORKs	5.7%	5.2%	6.1%
Ever received Pell Grant	38.8%	35.8%	38.2%
Course enrollments in 3 years prior to health program			
Average number of terms	2.8	2.5	2.3
Ever enrolled full-time	28.8%	26.8%	24.7%

	8+ Unit Sample	6+ Unit Sample	8+ Unit Sample (Excluding Registered Nursing)
Average total units completed	20.3	18.1	16.2
Enrolled in basic skills course	40.5%	37.6%	37.0%
Momentum flag (earned at least 30 units)	29.2%	25.4%	21.9%
Attempted biology course (did not complete)	8.5%	7.7%	7.0%
Attempted anatomy course (did not complete)	10.6%	8.6%	7.2%
Attempted chemistry course (did not complete)	9.4%	7.9%	7.0%
Completed biology course	22.2%	19.2%	16.4%
Completed anatomy course	28.5%	22.1%	16.5%
Completed chemistry course	23.6%	19.0%	14.3%
Earned another award prior to entering health program	9.8%	8.6%	8.4%
Received financial aid at least one term during health program	57.7%	53.2%	56.6%
Course enrollments during health program			
Average GPA	3.0	3.0	3.0
Average number of units per term	7.7	7.1	7.5
Ever enrolled full-time	70.3%	61.7%	71.6%
Persistence flag (earned units in 3 consecutive primary terms)	63.8%	54.5%	59.2%
<b>Sample Size</b>	<b>119,768</b>	<b>165,420</b>	<b>82,084</b>

SOURCE: Authors' calculations from COMIS data.

**TABLE A4**

Sample characteristics of health CTE intending students, by program

	Registered Nursing	Emergency Medical Services	Licensed Vocational Nursing	Medical Assisting	Certified Nursing Assistant
Mean age at program entrance	29.9	23.8	30.0	31.6	29.0
Female	83.5%	27.7%	85.7%	89.0%	87.9%
Citizen	82.4%	95.9%	80.4%	84.6%	85.4%
Race/Ethnicity					
White	42.9%	60.6%	36.1%	42.3%	39.8%
Latino	20.1%	24.2%	24.2%	26.6%	24.6%
African American	7.4%	3.7%	10.7%	7.3%	12.5%
Asian and Pacific Islander	26.8%	8.0%	25.7%	20.2%	18.8%
Other					
Education level (at program entrance)					
No High School Degree	3.4%	4.5%	4.5%	5.1%	8.9%
High school diploma	51.9%	71.6%	58.9%	60.9%	60.7%
GED or equivalent	11.9%	5.9%	15.9%	12.1%	12.4%
Associate degree	9.7%	2.9%	6.3%	6.0%	3.2%
Bachelor degree or higher	16.3%	8.2%	5.9%	11.1%	5.1%
Unknown/not reported					
Markers of Disadvantage					

	Registered Nursing	Emergency Medical Services	Licensed Vocational Nursing	Medical Assisting	Certified Nursing Assistant
Disabled	7.4%	5.9%	9.3%	12.3%	10.2%
Limited English proficient	6.0%	2.9%	9.2%	10.6%	8.3%
Academically disadvantaged (CCCCO definition)	54.9%	57.9%	71.1%	60.5%	68.5%
Ever received CalWORKs	4.8%	2.2%	9.3%	11.1%	11.9%
Ever received Pell Grant	40.1%	23.0%	56.2%	44.8%	44.0%
Course enrollments in 3 years prior to health program					
Ever enrolled full-time	37.9%	23.5%	25.8%	19.0%	18.7%
Enrolled in basic skills course	48.3%	28.5%	47.9%	33.3%	38.3%
Momentum flag (earned at least 30 units)	45.1%	15.3%	24.0%	14.8%	13.7%
Attempted biology course (did not complete)	11.8%	5.1%	11.0%	5.7%	7.1%
Attempted anatomy course (did not complete)	17.9%	2.0%	13.1%	2.3%	4.2%
Attempted chemistry course (did not complete)	14.8%	2.9%	9.4%	2.5%	4.5%
Completed biology course	34.9%	9.4%	20.5%	9.7%	11.3%
Completed anatomy course	54.6%	3.3%	26.2%	4.2%	7.1%
Completed chemistry course	43.7%	4.8%	15.6%	5.9%	8.2%
Earned another award prior to entering health program	13.0%	5.5%	6.3%	6.1%	3.5%
Received financial aid at least one term during health program	60.0%	41.7%	73.4%	59.1%	61.7%
Course enrollments during health program					
Average GPA	3.0	2.9	2.9	3.1	2.8
Average number of units per term	8.1	6.4	8.3	6.3	6.6
Ever enrolled full-time	67.4%	61.5%	91.2%	56.0%	60.9%
Persistence flag (earned units in 3 consecutive primary terms)	73.9%	41.6%	70.5%	64.2%	33.5%
<b>Sample Size</b>	<b>37684</b>	<b>16053</b>	<b>7832</b>	<b>4500</b>	<b>3367</b>

SOURCE: Authors' calculations from COMIS data.

NOTE: Includes all students in 8+ unit sample.

**TABLE A5**

Sample characteristics of health CTE intending students, by race-ethnic groups

	White	Latino	African American	Asian and Pacific Islanders
Mean age at program entrance	29.9	27.0	31.6	28.8
Female	70.4%	72.5%	75.9%	70.4%
Citizen	95.1%	85.6%	83.6%	65.0%
Education level (at program entrance)				
No High School Degree	3.7%	6.0%	5.4%	3.0%
High school diploma	59.7%	65.9%	53.9%	44.7%
GED or equivalent	8.5%	9.7%	17.6%	16.7%
Associate degree	8.2%	5.9%	7.9%	7.6%
Bachelor degree or higher	13.6%	5.4%	8.3%	21.1%



	White	Latino	African American	Asian and Pacific Islanders
Unknown/not reported	6.3%	7.1%	7.0%	7.0%
Markers of Disadvantage				
Disabled	8.7%	8.1%	11.2%	4.7%
Limited English proficient	3.6%	8.8%	5.0%	14.5%
Academically disadvantaged (CCCCO definition)	51.0%	70.2%	72.6%	58.7%
Ever received CalWORKs	4.6%	7.3%	13.4%	3.6%
Ever received Pell Grant	32.6%	49.2%	55.5%	35.3%
Course enrollments in 3 years prior to health program				
Ever enrolled full-time	27.2%	28.8%	24.3%	34.0%
Enrolled in basic skills course	34.5%	47.7%	45.9%	44.7%
Momentum flag (earned at least 30 units)	26.6%	31.2%	25.8%	34.4%
Attempted biology course (did not complete)	9.7%	10.2%	11.2%	13.1%
Attempted anatomy course (did not complete)	7.9%	8.5%	9.9%	9.6%
Attempted chemistry course (did not complete)	9.2%	9.2%	9.0%	10.6%
Completed biology course	22.3%	20.3%	20.7%	25.0%
Completed anatomy course	27.5%	26.8%	26.8%	33.6%
Completed chemistry course	22.7%	22.4%	21.3%	27.6%
Earned another award prior to entering health program	10.3%	9.6%	8.8%	9.9%
Received financial aid at least one term during health program	51.7%	67.7%	73.6%	54.3%
Course enrollments during health program				
Average GPA	3.2	2.9	2.7	3.0
Average number of units per term	7.9	7.3	7.2	7.8
Ever enrolled full-time	71.1%	68.6%	69.6%	70.7%
Persistence flag (earned units in 3 consecutive primary terms)	63.5%	63.3%	59.9%	66.7%
<b>Sample Size</b>	<b>53724</b>	<b>27250</b>	<b>8762</b>	<b>26300</b>

SOURCE: Authors' calculations from COMIS data.

NOTE: Includes all students in 8+ unit sample.

