Tracking Work-Related Injuries among Young Workers: An Overview of Surveillance in the United States

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Introduction

In this white paper, we provide an overview of surveillance of work-related injuries among youths less than 18 years of age (also referred to as teens or young workers) in the United States. We begin with brief discussions of public health surveillance, in general, and occupational health surveillance, in particular. We then review the major surveillance systems used to track fatal and nonfatal injuries among working teens. Discussions of surveillance systems typically focus on "numerator data" used for case ascertainment. However, surveillance also requires information on the population at risk – in this case teen employment data – to generate injury rates. Employment data sources ("denominator data") used in conducting surveillance of work-related injuries to teens are also briefly discussed. This paper is meant to serve as a stimulus for discussion of gaps in surveillance of work-related injuries to teens and strategies for improvement.

Surveillance of injuries to youths employed in agriculture poses unique challenges, in part, because of the blurred distinction between work and home life on family farms. Since 1996, the National Institute for Occupational Safety and Health (NIOSH) has undertaken a number of initiatives to improve surveillance of all injuries to children in agriculture. These initiatives, listed in Appendix Davis-I, are beyond the scope of this report.

Public Health Surveillance

Public health surveillance is the ongoing systematic collection, analysis, and interpretation of health data essential to the planning, implementation, and evaluation of public health practices, closely integrated with the timely dissemination of these data to those who need to know [CDC 2012]. It is often referred to as the "cornerstone of public health practice" that provides the foundation on which to build successful prevention programs. Several aspects of this definition merit elaboration. Surveillance is systematic; it is carried out using consistent methods over time. It is often continuous but may also be periodic. However, it should not be confused with one time survey research efforts. Surveillance also involves interpretation of findings. It is not sufficient to simply generate data tables. It is incumbent on the surveyor to apply epidemiologic skills to interpret surveillance findings for data users. Thirdly, and perhaps most importantly, surveillance carries with it a responsibility for public health action. While the precise boundary between surveillance and intervention is subject to debate, it is widely accepted that the final link in the surveillance chain is the application of the data to prevention. At a minimum, the surveyor must have working relationships with those in positions to influence policy

and implement programs and should provide surveillance findings to these data users in a format that meets their needs. Others have gone so far as to say that it is incumbent on the surveyor to follow-up to assure that effective action has been taken [Thacker and Berkleman 1992].

It is useful to make a distinction between case-based and population-based surveillance. Case-based surveillance involves the ongoing and rapid identification of identifiable cases for purpose of case follow-up. It is the approach generally used in conducting surveillance of communicable diseases and is related to the concept of a sentinel health event – a single health event is a sentinel or warning sign that our prevention system has failed and intervention is warranted [Rutstein et al 1983]. Follow-up may include interventions (e.g. efforts to control spread of disease, eliminate injury risks) and/or collection of additional data to augment the descriptive epidemiology of the condition under surveillance. Data from a case-based system may or may not be complete or representative. Population-based surveillance, on the other hand, involves collection of representative data that can be used to monitor trends in a defined population over time, locale, and population characteristics. It may involve collecting data on all cases (a census) or a representative sample. The data may be anonymous – i.e. do not necessarily contain individual (or in the domain of occupational health surveillance – employer) identifiers. Case- and population-based approaches to surveillance are not mutually exclusive. In our experience conducting surveillance at the state level, we have found that the most useful surveillance systems have attributes of both. These systems can be used to identify sentinel cases for follow-up and, at the same time, generate representative summary data to guide broader based prevention efforts. Arguably, it is the combination of case stories and statistics that is often most compelling in influencing public health policy [Derickson 1992].

Occupational Health Surveillance

Surveillance by definition involves the collection of "health data." In the domain of occupational health, surveillance may involve collecting data on work-related ***health outcomes,*** such as work-related injuries, illnesses or deaths, or ***health and safety hazards***, such as exposures to hazardous chemicals or the presence of unguarded equipment. Hazard surveillance is often considered optimal because it should allow for identification of risks before injuries or illnesses occur. In the United States, however, hazard surveillance efforts, outside of those undertaken internally by some of the larger employers, are generally quite limited. It would also be possible to conduct surveillance of ***worker or corporate health and safety behaviors***, such as use of respirators or the presence of workplace health and safety programs, but systems are not currently in place to track health and safety behaviors. The existing national and state occupational health surveillance systems collect data on occupational health outcomes. This paper therefore focuses on surveillance systems in place that document health outcomes – predominantly work-related injuries – among teens. Young workers are also at risk of work-related illness, yet many, if not most work-related illnesses are diseases of long latency that do not appear until years after initial exposure to workplace hazards. (Note that acute chemical poisonings, such as carbon monoxide poisoning, are considered injuries in the epidemiologic literature.)