**TABLE A6**

Sample characteristics of health CTE intending students, by economic disadvantage

	Ever receive Pell grants	No Pell grants	Economic disadvantage	No Economic disadvantage
Mean age at program entrance	28.1	29.8	28.8	29.9
Female	78.7%	66.6%	72.5%	68.9%
Citizen	83.7%	86.4%	84.4%	87.4%
Race/Ethnicity				
White	37.7%	49.4%	42.8%	49.2%
Latino	28.8%	18.9%	23.8%	20.6%
African American	10.5%	5.3%	8.0%	5.8%

	Ever receive Pell grants	No Pell grants	Economic disadvantage	No Economic disadvantage
Asian and Pacific Islander	20.0%	23.2%	22.4%	21.0%
Other	3.0%	3.2%	3.0%	3.5%
Education level (at program entrance)				
No High School Degree	5.0%	3.8%	4.6%	3.5%
High school diploma	63.3%	53.5%	57.6%	56.7%
GED or equivalent	14.1%	9.5%	11.7%	10.4%
Associate degree	7.7%	7.3%	7.4%	7.6%
Bachelor degree or higher	2.7%	19.4%	11.5%	15.9%
Unknown/not reported	7.3%	6.4%	7.1%	5.9%
Markers of Disadvantage				
Disabled	10.8%	6.0%	8.9%	5.7%
Limited English proficient	10.1%	5.5%	8.2%	5.5%
Academically disadvantaged (CCCCO definition)	74.9%	48.2%	62.6%	50.0%
Ever received CalWORKs	12.4%	1.4%	7.6%	1.5%
Ever received Pell Grant	100.0%	0.0%	45.6%	24.4%
Course enrollments in 3 years prior to health program				
Ever enrolled full-time	37.2%	23.5%	31.3%	23.7%
Enrolled in basic skills course	52.0%	33.3%	43.9%	33.4%
Momentum flag (earned at least 30 units)	38.0%	23.6%	31.9%	23.4%
Attempted biology course (did not complete)	10.8%	7.1%	9.3%	6.8%
Attempted anatomy course (did not complete)	13.2%	9.0%	11.8%	8.1%
Attempted chemistry course (did not complete)	12.3%	7.7%	10.7%	6.9%
Completed biology course	25.7%	20.0%	23.2%	20.1%
Completed anatomy course	33.1%	25.6%	30.2%	24.8%
Completed chemistry course	29.4%	19.9%	25.4%	19.6%
Earned another award prior to entering health program	12.0%	8.4%	10.4%	8.6%
Received financial aid at least one term during health program	94.8%	34.1%	65.8%	40.5%
Course enrollments during health program				
Average GPA	2.9	3.1	3.0	3.1
Average number of units per term	7.9	7.6	7.6	7.9
Ever enrolled full-time	78.6%	65.0%	72.6%	65.3%
Persistence flag (earned units in 3 consecutive primary terms)	69.2%	60.4%	66.3%	58.5%
<b>Sample Size</b>	<b>46470</b>	<b>73298</b>	<b>81442</b>	<b>38326</b>

SOURCE: Authors' calculations from COMIS data.

NOTE: Includes all students in 8+ unit sample.

## Appendix B: Analysis of Degree Completion

One of our primary outcomes of interest is the completion of a degree in a health program, although we also track completion of degrees in non-health fields and whether students transferred to a four year college after entering the health CTE program. To identify student award completion across the community college system, we use the Student Program Awards data file which includes one record for each award conferred and provides student identifiers along with TOP code, completion date, and the award level of the degree.

In total, there are 16 different types of awards that a student may earn – although several of them are categorized as non-credit awards and we do not include those in our analysis. We group awards into three categories: associate degrees, and for certificates, into long-term and short-term certificates based on the number of units required to complete the award. Specifically, associate degrees include both Associate of Arts and Associate of Science degrees; long-term certificates include certificates requiring 60+ units or 30–59 units; and short-term certificates include those requiring 18–29 units, 12–17 units, 6–17 units, and less than 6 units.

To calculate the time it takes a student to earn an award, we first assign all awards to a school term (Fall, Winter, Spring, or Summer). The award data and student enrollment data differ in that awards are assigned specific dates whereas the enrollment data uses term identifiers associated with semesters or quarters. In order to place awards within terms we utilize historical calendar data from COMIS. The calendar data is by school by term for a single school year (2000/2001) and contains start and end dates as well as a designation if the school was semester or quarters. We determine the average start date by semester or quarters and use it to assign terms to award dates throughout our period. We then calculate 3-year completion and 6-year completion based on the number of terms from when the student entered a health program (defined by their first observed vocational health course) entrance that it took to earn an award. For 3 year completion, the award must be conferred within 12 terms (including summer and winter) from entrance and for 6 year completion within 24 terms.

### Regression Analysis of Completion Rates

For our completion analysis, we exclude students enrolled in short-term health programs at colleges that do not seem to report local certificates (see discussion in previous section) as the non-reporting might bias our results by not accounting for all completed awards. Because we are also focused on understanding completion of health degrees, we exclude students who only completed a non-health award as well as students who transferred to a four year college during the six year completion window. Finally, we drop students with missing observations for our covariates. While these restrictions result in a smaller sample, there are few differences in the characteristics of our full CTE health sample and the analytic sample we use for our completion analysis (Table B1).

**TABLE B1**

Summary statistics, completion model samples after exclusions

	Completion analytic sample, 8+ units	Completion analytic sample, 6+ units
Age at program entrance	29.4	29.0
Female	74.9%	71.6%
Citizen	84.9%	86.0%
Race/ethnicity		
White	44.8%	45.5%
Latino	23.3%	23.9%
African-American	7.4%	7.6%
Asian Pacific Islander	23.4%	21.8%
Other race	1.1%	1.2%
Education level at program entrance (reference category High School diploma)		
No high school diploma	4.3%	4.6%
High school diploma	63.8%	61.3%
GED/Other diploma	12.4%	12.1%
Associate degree	8.6%	7.8%
Bachelor degree or higher	15.2%	14.2%
Disabled	7.8%	7.6%
Limited English	7.4%	7.0%
Academically Disadvantaged	58.8%	58.9%
Ever received CalWORKs	6.0%	5.8%
Ever receive Pell Grant	39.5%	37.8%
Took basic skills course in 3 year prior to program entrance	40.8%	38.6%
Ever took full-time courseload in 3 year prior to program entrance	26.8%	24.9%
Earned 30 units or more in 3 year prior to program entrance	28.1%	24.8%
Completed biology course in 3 year prior to program entrance	22.3%	19.6%
Completed anatomy course in 3 year prior to program entrance	30.8%	25.6%
Completed chemistry course in 3 year prior to program entrance	24.3%	20.5%
Completed another award at CCC in 3 years prior to program entrance	10.6%	9.5%
Received financial aid during health program	59.2%	56.2%
GPA after program entrance	3.0	3.0
Average number of units per term after program entrance	7.7	7.2
Ever took full-time courseload after program entrance	70.2%	62.6%
Persistence flag (earned units 3 consecutive terms)	64.6%	56.9%
<b>Sample Size</b>	<b>80,245</b>	<b>101,703</b>

SOURCE: Authors' calculations from COMIS data.

To examine differences in completion rates in more depth, we estimate linear probability models that control for student-level characteristics, markers of academic and economic disadvantage, program choice, academic preparation prior to entering the health CTE program, and course taking behavior. The dependent variable is whether a student completed a health award within six years. We include year and college dummy variables in all models to adjust for differences beyond those covariates that are already included. Table B2 presents regression results as we step in different sets of covariates. We ran alternative models to test the effects of when different covariates were stepped into the regressions and the results were not substantively different. All results we present in the report are based on Model 5 below which includes all covariates along with controls for program entrance year and college of attendance. Robust standard errors are clustered at the college level in all models.