There is no comprehensive system for surveillance of work-related injuries and illnesses in the United States. In the late 1980s, several national studies identified serious problems with

the national surveillance efforts and called for improvements [Pollack and Keimieg 1987; Keystone Center 1989]. Since that time, a comprehensive surveillance system for fatal occupational injuries has been established. Surveillance of nonfatal injuries, however, remains fragmented with significant gaps. As will be discussed, there is continuing and growing concern about undercounting of nonfatal injuries and about the possibility that undercounting may systematically vary by worker, establishment, or industry characteristics. These potential systematic biases are not well understood.

Goals of Tracking Work-related Injuries to Teens

Information about where and how young workers are injured on the job is essential to target, design and evaluate prevention efforts, ranging from regulatory and educational activities to the development of new safer technologies and public policies to promote safe work for youths. Surveillance provides this information, allowing us to set priorities for allocation of limited prevention resources, to design relevant interventions, such as amendments to child labor laws, and to monitor progress in meeting injury reduction goals. Surveillance can also play a critical role in mobilizing action to address the young worker health and safety problems. Surveillance is important at both the national and state levels. National data are essential to inform national prevention priorities and programs. However relying on national statistics can obscure dangers that may be specific to a particular state. State data help identify the specific occupations, industries and communities in which workplace hazards faced by teens need to be addressed. In addition, state surveillance systems can also pinpoint specific workplaces in which young workers are at risk and intervention is necessary. Publication of state data can also be a powerful means of attracting the attention and gaining support of local policy makers and the public [MDPH and EDC 2005]. In sum, the potential goals of conducting surveillance of work-related injuries among teens are many (Table 1) and vary according to surveillance system and geographic area under surveillance.

Table 1. Goals of Tracking Work-related Injuries among Young Workers

- To document the overall magnitude of the problem: How many teens are injured? At what rate? What is the human and economic impact of these injuries?
- To identify the industries and occupations where intervention is most needed: What industries and occupations have the highest injury rates? The highest numbers of teen injuries? The most severe injuries?
- To identify individual workplaces where intervention is warranted
- To characterize the populations (defined by age, gender, race/ethnicity) at risk that merit special attention
- To characterize the most common types of injuries, causes of injuries and known risk factors that need to be addressed.
- To identify potential, previously undocumented risk factors that require further etiologic research, e.g. lack of training/supervision
- To identify new or emerging risks for young workers
- To evaluate the effectiveness of intervention efforts
- To mobilize support for prevention activities

Surveillance of Fatal Occupational Injuries

There are two main sources of data on fatal occupational injuries among young workers in the United States. The Census of Fatal Occupational Injuries provides population-based data on fatalities at the national and state levels. The Fatality Assessment and Control Evaluation program provides in depth information about the circumstances surrounding fatal incidents for a sample of young worker deaths.

Census of Fatal Occupational Injuries

The Census of Fatal Occupational Injuries (CFOI), begun in 1992, is a cooperative effort of the Bureau of Labor Statistics (BLS) in the U.S. Department of Labor and the states to develop a complete and accurate annual census of all fatal occupational injuries [BLS 2012a]. For a death to be counted, the deceased must have been working for pay, compensation or profit at the time of the event, engaged in a legal work activity, or present at the site of the incident as a requirement of his or her job. Because no single source of data provides an exhaustive count of all workplace fatalities, CFOI uses multiple sources, such as death certificates, Occupational Safety and Health Administration (OSHA) records and news media reports, to identify and document work-related deaths. At least two or more source documents are required for each death to independently substantiate that the incident was work-related.

CFOI counts are considered a complete or nearly complete ascertainment of work-related injury deaths. However, an accurate count still depends on recognition in individual cases that the deceased was working at the time of the fatal incident. Youths are typically not thought of as workers, therefore, it is reasonable to assume that some deaths of children and adolescents may not be identified as work-related and are not captured by CFOI. This would be most likely when deaths involve young workers on family farms and in family businesses where the bound-

aries between work and family life are blurred. Conversely, there is the possibility of including fatalities among youth at family operated businesses that are not work-related because the youth was in a work environment due to its proximity to the home environment but not working. The potential under or over count of young worker fatalities, while likely small, has not been formally evaluated.

CFOI provides national (Table 2) and state level data annually on the numbers and rates of deaths by age groups.[1] Because the Current Population Survey (CPS) employment statistics used to calculate rates in these annual reports exclude workers under 16 years of age, annually published rates are limited to workers 16 years of age or older. Prior to 2008, these annually published rates were calculated using the number of employed persons in the denominator (i.e. deaths per 100,000 workers). Because teen workers typically work part time or temporary jobs, these rates underestimate the risk per hour worked for younger workers. (See denominator discussion below.) Since 2008, rates published by CFOI have been calculated using 100,000 full time employees equivalents (FTEs) as the denominator.