**TABLE B2**

Linear probability model completion results, main analysis

Independent variables:	Dependent Variable: Completed health award within six years of program entrance				
	Model 1	Model 2	Model 3	Model 4	Model 5
Age at program entrance	-0.000703	-0.000494	-0.00171***	-0.00118**	-0.00115**
Female	0.0926***	0.0897***	0.0327***	0.0302***	0.0193***
Citizen	-0.0318***	-0.0301***	-0.0207***	-0.0152**	-0.00561
Race/ethnicity (reference category White)					
Latino	-0.0494***	-0.0506***	-0.0304***	-0.0280***	0.00663
African-American	-0.0975***	-0.0997***	-0.0681***	-0.0620***	0.000975
Asian Pacific Islander	-0.00250	-0.00426	-0.0170**	-0.0178***	0.0101*
Other race	-0.0429***	-0.0436***	-0.0202	-0.0166	0.0100
Education level at program entrance (reference category High School diploma)					
No high school diploma	-0.0921***	-0.0896***	-0.0627***	-0.0584***	-0.0407***
GED/Other diploma	-0.0133*	-0.0137*	-0.00764	-0.00431	-0.00726
Associate degree	0.0255***	0.0240***	-0.00851	-0.00913	-0.00766
Bachelor degree or higher	-0.0191	-0.0136	-0.0371**	-0.0191	-0.0470***
Disabled		-0.0399***	-0.0341***	-0.0396***	-0.00805
Limited English		0.00145	0.0182*	0.00780	0.00652
Academically Disadvantaged		-0.0250***	-0.0143**	-0.0262***	0.00562
Ever received CalWORKs		-0.0381**	-0.0175	-0.0180	-0.00908
Ever receive Pell Grant		0.0532***	0.0314***	0.0246***	-0.0132***
Took basic skills course in 3 year prior to program entrance				0.0100*	0.0161***
Ever took full-time courseload in 3 year prior to program entrance				0.0146***	-0.0143***
Earned 30 units or more in 3 year prior to program entrance				0.0300***	0.0336***
Completed biology course in 3 year prior to program entrance				0.0337***	0.0214**
Completed anatomy course in 3 year prior to program entrance				0.0604***	0.0553***
Completed chemistry course in 3 year prior to program entrance				0.0343***	0.0262***

	Dependent Variable: Completed health award within six years of program entrance				
Independent variables:	Model 1	Model 2	Model 3	Model 4	Model 5
Completed another award at CCC in 3 years prior to program entrance				0.00212	0.0129**
Received financial aid during health program					0.0422***
GPA after program entrance					0.121***
Average number of units per term after program entrance					0.0200***
Ever took full-time courseload after program entrance					0.101***
Persistence flag (earned units 3 consecutive terms)					0.154***
Year Fixed Effects	X	X	X	X	X
College Fixed Effects	X	X	X	X	X
Program Fixed Effects			X	X	X
Constant	0.685***	0.891***	0.891***	0.800***	0.0248
Observations	80,245	80,245	80,245	80,245	80,245
R-squared	0.128	0.229	0.229	0.239	0.332

SOURCE: Authors' calculations from COMIS data.

NOTES: Robust standard errors clustered at the college level. Standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**TABLE B3**

Linear probability model completion results, sensitivity checks for 6+ unit sample

	Dependent Variable: Completed health award within six years of health program entrance				
Independent variables:	Model 1	Model 2	Model 3	Model 4	Model 5
Age at program entrance	.000071	0.000258	-0.00146***	-0.000876**	-0.000532
Female	0.112***	0.106***	0.0307***	0.0271***	0.0200***
Citizen	-0.0415***	-0.0397***	-0.0232***	-0.0172**	-0.00789
Race/ethnicity (reference category White)					
Latino	-0.0475***	-0.0514***	-0.0282***	-0.0251***	0.00769
African-American	-0.117***	-0.124***	-0.0818***	-0.0735***	-0.0103
Asian Pacific Islander	0.00523	0.00250	-0.0164**	-0.0181***	0.00789
Other	-0.0553***	-0.0585***	-0.0227*	-0.0170	0.00871
Education level at program entrance (reference category High School diploma)					
No high school diploma	-0.108***	-0.104***	-0.0643***	-0.0584***	-0.0328***
GED/Other diploma	-0.0161**	-0.0169**	-0.01000*	-0.00564	-0.00564
Associate degree	0.0438***	0.0422***	-0.00499	-0.00727	-0.00741
Bachelor degree or higher	-0.0103	0.00217	-0.0300**	-0.0115	-0.0408***
Disabled		-0.0183	-0.0170*	-0.0235**	-0.00247
Limited English		-0.00132	0.0168*	0.00554	0.00380
Academically Disadvantaged		-0.0226***	-0.0120**	-0.0239***	0.00467
Ever received CalWORKs		-0.0564***	-0.0272**	-0.0263**	-0.0173*

Independent variables:	Dependent Variable: Completed health award within six years of health program entrance				
	Model 1	Model 2	Model 3	Model 4	Model 5
Ever received Pell Grants		0.0782***	0.0440***	0.0353***	-0.0138***
Took basic skills course in 3 year prior to program entrance				0.00941*	0.0139***
Ever took full-time courseload in 3 year prior to program entrance				0.0222***	-0.0133***
Earned 30 units or more in 3 year prior to program entrance				0.0317***	0.0363***
Completed biology course in 3 year prior to program entrance				0.0458***	0.0288***
Completed anatomy course in 3 year prior to program entrance				0.0825***	0.0682***
Completed chemistry course in 3 year prior to program entrance				0.0361***	0.0264***
Completed another award at CCC in 3 years prior to program entrance				0.000387	0.0141**
Received financial aid during health program					0.0482***
GPA after program entrance					0.0986***
Average number of units per term after program entrance					0.0227***
Ever took full-time courseload after program entrance					0.108***
Persistence flag (units in 3 consecutive terms)					0.159***
Year Fixed Effects	X	X	X	X	X
College Fixed Effects	X	X	X	X	X
Program Fixed Effects			X	X	X
Constant	0.726***	0.714***	1.181***	1.056***	0.281***
Observations	101,703	101,703	101,703	101,703	101,703
R-squared	0.135	0.141	0.278	0.290	0.384

SOURCE: Authors' calculations from COMIS data.

NOTES: Robust standard errors clustered at the college level. Standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**TABLE B4**

Linear probability model completion results, sensitivity checks by program length

Independent variables:	Dependent Variable: Completed health award within six years of program entrance		
	Full model (model 5) Associate programs	Full model (model 5) Long certificate programs	Full model (model 5) Short certificate programs
Age at program entrance	-0.00151***	-0.00174***	0.000490
Female	0.0120***	0.0289***	0.0222***
Citizen	-0.00373	-0.0149*	-0.00661
Race/ethnicity (reference category White)			
Latino	0.0191***	0.0135	-0.0144
African-American	0.00671	0.00471	0.00200

Independent variables:	Dependent Variable: Completed health award within six years of program entrance		
	Full model (model 5) Associate programs	Full model (model 5) Long certificate programs	Full model (model 5) Short certificate programs
Asian Pacific Islander	0.00313	0.0124	0.0167
Other race	0.00897	0.0158	0.00208
Education level at program entrance (reference category High School diploma)			
No high school diploma	-0.0270***	-0.0386**	-0.0393***
GED/Other diploma	-0.0140***	-0.0170*	0.0165
Associate degree	-0.0165***	-0.00535	0.0252
Bachelor degree or higher	-0.0542***	-0.0329***	-0.0305**
Disabled	-0.0164***	0.00586	0.00482
Limited English	-0.0136**	-0.00262	0.0514***
Academically Disadvantaged	0.00348	0.0118	0.0230***
Ever received CalWORKs	-0.0195***	0.0196*	-0.00363
Ever receive Pell Grant	-0.0172***	-0.00429	0.00145
Took basic skills course in 3 year prior to program entrance	0.00975***	0.00828	0.0159*
Ever took full-time courseload in 3 year prior to program entrance	-0.0219***	-0.0107	-0.00201
Earned 30 units or more in 3 year prior to program entrance	0.0227***	0.0363***	0.0480***
Too any biological science course in 3 year prior to program entrance	0.0844***	0.0101	0.0121
Took any chemistry course in 3 year prior to program entrance	0.0183***	0.0476***	0.0142
Completed another award at CCC in 3 years prior to program entrance	0.00279	0.0289**	-3.94e-05
Received financial aid during health program	0.0552***	0.0306***	0.0252***
GPA after program entrance	0.124***	0.166***	0.0845***
Average number of units per term after program entrance	0.0307***	0.0144***	0.00319**
Ever took full-time courseload after program entrance	0.0711***	0.298***	0.0796***
Persistence flag (earned units 3 consecutive terms)	0.164***	0.126***	0.131***
Year Fixed Effects	X	X	X
College Fixed Effects	X	X	X
Program Fixed Effects	X	X	X
Constant	0.0292	-0.438***	0.331
Observations	43,359	15,409	16,781
R-squared	0.337	0.320	0.296

SOURCE: Authors' calculations from COMIS data.