[1] *State level data are reported by state in which the fatal incident occurred.*

Table 2. Numbers and rates* of fatal occupational injuries among workers less than 18 years of age, United States, 2005-2010

Age (years)	2005		2006		2007		2008		2009		2010	
	#	Rate	#	Rate	#	Rate	#	Rate	#	Rate	#	Rate
≤ 15	23	--	11	--	18	--	11	--	13	--	16	--
16-17	31	1.4	21	.9	20	.9	23	2.5	14	n/a	18	3.0
Total	54	--	31	--	38	--	34	--	27	--	34	--

Source: Census of Fatal Occupational Injuries, available at: http://www.bls.gov/iif/oshcfoi1.htm. Date accessed July 13, 2012.
*2005-2007 rates are based on number of deaths per 100,000 workers. 2008-2010 rates are based on number of deaths per 10,000 FTEs.

In a 2005 BLS special report based on CFOI data, national rates including rates for workers 15 years of age and taking hours of work into account were provided (Figure 1.) [Windau and Meyer, 2005]. Rates for workers 15 years of age were found to be higher than rates for workers aged 16-17 years during the 1994-2004 period and to have increased during this period whereas rates for workers 16-17 years of age decreased (not shown). These findings underscore the need to examine age specific patterns. Denominator data necessary to compute rates for teens less than 15 years of age are not available.

Source: Census of Fatal Occupational Injuries. Reported in Monthly Labor Review, October 2005, by Windau and Meyer.
**Rate for 15 and 16-17 year olds is for 1994-2004.*

One of the pressing policy questions in this area of safe youth employment is whether young workers are being fatally injured in jobs that are currently prohibited for youths, indicating a need for better law enforcement, or in jobs that are legally allowed, indicating a need for new regulations. Notably, CFOI does not collect specific information about whether the deaths of young workers occurred in circumstances violating child labor laws, although in some cases this can be implied from available data elements, e.g. time of incidents. Violations of safety laws are likewise not documented in CFOI. [2]

Fatality Assessment Control and Evaluation (FACE) Program

The National Institute for Occupational Safety and Health's (NIOSH) FACE program aims to prevent fatal occupational injuries by identifying risk factors and developing and disseminating prevention recommendations. FACE is a collaborative effort of NIOSH staff (in-house program) and a subset of states (currently nine) that have NIOSH funding to conduct surveillance and intervention activities following the FACE model. FACE provides in-depth information about targeted fatal incidents collected through on-site, research-oriented field investigations. Each fatality investigation results in a FACE report describing the fatal event that includes recommendations to prevent similar incidents. These reports and related alerts are disseminated widely to industry, labor, manufacturers and other stakeholders. National targets for FACE investigations vary over time.[3] Young worker deaths were included as a target from 1999 through 2009. Many of the subsequent investigations identified common risk factors, including employment in violation of hazardous orders in child labor laws and lack of health and safety training. Because additional investigations were not generating significant new information about other needed prevention strategies, starting in 2010, NIOSH narrowed its focus to young worker deaths in which the hazards involved are not already covered by the hazardous orders. Since 1999, 106 FACE investigations of young worker deaths have been completed and are available on the NIOSH website [NIOSH 2012].

FACE serves as an important case-based complement to the population-based CFOI data on young worker deaths. It provides in-depth information about the circumstances leading to young worker deaths that is used to develop prevention recommendations and that has generated hypotheses about potential risk factors that merit further etiologic research, e.g. the role of supervision. FACE reports also serve as compelling case studies that augment the CFOI statistics. Aggregate FACE data are informative (e.g. the % of young worker deaths investigated that occurred in jobs prohibited by child labor laws) but not necessarily representative as not all young worker deaths are investigated [Higgins et al. 2002]. Despite the limitations in using aggregate FACE data, FACE is widely recognized as a flagship NIOSH program that has had demonstrable impact in reducing workplace injury risks.

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[2] *For fatal incidents investigated by the Occupational Safety and Health Administration (OSHA), safety violations related to fatal incidents are documented in the OSHA Integrated Management Information System (IMIS) database.*

[3] *In 2012, national targets include falls in residential and commercial construction, machine related fatalities, immigrant worker deaths, deaths involved in energy production, deaths of foreign-born workers, and young worker deaths in which hazards involved are not covered by child labor laws.*

Surveillance of Nonfatal Injuries

There are two main sources of national population-based data on nonfatal work-related injuries to youths, the annual Survey of Occupational Injuries and Illnesses (SOII) and the National Electronic Injury Surveillance System- Occupational Supplement (NEISS-Work). These are valuable sources of information, yet, as described below, each captures only part of the picture, and each is subject to undercounting injuries. Additional data sources have been used for surveillance of work-related injuries to teens in some states. Several of the state approaches to surveying injuries among young workers are also discussed below.