NOTES: Robust standard errors clustered at the college level. Standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.



**TABLE B5**

Linear probability model completion results, sensitivity checks by racial/ethnic groups

Independent variables:	Dependent Variable: Completed health award within six years of health program entrance			
	Full model White	Full model Latino	Full model African American	Full model Asian Pacific Islander
Age at program entrance	-0.00100***	-0.000854**	-0.00267***	-0.000296
Female	0.0243***	0.0164**	0.0216	0.00752
Citizen	-0.000565	-0.00193	-0.00898	-0.0130**
Education level at program entrance (reference category High School diploma)				
No high school diploma	-0.0362***	-0.0492***	-0.0317	-0.0190
GED/Other diploma	-0.0142**	-0.00209	0.00898	-0.00227
Associate degree	-0.0112	0.0162	-0.00314	-0.0155
Bachelor degree or higher	-0.0399***	-0.0490***	0.0229	-0.0532***
Disabled	-0.00936	0.00231	-0.0253	-0.0164
Limited English	-0.000648	0.0205*	0.00730	-5.88e-05
Academically Disadvantaged	0.0125***	0.00260	-0.00395	-0.00848
Ever received CalWORKs	-0.0221**	-0.0143	0.0482***	-0.00441
Ever receive Pell Grant	-0.0155***	-0.0110	-0.00567	-0.00223
Took basic skills course in 3 year prior to program entrance	0.0148***	0.00990	0.00877	0.0135*
Ever took full-time course load in 3 year prior to program entrance	-0.0124**	-0.0163**	-0.00619	-0.0205**
Earned 30 units or more in 3 year prior to program entrance	0.0304***	0.0389***	0.00758	0.0466***
Too any biological science course in 3 year prior to program entrance	0.0542***	0.0606***	0.0631***	0.0627***
Took any chemistry course in 3 year prior to program entrance	0.0168***	0.0387***	0.0536***	0.00905
Completed another award at CCC in 3 years prior to program entrance	0.0160**	-0.00384	-0.0104	0.0187*
Received financial aid during health program	0.0386***	0.0480***	0.0400***	0.0471***
GPA after program entrance	0.109***	0.134***	0.164***	0.119***
Average number of units per term after program entrance	0.0198***	0.0208***	0.0184***	0.0208***
Ever took full-time course load after program entrance	0.0999***	0.107***	0.114***	0.0907***
Persistence flag (earned units 3 consecutive terms)	0.152***	0.145***	0.145***	0.168***
Year Fixed Effects	X	X	X	X
College Fixed Effects	X	X	X	X
Program Fixed Effects	X	X	X	X
Constant	0.276***	0.122***	0.0839	0.217***
Observations	35,914	18,669	5,970	18,809
R-squared	0.357	0.362	0.331	0.289

SOURCE: Authors' calculations from COMIS data.

NOTES: Robust standard errors clustered at the college level. Standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

## Appendix C: Analysis of Wage Returns and Industry

Our analysis of wages relies on statistical models relating wage outcomes to student and program characteristics and the timing of credential receipt. The labor market return to credentials can be summarized simply using an ordinary least squares regression. However, as is well-understood in the research literature, these simple correlations are likely biased upwards if high ability individuals are more likely to pursue and complete higher education credentials. To address these concerns, we use student fixed effect models. Because CTE students tend to be older and have relatively long pre-enrollment wage history, their earnings before entering CTE study provide perhaps the best control for unobserved ability. We thus measure the labor market return to credentials relative to a student’s own average wage to control for many unobserved, idiosyncratic, individual factors potentially correlated with labor market outcomes. The student fixed effects also subsume any characteristics that do not vary over time, such as race, economic status, prior education level, program choice, region (for most students, who do not move).

Relying on pre-enrollment earnings to control for individual ability is still potentially misleading if entry into CTE is motivated by a dip in earnings. This endogeneity problem—common to much of the job training literature (e.g. Heckman et al, 1999)—could produce overestimated returns to CTE credentials even after controlling for student ability. Following Stevens et al (2015), we construct a control group of students who also had earnings prior to entering CTE training, but failed to complete a credential. As described above, the nature of the COMIS data permits identification of all students who completed CTE courses. We use our full sample of students identified as CTE-intending based on having completed 8 units in a specific health CTE program within 3 years of the first CTE course. This is similar to the definition used by the CCCCCO for measuring CTE intent (8 units within 3 years), but we will vary this definition to test alternative levels of intensity. Among all students who are defined as “intending” to complete a health program, then, those who complete a credential in the program can be thought of as our treatment group and those who do not as the control. We exclude students who transferred or completed only credentials that are either non-credit or in non-health programs. By examining differences in wage trajectories for the treatment and control groups, we arrive at a more causal estimate of the return to health CTE credentials.

To estimate these trajectories specifically, we employ a detailed student-term level specified as follows:

$$\ln(\text{wage}_{it}) = \alpha_i + \gamma_t + \beta \text{Enrolled}_{it} + \delta \text{Postaward}_{it} + \sum_j \varphi_j (\text{Age} = j)_{it} + \varepsilon_{it}$$

where subscript  $i$  denotes individual and  $t$  denotes quarter, as our wage data is given at the quarter level (school terms are matched to calendar quarters). The logarithm of quarterly wages is the key dependent variable, and  $\delta$  is the coefficient of interest, measuring the percent change in quarterly wages due to credential receipt. *Postaward* is an indicator that becomes 1 in every quarter after the student receives a credential. Some students obtain multiple credentials, but for this study, we primarily measure the wage effect of the “highest” credential obtained, based on length of program (see robustness check below). Student-level fixed effects are captured in  $\alpha$ , and time effects in  $\gamma$ . Indicator variables for age at term  $t$  control for age-earnings profile. *Enrolled* is an indicator variable for whether student  $i$  is enrolled in term  $t$ , controlling for depressed wages while in school. This baseline model closely follows the specification in Stevens et al (2015). The sample includes both the treatment and control groups described above. Thus, estimates are interpreted as the return to credentials relative CTE students who did not complete.

Our baseline sample includes students who enter the health CTE-intending sample between 2003 and 2009. We observe their enrollment, completion, and wage outcomes from 2000 through 2014. The selected time horizon of the sample is an important consideration, so that we have proper windows for observing wages before and after schooling, sufficient time to reveal CTE “intentions” as we define them, and sufficient time to earn an award. We

thus test the robustness of our results to alternate sample entry years. As noted above, students who complete a non-credit award only or who transfer to a four-year college are omitted from the analysis. Our baseline sample is also limited to students age 18-54 at the beginning of their CTE schooling. We test these sample choices in checks that follow, and find none alter the conclusions from the baseline model.

Throughout, we also test alternative specifications of the treatment and control groups. Given the systematic differences in students who choose to pursue different health programs, we are concerned that a control group based on all health CTE-intending students might camouflage important differences across programs. Thus, we use student demographic characteristics and the programs where students earned the most health CTE credits to define alternate control groups. We find no systematic differences, although the magnitude of point estimates does shift in some cases.

Given that many studies have documented variation in returns across programs and credential type, after confirming consistency with the literature, we focus on uncovering variation at a more detailed level. First, we examine variation in returns for health programs (at the 6 digit TOP code level) and for award length. We adjust the fixed effect model specification in two ways to capture this variation. We first split coefficient  $\delta$  according to credential type or program. This identifies the return to an award type or program relative to all health students who do not complete. Because this may induce bias, given the wide variation in returns across programs, we next run our baseline model separately according to the program students enter (or, technically “appear” to enter based on course taking). We use 6 digit TOP codes, based on the award a student receives or, for non-completers, based on the health program in which they obtained the most credits. Programs are also categorized based on the most common type of credential—associate degree, long term or short term certificate—in order to obtain within-credential type wage returns.