Survey of Occupational Injuries and Illnesses

The official source of statistics on nonfatal work-related injuries and illness in the United States is the annual Survey of Occupational Injuries and Illnesses (SOII). Like CFOI, the SOII is a collaboration of the federal BLS and the states. Information is collected through a survey mailed to a stratified random sample of private sector employers (n~190,000) who are required to provide information on all work-related injuries and illness that meet the OSHA record-keeping requirements. These include injuries that result in loss of consciousness, one or more days away from work, restricted worker activity, transfer to another job, or medical treatment beyond simple first aid. Excluded from the SOII are the self-employed, household workers and workers on farms with fewer than 11 employees[4].

The SOII provides national and state estimates[5] of the numbers and rates of occupational injuries and illnesses overall and by industry. More detailed data on injury by worker and injury characteristics, including age, are available only for the injuries and illnesses resulting in one or more days away from work. The most recent SOII estimates of the number of young worker injuries are included in Table 3. Note that standard BLS tables include data for workers 16-17 years of age in the 16-19 year age group; however, data for individual ages can be obtained from the BLS-SOII custom reports [BLS 2012b].

[4]Prior to 2008, national illness and injury estimates based on the SOII excluded public sector workers. Since 2008, the national estimates have included data on state and municipal workers from all states.

[5] State level estimates are available for about 42 states that participate in SOII. For those states that do not participate, BLS collects data from a sample of establishments to generate national estimates. The number of participating states varies slightly from year to year.

Table 3. Estimated number of occupational injuries and illnesses involving days away from work among workers 14-17 years of age, United States, private industry, 2005-2010

Age (years)	2005	2006	2007	2008	2009	2010
14	20	20	120	--	--	60
15	60	160	270	130	150	140
16	2,780	2,720	1,660	1,790	1,060	980
17	4,860	4,730	4,210	4,320	3,140	2,790
Total	7,720	7,630	6,260	6,240	4,350	3,970

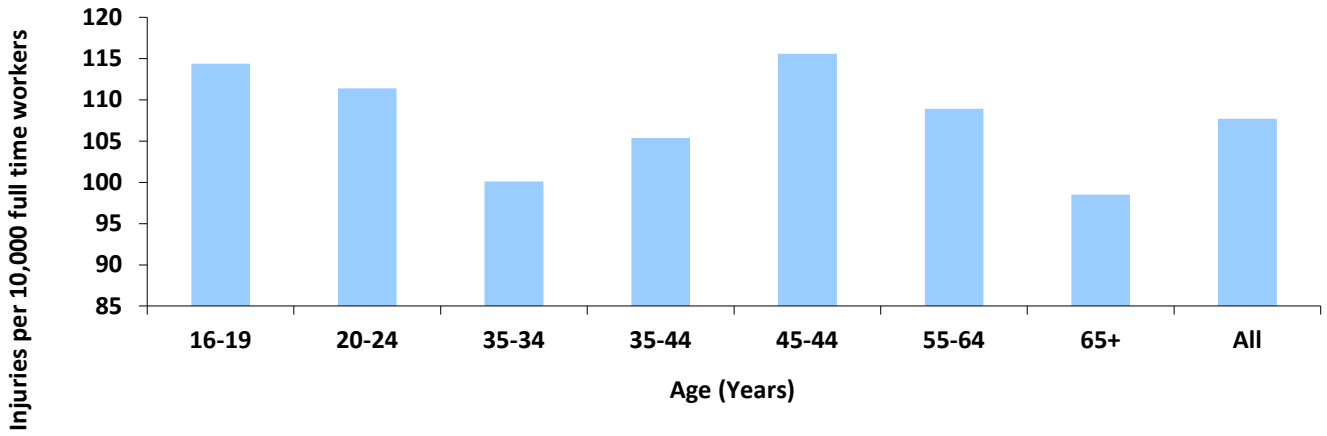
Source: Survey of Occupational Injuries and Illness, available at http://data.bls.gov/cgi-bin/dsrv Date accessed July 17, 2012.

The SOII has a number of limitations that need to be taken into account in interpreting the data on work-related injuries to teens. Given the groups of workers excluded from the survey, it has been estimated that it misses at least 11% of working teens [CDC 1996]. It is has long been recognized that the SOII does not capture most occupational illnesses among all age groups, and there is mounting evidence that work-related injuries are substantially undercounted. Estimates of the undercount range widely from 20% to 70%. [Ruser 2008; Rosenman et al. 2006; Boden and Ozonoff 2008].

Systematic biases in undercounting, by age, for example, are not well understood. Because most young people work only part-time, they may sustain injuries that do not interfere with scheduled work but would have prevented them from working had they been scheduled to work in the days following the injury. Technically, these injuries should be recorded on OSHA logs, but it is reasonable to assume that these injuries would be less likely to be recorded than injures sustained by full-time adult workers. The SOII is also subject to sampling error. At the state level, in all but the most populous states, the sample size is too small to obtain detailed data on injuries to young workers by industry, occupation, nature of injury or event.

Another significant limitation is that the SOII has not until recently provided rates of injuries sustained by teens. Prior to 2006, injury/illness rates based on SOII data routinely reported by BLS were generated using data on hours of employment provided by the employers participating in the survey. This information is not broken down by age, precluding computation of age specific rates. Since 2006, BLS has annually published national rates by age and other demographic characteristics, using data on employment and hours worked from external sources [Pierce 2008]. As shown in Figure 2, data on workers aged 16-17 are included in the 16-19 year age group. Rates by age are available by nature of injury, type of event and source [BLS 2012b].

Figure 2. Estimated incidence rates of nonfatal occupational injuries and illness involving days away from work by age group, United States, private sector, 2010



Source: Survey of Occupational Injuries and Illnesses available at www.bls.gov/news.release/archives/osh2_11092011.pdf Date accessed July 17, 2012

National Electronic Injury Surveillance System—Occupational Supplement

NIOSH collects information on nonfatal occupational injuries and illnesses through a national probability-based sample of U.S. hospital emergency departments (EDs). The work-related injury data collection known as NEISS-Work is an occupational supplement to the Consumer Product Safety Commission's (CPSC) National Electronic Injury Surveillance System (NEISS).[6] Work-related cases are identified by chart review conducted at the participating hospitals. An injury/illness is considered work-related if it occurred while the patient was working for pay or other compensation, working on a farm or volunteering for an organized group. NIOSH uses these data to obtain demographics of the injured workers, and a description of the injury event. National estimates of ED-treated work-related injuries and illnesses can be made, as well as estimates for injuries and illnesses to special populations (e.g., children, women, African-Americans), injury events (e.g., falls), and types of injuries (e.g., eye injuries). Approximately 95% of the NEISS-Work cases are injuries.

An inherent limitation of NEISS-Work is that it captures only those injuries treated in emergency departments, which have been estimated to represent about one third of all workplace injuries requiring medical treatment among workers of all ages [CDC 1998]. Furthermore, for children and adolescents, ED staff may not think to ask about the work-relatedness of an injury or may not note work-relatedness in the medical records. As discussed below, youths who are covered on their parents' insurance may be less likely than adults to file for workers' compensation, one of the data elements looked at in medical records to identify work-related cases. Small sample size is also a limitation. Additionally, limited resources have precluded NIOSH's routine coding and analysis of industry and occupation data collected by NEISS-Work. However, NIOSH is beginning to code industry, although not routinely yet.

[6] *NEISS-Work uses a 67-hospital subset of the CPSC's larger hospital collection network. CPSC's data collection focuses on product- and recreation-related injuries and illnesses and excludes work-related cases. The number of participating hospitals in NEISS and NEISS-Work can vary from year to year.*

As shown in Table 4, NEISS-Work national estimates of the numbers of injuries among workers 15-17 years of age treated in EDs are much higher than the estimates of injuries to young workers (aged 14-17 years) based on the SOII (Table 3). Differences in scope of the survey (worker populations covered and case definitions) and sampling error explain part of the discrepancy. For example, not all workers treated in EDs necessarily lost a day or more of work. SOII findings for 2010 indicate that median lost time for injuries/illnesses resulting in days away from work was lowest among the young age groups [BLS 2011]. One follow-up study based on interviews with injured youths identified by NEISS-Work, found that 68% of them experienced limitations in their normal activities for a least one day, however, these cases may not have lost a day or more of work [Knight et al. 1995].

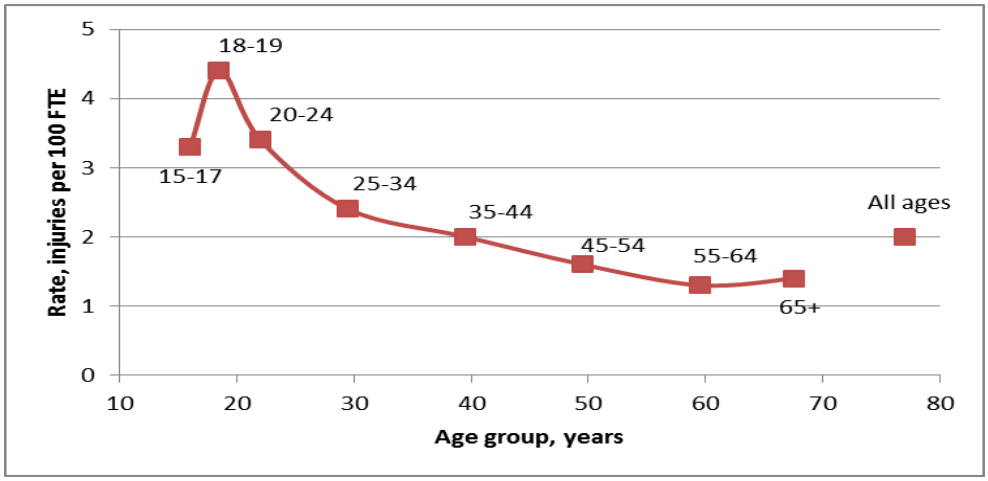
Table 4. Estimated number of emergency department-treated injuries/illness among workers 15-17 years of age, United States by year, 1998-2009