We first present summary statistics for our baseline student sample used in these wage analyses. The treatment and control groups (completers and non-completers, respectively) are similar on most dimensions. We have about 49,000 students in the sample, of which 71% completed an award. On average, students have 14 quarters of wage data before entering the CTE sample, and 27 quarters after. This gives us a relatively long pre- and post-treatment window in which to observe changes in wages as a result of schooling. The majority of the sample is younger than 25, though there are sizeable samples of older students as well. The treatment and control groups do not vary systemically across age, race, or year of entry. For the most part, we have a similar share of treatment and control group students across health programs as well. The exceptions are registered nursing (significantly higher share complete an award) and EMS (significantly higher share do not complete).<sup>1</sup>

**TABLE C1**  
Summary statistics, student sample for wage regressions

	Number			Distribution (%)		
	Total	Treated (Award)	Control (Non-completer)	Total	Treated (Award)	Control (Non-completer)
Total students	49268	34813	14455	100%	70.7%	29.3%
<b>Award type typically granted by program entered</b>						
Associates	27204	22528	4676	55.2%	64.7%	32.3%
Long term certificate	8996	6861	2135	18.3%	19.7%	14.8%
Short term certificate	13068	5424	7644	26.5%	15.6%	52.9%

<sup>1</sup> As discussed above, the EMS completion rate may be affected by underreporting of locally awarded certificates. We test whether this impacts our main results by excluding colleges and programs that appear likely to award a large share of local certificates (as described above). See results below.

	Number			Distribution (%)		
	Total	Treated (Award)	Control (Non-completer)	Total	Treated (Award)	Control (Non-completer)
<b>Quarters in sample</b>						
Quarters employed before entering health CTE (average)	14.4	14.7	13.7			
Quarters employed after entering health CTE (average)	26.8	27.6	24.6			
Quarters enrolled after entering health CTE (average)	6.3	6.6	5.4			
<b>Entrance year (CTE-intending sample)</b>						
2003	7649	5380	2269	15.5%	15.5%	15.7%
2004	7488	5415	2073	15.2%	15.6%	14.3%
2005	7160	5077	2083	14.5%	14.6%	14.4%
2006	6936	4997	1939	14.1%	14.4%	13.4%
2007	6846	4853	1993	13.9%	13.9%	13.8%
2008	6701	4740	1961	13.6%	13.6%	13.6%
2009	6488	4351	2137	13.2%	12.5%	14.8%
<b>Age at start</b>						
18-25	26390	18491	7899	53.6%	53.1%	54.7%
26-30	7344	5510	1834	14.9%	15.8%	12.7%
31-35	5555	4069	1486	11.3%	11.7%	10.3%
36-40	4573	3241	1332	9.3%	9.3%	9.2%
40+	5406	3502	1904	11.0%	10.1%	13.2%
<b>Race</b>						
Asian	11724	8737	2987	24.3%	25.6%	21.1%
Black or African-American	3631	2263	1368	7.5%	6.6%	9.7%
Hispanic or Latino	11113	7574	3539	23.0%	22.2%	25.0%
American Indian, Alaska Native	457	323	134	1.0%	0.9%	1.0%
Pacific Islander, Native Hawaiian	387	251	136	0.8%	0.7%	1.0%
Two or more races	73	47	*	0.2%	0.1%	*
White	20934	14993	5941	43.3%	43.9%	42.0%
<b>Gender</b>						
Female	35952	26650	9302	73.1%	76.6%	64.5%
Male	13238	8120	5118	26.9%	23.4%	35.5%
<b>6 digit TOP code (based on Award for completers and based on credit accumulation for non-completers)</b>						
General	413	19	394	0.8%	0.1%	2.7%
Medical Laboratory Technology	82	34	48	0.2%	0.1%	0.3%
Phlebotomy	90	60	30	0.2%	0.2%	0.2%
Physician's Assistant	239	217	*	0.5%	0.6%	*
Medial Assisting	1958	1177	781	4.0%	3.4%	5.4%
Clinical Medical Assisting	429	243	186	0.9%	0.7%	1.3%
Administrative Medical Assisting	546	292	254	1.1%	0.8%	1.8%
Respiratory Care/Therapy	1700	1509	191	3.5%	4.3%	1.3%
Cardiovascular Technician	452	331	121	0.9%	1.0%	0.8%
Surgical Technician	217	155	62	0.4%	0.5%	0.4%
Occupational Therapy Technology	270	238	32	0.6%	0.7%	0.2%
Speech Pathology	522	361	161	1.1%	1.0%	1.1%
Pharmacy Technology	931	540	391	1.9%	1.6%	2.7%
Physical Therapist Assistant	419	387	32	0.9%	1.1%	0.2%
Health Information Technology	1283	590	693	2.6%	1.7%	4.8%
Health Information Coding	571	295	276	1.2%	0.9%	1.9%
Radiologic Technology	2092	1750	342	4.3%	5.0%	2.4%
Sonography	208	175	33	0.4%	0.5%	0.2%

	Number			Distribution (%)		
	Total	Treated (Award)	Control (Non-completer)	Total	Treated (Award)	Control (Non-completer)
General Nursing	235	*	218	0.5%	*	1.51%
Registered Nursing	19215	16762	2453	39.0%	48.2%	17.0%
Licensed Vocational Nursing	3638	2852	786	7.4%	8.2%	5.4%
Certified Nurse Assistant	1207	467	740	2.5%	1.3%	5.1%
Home Health Aide	106	*	83	0.2%	*	0.6%
Psychiatric Technician	2245	1692	553	4.6%	4.9%	3.8%
Dental Assistant	1709	1278	431	3.5%	3.7%	3.0%
Dental Hygienist	1024	979	45	2.1%	2.8%	0.3%
Dental Laboratory Technician	279	152	127	0.6%	0.4%	0.9%
Emergency Medical Services	3794	793	3001	7.7%	2.3%	20.8%
Paramedic	937	519	418	1.9%	1.5%	2.9%
Mortuary Science	350	256	94	0.7%	0.7%	0.7%
Health Professions, Transfer Core Curriculum	651	118	533	1.3%	0.3%	3.7%
Community Health Worker	61	*	37	0.1%	*	0.3%
Massage Therapy	228	95	133	0.5%	0.3%	0.9%
Other	720	233	487	1.5%	0.7%	3.4%
<b>Ever Received Pell Grant</b>						
Yes (1)	19829	15033	4796	40.2%	43.2%	33.2%
No (0)	29439	19780	9659	59.8%	56.8%	66.8%
<b>Ever Identified as CalWORKs participant</b>						
Yes (1)	2814	1940	874	5.7%	5.6%	6.0%
No (0)	46454	32873	13581	94.3%	94.4%	94.0%
<b>College Region (where entered CTE program)</b>						
Central Valley	5776	4712	1064	11.7%	13.5%	7.4%
East Bay	2200	1449	751	4.5%	4.2%	5.2%
Greater Sacramento	2510	1749	761	5.1%	5.0%	5.3%
Inland Empire	4556	3353	1203	9.3%	9.6%	8.4%
Los Angeles	10504	7031	3473	21.4%	20.2%	24.2%
Mid-Peninsula	2532	1682	850	5.1%	4.8%	5.9%
Mother Lode	128	*	116	0.3%	*	0.8%
North Bay	2812	2226	586	5.7%	6.4%	4.1%
Northern Coastal	555	463	92	1.1%	1.3%	0.6%
Northern Inland	1082	772	310	2.2%	2.2%	2.2%
Orange	3847	2917	930	7.8%	8.4%	6.5%
San Diego Imperial	4288	2724	1564	8.7%	7.8%	10.9%
Santa Cruz Monterey	1083	693	390	2.2%	2.0%	2.7%
Silicon Valley	2675	1917	758	5.4%	5.5%	5.3%
South Central Coast	4631	3101	1530	9.4%	8.9%	10.6%

SOURCE: Authors' calculations from COMIS data.

NOTE: Regions defined by Chancellor's Office Division of Workforce and Economic Development. Any cells with fewer than 10 observations have been removed from the table. Any cell with fewer than 30 observations is masked for confidentiality and indicated by an \*.

Table C2 presents detailed regression results from our baseline estimates. A simple, naïve comparison of average wages before and after awards indicates a substantial boost in wages, on the order of 94 percent. Controlling for the fact that earnings tend to rise over time with age and experience and that earnings prior to an award are lower since students are enrolled in school (Model 2), we estimate a 47 percent return to a health CTE credential. Adding controls for student characteristics, both observable and not, we estimate a slightly smaller but still large return of 51 percent (Model 3). We take this estimate as our baseline wage return for health CTE credentials.

Model 4 shows that returns vary substantially across type of credential, from 62% wage increase for associate degrees, compared to 40% for long term certificates and 6% for short term certificates.