Year	Number of Injuries	95% CI	Year	Number of Injuries	95% CI
1998	73,700	14,500	2004	50,200	11,000
1999	80,400	16,900	2005	51,600	13,400
2000	74,600	17,200	2006	52,600	14,500
2001	60,300	12,400	2007	48,600	12,600
2002	54,500	10,900	2008	37,800	11,400
2003	51,000	10,400	2009	26,600	6,700

Source: National Electronic Injury Surveillance System—Occupational Supplement

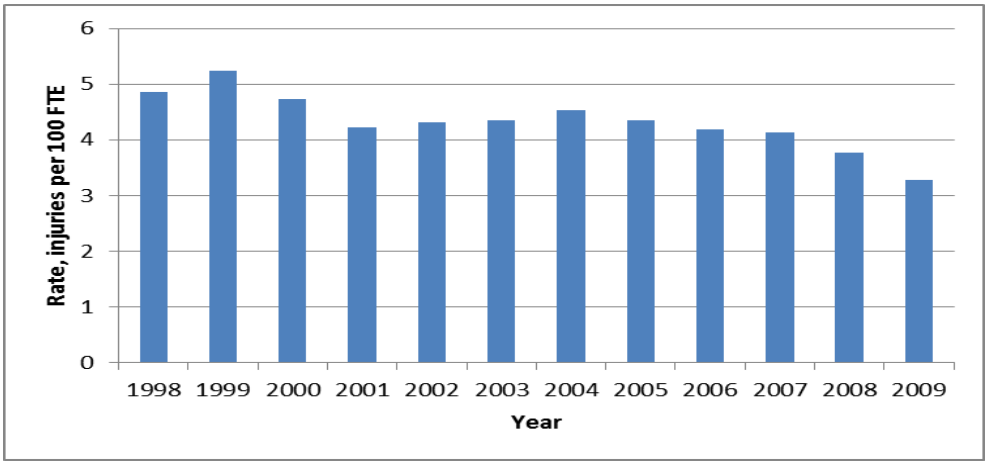
NEISS-Work also provides important national surveillance findings on nonfatal occupational injury rates by age. Work-related injury rates for workers 15-17 years of age have consistently been found to be between 60% - 70% higher than the rates for workers of all ages and second only to rates for workers 18-24 years of age (Figure 3) [CDC 1998; CDC 2006; CDC 2007; NIOSH 2003]. The estimated injury rates for workers 15-17 years of age over time are shown in Figure 4.

Figure 3. Estimated rates* of work-related nonfatal injuries and illnesses treated in hospital emergency departments, by age group, 2009



Source: National Electronic Injury Surveillance System—Occupational Supplement
**Numbers of injuries and illnesses per 100 full time workers; standard errors range from 10-15% (not shown).*

Figure 4. Estimated rate* of work-related nonfatal injuries and illnesses treated in hospital emergency departments, 15-17 year-olds, 1998-2009



Source: National Electronic Injury Surveillance System—Occupational Supplement
**Numbers of injuries and illnesses per 100 full time workers; standard errors range from 10-15% (not shown).*

State-based Surveillance

State-based surveillance of work-related injuries to teens provides important opportunities to identify local concerns and to link data collection with active intervention in the workplace and the community. The most comprehensive system using multiple data sources has been implemented, with NIOSH support, in Massachusetts (See box.) Other states have made use of state workers' compensation data to document injuries to working teens [Banco et al. 1992; Bellville et al. 1993; Miller and Kaufman 1998; Cooper et al. 1999; Horwitz and McCall 2005; McCall et al. 2007; Walters et al. 2010; Mujuru and Mutambudzi 2007]. Changes in information technology continue to lead to new injury data sources in states, such as statewide emergency department data, that offer new opportunities for tracking injuries to young workers at the state level.

Massachusetts Teens at Work: Injury Surveillance and Prevention Project

Since 1992, the Massachusetts Department of Public Health, with funding provided by NIOSH, has tracked work-related injuries to workers less than 18 years of age using multiple data sources. The surveillance system is designed both to identify sentinel cases for worksite follow-up and to generate summary data to inform broad-based prevention efforts. Workers' compensation claims for injuries resulting in more than five lost work days, together with statewide inpatient hospitalization data and emergency department data are used to identify cases. Follow-up interviews are conducted with a sample of injured teens both to triage cases for worksite follow-up and to learn more about factors leading to the injuries. Summary data have been used to promote a wide range of prevention efforts ranging from changes in the child labor laws, to technological interventions to reduce hazards and educational initiatives to protect working teens [MDPH and EDC 2005].