**TABLE C2**

Fixed effect models of log quarterly wages

Variables	Model 1 (Naïve)	Model 2	Model 3	Model 4
Enrolled		-0.383**	-0.352**	-0.334**
Postaward	0.944**	0.469**	0.514**	
Postaward*Associates				0.625**
Postaward* Long term certificate				0.388**
Postaward*Short term certificate				0.0606*
Constant	8.461**	7.158**	7.519**	7.504**
Year-Quarter FE		X	X	X
Student FE			X	X
Age FE		X	X	X
Observations	2,028,717	2,028,717	2,028,717	2,028,717
R-squared	0.160	0.268	0.515	0.519

SOURCE: Authors' calculations from COMIS data.

NOTES: Standard errors available upon request. \*\* p<0.01, \* p<0.05.

Taking a similar approach to Stevens et al. (2015), the other recent California paper, it is not surprising that we estimate very similar returns. Stevens et al estimate a 64 percent return to associate degrees, 30 percent for certificates of 30-60 hours (roughly corresponding to our long-term certificates), 11 percent for certificates of 18-30 hours and insignificant result for 6-18 hour certificates. Our slightly different categorization of certificate length explains some of the difference in coefficient estimates, as well as slight differences in time period, amount of data (we have only more recent wages) and definition of the comparison group (we align time period for treated and control exactly). Despite these differences, our estimates are nearly identical. These findings also correspond with those from other states. Dadgar and Weiss (2015), pertaining to Washington state community colleges, find the largest returns for associate degrees in general, and in health specifically. Jepsen, Troske, and Coombs (2015) estimate CTE associate degrees earn 24 to 56 percent returns for men and women, respectively, in Kentucky, and certificates returns as low as 5-7 percent. Given this consistency with prior literature, we next turn to probing the baseline results in more detail.

Our baseline estimates compare wage gains for completers to that of non-completers writ large. So we next test the return to credentials when measured against a variety of alternate control groups. First we examine returns within programs according to the typical award offered. The first panel of the following table shows how the returns within program length varies depending on when compared to all health CTE intending students (first column) vs compared to only students who entered similar length programs.<sup>2</sup> We find only small differences in

<sup>2</sup> Programs are split into Associates, Long Term, and Short Term based on the share of awards (some programs award credentials of varying lengths). We classify as follows: AA: 123010, 120500, 121000, 121100, 121200, 121400, 121800, 121900, 122000, 122200, 122500, 122600, 122800, 123000, 124020, 125500, 126000, 127000; LT: 123020, 120600, 121300, 121700, 122700, 123900, 124000, 124010, 124030; ST: 120200, 125000, 120500, 120510, 120700, 120800, 120810, 120820, 120830, 120900, 121400, 121500, 122100, 122310, 122400, 123030, 123080, 126100, 126200, 129900

the wage return under these alternative control group specifications. The return to short term credentials is slightly larger when compared to students who also entered short term programs.

Given the variation in returns across categories of programs, we also find it important to look at programs individually. The second panel presents wage returns by program, measured in the same two ways. The first column estimates the baseline model by breaking out the postaward coefficient  $\delta$  into separate coefficients for each 6 digit TOP code. These estimates can be interpreted as the return to completing a credential in the given program relative to all health CTE-intending student. In many programs, the wage return is negative. For example students who earn a credential in “general health” earn 36% less than students in health that do not complete an award. This is after controlling for each student’s average wage level over time and their age-earnings profile. Again, clearly the comparison group is a crucial piece to correctly interpreting these results. Students who earn registered nursing, radiology, radiation therapy, and dental hygiene credentials experience among the largest (50% and above) wage return relative to students who do not complete a health award.

We test these findings further by next estimating separate models for all students in a given program. Relative to students who begin the same program but do not complete a health award of any sort, wage returns are generally similar. A few programs that are typically short term—such as medical assisting—yield zero or negative returns relative to all health CTE students but positive returns when compared to the closest peers.

Taken together, these results suggest that program choice is hugely important when considering the economic value of CTE credentials for students. But even lower value credentials may pay off for students who complete them, especially if they are otherwise unlikely to enter a higher return (i.e. lengthier or more difficult) program of study.

**TABLE C3**

Baseline coefficient of interest, by program and alternating comparison groups

	Compared to all CTE-intending	Compared to students who entered the same program	
		Coefficient	Number Obs
<b>Program length</b>			
Associates	0.625**	0.634**	1,170,448
Long-term Certificate	0.388**	0.330**	358,447
Short-term Certificate	0.0606*	0.119**	499,822
<b>Program TOP code</b>			
General (120100)	-0.200	-0.0380	14,249
Hospital and Health Care Administration (120200)	-0.522**		
Medical Laboratory Technology (120500)	0.362**		
Phlebotomy (120510)	-0.0893*		
Physician’s Assistant (120600)	0.568**	0.354*	10,524
Electro-Diagnostic Technology (120700)	-0.0360		
Medical Assisting (120800)	0.0440	0.148**	69,199
Clinical Medical Assisting (120810)	0.0599	0.120	13,728
Administrative Medical Assisting (120820)	-0.0344	0.144	18,700
Hospital Service Technology (120900)	-0.424		
Respiratory Care/Therapy (121000)	0.598**	0.596**	70,039
Polysomnography (121100)	0.334**		

	Compared to all CTE-intending	Compared to students who entered the same program	
		Coefficient	Number Obs
Electro - Neuro Technology (121200)	0.780**		
Cardiovascular Technician (121300)	0.298*	0.209	17,746
Orthopedic Assistant (121400)	0.111		
Electrocardiography (121500)	-0.0374		
Surgical Technician (121700)	0.326**	0.290*	8,906
Occupational Therapy Technology (121800)	0.440**	0.496**	11,591
Speech Pathology (122000)	-0.0182	0.193**	22,860
Pharmacy Technology (122100)	0.0772	0.0956*	34,117
Physical Therapist Assistant (122200)	0.287**	0.363**	19,231
Health Information Technology (122300)	0.111**	0.158**	55,540
Health Information Coding (122310)	0.0783*	0.0825	27,626
School Health Clerk (122400)			
Radiologic Technology (122500)	0.701**	0.685**	89,493
Radiation Therapy Technician (122600)	0.878**		
Sonography (122700)	0.721**	0.664**	8,623
Sports Medicine (122800)	0.104		
General Nursing (123000)	0.741**	0.745**	9,674
Registered Nursing (123010)	0.709**	0.652**	839,457
Licensed Vocational Nursing (123020)	0.374**	0.337**	144,119
Certified Nurse Assistant (123030)	-0.0912	-0.0297	42,521
Home Health Aide (123080)	-0.0913	-0.252	3,660
Psychiatric Technician (123900)	0.429**	0.337**	99,708
Dental General (124000)	0.0400		
Dental Assistant (124010)	0.102**	0.249**	60,172
Dental Hygienist (124020)	0.611**	0.757**	44,376
Dental Laboratory Technician (124030)	-0.0827**	0.0615	8,375
Emergency Medical Services (125000)	0.0855	0.0603	141,174
Paramedic (125100)	0.563**	0.285**	42,257
Mortuary Science (125500)	0.126**	0.300**	13,128
Health Professions, Transfer Core Curriculum (126000)	0.109	0.0848	24,550
Community Health Worker (126100)	-0.301**		
Massage Therapy (126200)	-0.213**	-0.0324	8,220
Other (129900)	0.0506**	0.0927*	28,907

SOURCE: Authors' calculations from COMIS data.

NOTES: All models include student, year-quarter, and age fixed effects and controls for enrollment and a constant. Full regression results available upon request. \*\* p<0.01, \* p<0.05.



Although fixed effect models account for all individual-level characteristics, we are nonetheless interested in whether returns vary within socioeconomic subgroup. The following table estimates the baseline model separately for each group in the first column. The return to health CTE credentials is remarkably similar regardless of gender, race and ethnicity, economic disadvantage, region.