Workers' Compensation Data

Workers' compensation (WC) records can be an important, readily available source of information about nonfatal teen injuries at the state level. WC systems and the data they collect vary markedly from state to state, and the data cannot be compiled or compared across states. Some state WC data bases, for example, include all cases for which either medical and/or lost wage claims that meet the eligibility requirements have been filed. In many states, just the lost wage claim data are available for analysis. Eligibility requirements (i.e. number of lost work days) varies markedly by state. Self-employed workers, including, for example, news carriers in Massachusetts, are not covered by WC. It also is well recognized that many injured workers who are covered by WC never apply, and there is some evidence that teens injured on the job are less likely to file claims than injured adults [Brooks and Davis 1996; Fingar et al. 1992]. Despite these limitations, states have been able to use WC data on young worker injuries effectively to raise awareness about the problem and identify state prevention priorities.

Hospital Data

Most states collect and maintain data on all inpatient hospitalizations (CSTE 2005). In recent years a growing number of states have developed similar statewide data bases on all emergency department visits [CDC 2008a]. While these state data sets have been developed primarily for administrative purposes, they can be a useful source of population-based information about work-related injuries among teens. These data sets do not include explicit information about work-relatedness of the health conditions for which the patient is treated, and it is necessary to rely on designation of workers' compensation as payer to identify work-related cases. Several studies suggest that this designation captures approximately 80% of the work-related injury cases [Sorok et al. 1993; Davis et al. 2012] These hospital based data sets likely provide the best information about injury diagnoses, and in states where the data have External Cause of Injury codes, they can also provide information about cause of injury. However, these data sources do not include information about industry or occupation. They can be used to provide useful information about the extent of the problem and types of injuries experienced by young workers, but are of limited usefulness in targeting industry or occupation specific interventions at the state level.

One recent study in Massachusetts in which medical records were reviewed for a sample of work-related injuries among workers of all ages treated in EDs found that these records contained information on employer name for over 80% the injury cases [Davis et al. 2012]. The option of including employment information in these large administrative data sets is an important policy consideration. An even more pressing issue for the occupational health community interested in surveillance is the ongoing effort to include information about employment and work-relatedness of health conditions in electronic health records [IOM 2011].

Youth Risk Behavior Survey

A potentially useful source of self-reported data on young worker injuries at both the national and state levels is the Youth Risk Behavior Survey (YRBS) that monitors priority health-risk behaviors and the prevalence of obesity and asthma among youth and young adults. The YRBS, a collaboration of CDC and state education and health agencies, collects information through national, state and local school-based surveys of students in grades 9-12 [CDC 2008b]. Questions about work and work-related injuries are not currently included in the national survey, although states do have the option of adding state specific questions.

Some states conduct additional surveys to collect information about the health of youth [Weller et al. 2003]. Massachusetts, for example, conducts the Massachusetts Youth Health Survey (YHS) in conjunction with the YRBS. The YHS collects data from a sample of middle and high schools throughout the state. In 2009 the Massachusetts Department of Public Health included questions about work and work-related injuries on the YHS; 18% of middle school students reported having a paid job other than babysitting or yard work in the past year. Approximately 5% of these students reported being injured badly enough to seek medical care. Among high school students, 49% reported having a paid job of whom 4% reported being injured badly enough to seek medical care [MDESE and MDPH 2010].

Denominator Data

Data on teen employment are necessary to calculate rates of injuries among young workers. The number of workers employed is often used as the denominator in calculating occupational injury rates. However, for groups who typically work part-time, such as teens, "hours worked" (which is usually expressed as "full-time equivalents") is a more appropriate denominator. As noted above, failure to take the number of hours worked into account can result in underestimates of the risk of injury for part-time employees [Ruser 1998].

Official estimates of employment in the United States are derived from the Current Population Survey (CPS) a monthly survey of about 60,000 households nationwide conducted by the Census Bureau for the BLS. It provides a comprehensive data set on the labor force, employment, unemployment, and persons not in the labor force. Data on industry, occupation, weeks worked, and hours worked per week are available for people 15 years of age and older. Notably, the U.S. Department of Labor's definition of the labor force excludes people under the age of 16. Even though data are collected on 15 year olds, those data are not used in the official estimates, nor are they included in most of the published tables. In all but the most detailed tables, data for workers 16 and 17 years of age are aggregated with those for older age groups.

Finding data on teen employment for injury surveillance purposes at the state level is challenging. While the CPS provides reliable data for computing teen injury rates based on both employees and FTEs by industry and occupation at the national level, the sample size in many states is too small to provide reliable estimates of teen employment at any level of detail. Historically, the data collected on the long form of the decennial Census has been a source of more reliable detailed state level data but the Census is conducted only every ten years and youth employment patterns may vary in the interim. In 2005, the Bureau of Census introduced the American Community Survey (ACS). The ACS is a monthly survey of about 3 million households that has replaced the decennial Census long form and provides estimates of demographic, housing, social, and economic characteristics every year for all states. ACS is fully implemented and provides more reliable data on the number of teens employed at the state, county and census track levels. However, due to the way the questions are asked in the ACS, it does not provide reliable data on hours of teen employment throughout the year (i.e. teen FTE estimates). The standard ACS data tables currently available do not include employment information for 15 year olds but such information is available in the ACS micro-data [US Census Bureau 2012].