**TABLE C4**

Baseline coefficient of interest, by program and alternating comparison groups

	Compared to students with same characteristic	
	Coefficient	Number Obs
<b>Gender</b>		
Female	0.535**	1,478,889
Male	0.469**	546,851
<b>Race/ethnicity</b>		
Asian	0.460**	471,267
Black	0.438**	152,820
Hispanic or Latino	0.490**	472,600
American Indian	0.552**	18,845
Pacific Islander	0.510**	15,710
Two or more	0.487*	2,593
White	0.554**	858,407
<b>Received Pell</b>		
Yes	0.615**	786,913
No	0.453**	1,241,804
<b>CalWORKs participant</b>		
Yes	0.704**	101,422
No	0.505**	1,927,295
<b>Entered Program Quickly</b>		
Yes	0.501**	1,347,915
No	0.538**	680,802
<b>College Region (where entered CTE program)</b>		
Northern Coastal	0.603*	21,481
Northern Inland	0.679**	43,887
Greater Sacramento	0.637**	108,803
North Bay	0.464**	118,458
East Bay	0.631**	90,437
Mid Peninsula	0.295**	105,212
Silicon Valley	0.389**	104,609
Santa Cruz Monterey	0.644**	43,286
Central Valley	0.677**	253,763
Mother Lode	0.434	5,296
South Central Coast	0.531**	192,621
Los Angeles	0.430**	434,748
Orange	0.487**	156,138
Inland Empire	0.565**	177,014
San Diego Imperial	0.474**	169,421

SOURCE: Authors' calculations from COMIS data.

NOTES: All models include student, year-quarter, and age fixed effects and controls for enrollment and a constant. Full regression results available upon request. \*\* p<0.01, \* p<0.05.

Last, we test our baseline estimates to a variety of sensitivity checks on the definition of the health CTE student sample. The sample checks we conduct are as follows:

- Include only students who entered health CTE programs between a narrower time window (2006-2008) so as to observe longer pre- and post- award wages
- Include a longer time window for entering health CTE programs, so as to use all data available to us (2000-2010)
- Define CTE-intending students in less intensive manner: having earned 6 or more credits in a single health program
- Define in even broader manner: 4 or more credits in a single health program
- Eliminate students under 26 years of age, since have less established earnings history
- Drop students who appear to be “skills builders” from the comparison group
- Drop programs that, based on their completion rate relative to the same programs in other colleges, may be more likely to award local certificates that are not reported in CCCCCO MIS data
- Examine the return to first health award received instead of the highest
- Examine returns only among completers, that is, drop the control group of students who entered but failed to complete programs to test the impact of a pre-enrollment dip in earnings.

**TABLE C5**

Baseline coefficients of interest, sample sensitivity tests

Variables	Baseline sample	Restricted years (2006-2008)	Expanded years (2000-2010)	CTE-intending based on 6 or more units	CTE-intending based on 4 or more units	Older students (26-54)	Dropping skills builders	Dropping programs that might award local certificates only	Measure first award instead of max award	Drop control group
Postaward	0.514**	0.498**	0.523**	0.517**	0.544**	0.480**	0.508**	0.519**	0.499**	0.526**
Postaward*Associates	0.625**	0.604**	0.636**	0.637**	0.667**	0.591**	0.620**	0.628**	0.627**	0.646**
Postaward* Long term certificate	0.388**	0.372**	0.397**	0.397**	0.430**	0.368**	0.384**	0.393**	0.390**	0.418**
Postaward*Short term certificate	0.0606*	0.0525	0.0581*	0.0510*	0.0717**	0.0423	0.0569*	0.0606*	0.0929**	0.0957**
Observations	2,028,717	818,901	3,085,418	2,497,636	4,753,138	962,251	1,941,266	1,892,468	2,028,370	1,474,482

SOURCE: Authors' calculations from COMIS data.

NOTES: All models include student, year-quarter, and age fixed effects and controls for enrollment and a constant. Postaward is from a single model and the three interacted postaward variables are from a separate, single model. Full regression results available upon request. \*\* p&lt;0.01, \* p&lt;0.05.

Although health CTE is the focus of this report, we also examine differences in wage returns for other CTE programs. Tables C6—C10 provide estimates of the return to credentials in the 5 other major CTE programs offered in California Community Colleges: Business and Management, Information Technology, Engineering and Industrial Technologies, Family and Consumer Sciences, and Public and Protective Services.

**TABLE C6**  
Fixed effect models of log quarterly wages for Business and Management (TOP code 05)

Variables	Model 1 (Naïve)	Model 2	Model 3	Model 4	Model 5
Enrolled		-0.183**	-0.0814**	-0.0816**	-0.0820**
Postaward	0.0297**	-0.226**	0.0133**		
Postaward*Associates				0.00403	
Postaward* Long term certificate				0.0458**	
Postaward*Short term certificate				0.0210**	
postaward * 050100					-0.0258**
postaward * 050200					0.0934**
postaward * 050210					0.115**
postaward * 050400					0.0737*
postaward * 050500					-0.0313**
postaward * 050600					-0.0476**
postaward * 050630					0.00615
postaward * 050640					-0.124**
postaward * 050650					-0.0883**
postaward * 050800					0.00989
postaward * 050900					-0.0442*
postaward * 050910					0.127
postaward * 050920					0.266
postaward * 050940					0.190**
postaward * 050960					-0.460
postaward * 051000					-0.0702**
postaward * 051100					-0.146**
postaward * 051110					-0.0160
postaward * 051200					0.0313
postaward * 051400					0.0954**
postaward * 051410					0.0247
postaward * 051420					0.0294
postaward * 051430					0.239**
postaward * 051440					0.0549
postaward * 051600					-0.113**
postaward * 051800					0.173
postaward * 059900					-0.0373
Constant	8.790**	7.005**	7.567**	7.567**	7.052**
Year-Quarter FE		X	X	X	X
Student FE			X	X	X

Variables	Model 1 (Naïve)	Model 2	Model 3	Model 4	Model 5
Age FE		X	X	X	X
Observations	2,930,472	2,930,472	2,930,472	2,930,472	2,930,472
R-squared	0.000	0.154	0.581	0.581	0.580

SOURCE: Authors' calculations from COMIS data.

NOTES: Standard errors in parentheses. \*\* p<0.01, \* p<0.05. Models 5A through 5C use subsamples of students who entered a program and/or obtained a credential in a program that typically offers associates, long term certificates, or short term certificates, respectively. All other models use the full sample of CTE-intending students as described in the text.

**TABLE C7**  
Fixed effect models of log quarterly wages for Information Technology

Variables	Model 1 (Naïve)	Model 2	Model 3	Model 4	Model 5
Enrolled		-0.272**	-0.122**	-0.121**	-0.123**
Postaward	0.0583**	-0.151**	0.0150*		
Postaward*Associates				0.0293**	
Postaward* Long term certificate				-0.0298	
Postaward*Short term certificate				0.0101	
postaward * 070100					0.0445**
postaward * 070200					-0.0505**
postaward * 070210					-0.0596**
postaward * 070600					0.175**
postaward * 070700					0.203**
postaward * 070710					0.0502**
postaward * 070720					0.0138
postaward * 070730					-0.291**
postaward * 070800					0.0549*
postaward * 070810					0.0204
postaward * 070820					0.0801**
postaward * 070900					-0.0527
postaward * 070910					-0.176
postaward * 079900					0.0406*
Constant	9.032**	7.076**	7.732**	7.732**	7.280**
Year-Quarter FE		X	X	X	X
Student FE			X	X	X
Age FE		X	X	X	X
Observations	804,246	804,246	804,246	804,246	804,246
R-squared	0.000	0.214	0.631	0.631	0.631

SOURCE: Authors' calculations from COMIS data.

NOTES: Standard errors in parentheses. \*\* p<0.01, \* p<0.05. Models 5A through 5C use subsamples of students who entered a program and/or obtained a credential in a program that typically offers associates, long term certificates, or short term certificates, respectively. All other models use the full sample of CTE-intending students as described in the text.

**TABLE C8**

Fixed effect models of log quarterly wages for Engineering and Industrial Technologies

Variables	Model 1 (Naïve)	Model 2	Model 3	Model 4	Model 5
Enrolled		-0.119**	-0.133**	-0.133**	-0.134**
Postaward	0.280**	0.0650**	0.102**		
Postaward*Associates				0.149**	
Postaward* Long term certificate				0.125**	
Postaward*Short term certificate				0.0481**	
postaward * 090100					0.226**
postaward * 092400					0.0966*
postaward * 093400					0.105**
postaward * 093410					-0.0398
postaward * 093420					0.173**
postaward * 093430					0.0512
postaward * 093440					0.179**
postaward * 093460					0.00717
postaward * 093470					0.870**
postaward * 093480					0.0934**
postaward * 093500					0.435**
postaward * 093510					-0.166**
postaward * 093600					0.0328
postaward * 094300					0.655**
postaward * 094330					0.336*
postaward * 094500					0.274**
postaward * 094600					0.0658**
postaward * 094610					-0.237**
postaward * 094700					0.0678**
postaward * 094720					0.107*
postaward * 094730					-0.0831*
postaward * 094740					0.168**
postaward * 094800					0.0886**
postaward * 094830					0.00923
postaward * 094840					0.267**
postaward * 094900					0.0526**
postaward * 094910					-0.699**
postaward * 095000					0.156**
postaward * 095010					0.169**
postaward * 095020					0.0760**
postaward * 095040					0.457*
postaward * 095050					0.105*
postaward * 095200					0.0344
postaward * 095210					-0.0788**
postaward * 095220					0.218**
postaward * 095230					0.169**
postaward * 095250					-0.167**

Variables	Model 1 (Naïve)	Model 2	Model 3	Model 4	Model 5
postaward * 095260					-0.521**
postaward * 095280					-0.158**
postaward * 095300					0.136**
postaward * 095310					0.148**
postaward * 095320					-0.0458
postaward * 095330					0.218**
postaward * 095340					0.123**
postaward * 095360					-0.111
postaward * 095400					0.237**
postaward * 095500					0.187**
postaward * 095600					0.0812**
postaward * 095630					0.120**
postaward * 095640					0.192**
postaward * 095650					0.0619**
postaward * 095670					0.140*
postaward * 095680					-0.256**
postaward * 095700					0.0905**
postaward * 095720					0.0332**
postaward * 095730					0.158**
postaward * 095800					0.222**
postaward * 095900					0.267**
postaward * 095910					0.216**
postaward * 099900					0.115**
Constant	8.790**	7.005**	7.567**	7.567**	7.052**
Year-Quarter FE		X	X	X	X
Student FE			X	X	X
Age FE		X	X	X	X
Observations	2,930,472	2,930,472	2,930,472	2,930,472	2,930,472
R-squared	0.000	0.154	0.581	0.581	0.580

SOURCE: Authors' calculations from COMIS data.

NOTES: Standard errors in parentheses. \*\* p<0.01, \* p<0.05. Models 5A through 5C use subsamples of students who entered a program and/or obtained a credential in a program that typically offers associates, long term certificates, or short term certificates, respectively. All other models use the full sample of CTE-intending students as described in the text.

**TABLE C9**

Fixed effect models of log quarterly wages for Family and Consumer Sciences

Variables	Model 1 (Naïve)	Model 2	Model 3	Model 4	Model 5
Enrolled		-0.164**	-0.115**	-0.114**	-0.113**
Postaward	0.131**	-0.0576**	0.0574**		
Postaward*Associates				0.0944**	
Postaward* Long term certificate				0.0155*	
Postaward*Short term certificate				0.0451**	
postaward * 130100					0.173**
postaward * 130200					-0.120**
postaward * 130300					-0.130**
postaward * 130310					0.0554**
postaward * 130320					-0.0720**
postaward * 130330					0.240**
postaward * 130500					0.0847**
postaward * 130520					-0.0262
postaward * 130540					0.0981**
postaward * 130550					0.142**
postaward * 130560					-0.249
postaward * 130580					-0.0332*
postaward * 130590					0.0924**
postaward * 130600					0.0736*
postaward * 130620					0.248**
postaward * 130630					-0.00954
postaward * 130660					0.172**
postaward * 130700					0.0925**
postaward * 130710					0.110**
postaward * 130720					0.206**
postaward * 130730					-0.425**
postaward * 130800					0.422**
postaward * 130900					-0.228**
Constant	8.243**	6.970**	7.378**	7.378**	6.972**
Year-Quarter FE		X	X	X	X
Student FE			X	X	X
Age FE		X	X	X	X
Observations	2,023,865	2,023,865	2,023,865	2,023,865	2,023,865
R-squared	0.002	0.081	0.471	0.471	0.468

SOURCE: Authors' calculations from COMIS data.

NOTES: Standard errors in parentheses. \*\* p<0.01, \* p<0.05. Models 5A through 5C use subsamples of students who entered a program and/or obtained a credential in a program that typically offers associates, long term certificates, or short term certificates, respectively. All other models use the full sample of CTE-intending students as described in the text.



**TABLE C10**

Fixed effect models of log quarterly wages for Public and Protective Services

Variables	Model 1 (Naïve)	Model 2	Model 3	Model 4	Model 5
Enrolled		-0.137**	-0.0808**	-0.0829**	-0.0845**
Postaward	0.389**	0.0592**	0.142**		
Postaward*Associates				0.0785**	
Postaward* Long term certificate				0.115**	
Postaward*Short term certificate				0.206**	
postaward * 210200					0.193
postaward * 210210					-0.000297
postaward * 210400					-0.00853
postaward * 210440					0.141**
postaward * 210450					-0.205
postaward * 210500					0.105**
postaward * 210510					0.0395**
postaward * 210520					-0.143**
postaward * 210530					-0.167*
postaward * 210540					-0.0288
postaward * 210550					0.341**
postaward * 213300					0.178**
postaward * 213310					0.0330
postaward * 213350					0.169**
postaward * 214000					-0.115**
postaward * 219900					0.0813*
Constant	8.756**	6.969**	7.450**	7.450**	6.953**
Year-Quarter FE		X	X	X	X
Student FE			X	X	X
Age FE		X	X	X	X
Observations	2,056,322	2,056,322	2,056,322	2,056,322	2,056,322
R-squared	0.014	0.195	0.563	0.563	0.562

SOURCE: Authors' calculations from COMIS data.

NOTES: Standard errors in parentheses. \*\* p<0.01, \* p<0.05. Models 5A through 5C use subsamples of students who entered a program and/or obtained a credential in a program that typically offers associates, long term certificates, or short term certificates, respectively. All other models use the full sample of CTE-intending students as described in the text.

## Analysis of Industry

In addition to wage outcomes, the quarterly employment records in our data include information about the industry of employment for students with UI-covered jobs. Specifically, the data reports the 6-digit NAICS industry code(s) of employment. It is not possible to tell how many jobs students have within an industry in a given quarter, but it is possible to tell which and how many industries they are employed in overall.

We use the NAICS codes – and in most cases focus on the first 3 digits – to examine the industry distribution for students in our health CTE-intending sample who are working, both before, during, and after enrollment (Table C11). Each period is three years and is based on when the student began the health CTE program; the pre-enrollment period is the 3 years prior to entrance into the health CTE program. The during period starts when the student enters the health CTE program and the post period captures years three through six after the student enters the health CTE program. Students may or may not have course enrollments in any of these periods and may or may not have completed a health award.

In each period we define the industrial sector based on the highest aggregate wages by industry over the given period. Students were flagged as working in a health industry if their total wages across all quarters in the 3 year period was in one of these 3-digit NAICS: 621, 622, 623.

**TABLE C11**

Distribution of health CTE students across industrial sectors of employment

Industry of Employment (2-digit NAICS)	Pre - health CTE program	During - health CTE program	Post - health CTE program
62	26%	53%	61%
72	14%	7%	4%
44	12%	6%	4%
45	7%	3%	2%
56	6%	5%	4%
61	5%	5%	5%
54	4%	2%	2%
92	4%	6%	8%
81	3%	2%	2%
52	3%	2%	1%
71	3%	2%	1%
42	2%	1%	1%
33	2%	1%	1%
23	2%	1%	1%
51	2%	1%	1%
53	1%	1%	1%
48	1%	1%	1%
32	1%	0%	0%
31	1%	0%	0%
11	1%	0%	0%
49	0%	0%	0%

Industry of Employment (2-digit NAICS)	Pre - health CTE program	During - health CTE program	Post - health CTE program
22	0%	0%	0%
55	0%	0%	0%
99	0%	0%	0%
21	0%	0%	0%
Sample size (students)	87978	93262	90229

SOURCE: Authors' calculations from COMIS data.



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