Conclusion

Surveillance of fatal occupational injuries among young workers is comprehensive, and includes both population- and case-based approaches. Minor improvements could be made to improve collection of some important data elements in CFOI and to improve standard CFOI data reports for workers less than 18. Research to assess systematic over or under count of young worker deaths in CFOI particularly those in family businesses and on family farms might also be carried out.

Surveillance of nonfatal injuries among young workers is much more problematic. While differences in the scope of the SOII and NEISS preclude comparisons, the substantial disparity in the estimated numbers of cases underscores the need for surveillance research to better un-

derstand the scope of the problem. While both data sources point to relatively higher risk among young workers compared to workers of all ages, reliable national or state data on teen injury rates by industry or occupation necessary to focus prevention activities are not routinely available. Data on risks of teens versus adults in the same jobs are consequently also not available. Recent efforts by BLS to publish nonfatal injury/illness rates by age and other worker characteristics are to be applauded but interpreting these findings in light of concerns about underreporting in this system and comparisons with the NEISS-Work counts is challenging. Surveillance research to better understand the undercount and systematic biases in undercounting by age is needed. BLS should also be encouraged to publish data for the "under 18" age group in standard reports.

While not addressed explicitly in this review, better information on severity of nonfatal injuries sustained by teens (as well as older workers) is needed. Cuts and lacerations experienced by young workers, for example, are often viewed as not serious. Yet findings based on an albeit small number of interviews conducted by the Massachusetts surveillance system indicate that 14% of teens with such injuries anticipate long term loss of sensation and 7% anticipate long term loss of motion. The number of days of lost work, used in the SOII as the indicator of severity, likely underestimates severity of injuries experienced by part-time or temporary workers.

Additionally, it is well recognized that low income minority and immigrant workers, including young minority and immigrant workers, are more likely employed in the most hazardous jobs [Baron and Wilson 2011]. Emergency department data from Massachusetts have consistently revealed that Hispanic teens have a higher rate of ED visits for work-related injuries compared to white teens [MDPH 2012]. Better surveillance information on race and ethnicity of workers with nonfatal injuries is also needed to document and address occupational health disparities among workers of all ages. While the SOII collects data on race and ethnicity that is recorded in the OSHA logs, employers are not required to record this information, and it is available in the SOII for only about two-thirds of cases. OSHA should consider making race and ethnicity information mandatory data elements as they are in other federal health surveys as set forth in the Affordable Care Act [Public law 111-148].

Notably, this review has focused on surveillance of work-related injuries to U.S. workers under age 18. Yet workers ages 18-24, who are no longer protected under child labor laws, are also at high risk of nonfatal injuries. Future surveillance activities targeting young workers should be expanded to include workers in this age group as they are in many other countries.

Finally it is important to recognize that surveillance of nonfatal occupational injuries at both the national and state levels is hampered by lack of resources. Stakeholder input to NIOSH through its National Occupational Health Research Agenda process and from program reviews conducted by the National Academy of Sciences have called for improved surveillance and surveillance research [IOM 2009]. This is an opportune time to recommend new initiatives to improve tracking work-related injuries among young workers.

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Appendix Davis-I: National Institute for Occupational Safety and Health (NIOSH) Child Agricultural Injury Prevention Initiative

Fatality Surveillance

As part of the larger Childhood Agricultural Injury Prevention Initiative, NIOSH conducts surveillance of all fatal injuries to youths less than 20 years old that occur on farms by using four separate fatality data sources: 1) Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries surveillance data (CFOI); 2) National Center for Health Statistics (NCHS) Vital Statistics Mortality (VSM) surveillance data; 3) death certificates from state vital statistics registrars; and 4) NIOSH Fatality Assessment and Control Evaluation (FACE) fatality investigations.

CFOI: CFOI is a census of all occupational fatalities occurring in the U.S. These data are compiled by BLS from all 50 states, the District of Columbia, and New York City using multiple data sources (e.g., death certificates, newspaper clippings, corner reports, police reports). CFOI records include information on the age of the victim, the industry in which the victim was employed at the time of death, and the victim's occupation at the time of death. By using the industry information in the CFOI, occupational farming related deaths can be identified regardless of whether the death occurred on a farm or not. There are no age limitations placed on whether a death is included in the CFOI system, which allows for the identification of occupational deaths to youth of all ages.

VSM: VSM is a census of all deaths occurring in the U.S. as reported through death certificates filed with state Vital Statistics Offices to NCHS. VSM data are coded using the International Classification of Disease for location and underlying external cause of death. Location of Injury is used to identify all unintentional fatalities that occurred on farms regardless of work-relatedness. Farm-related deaths identifiable through the VSM data include those sustained doing chores, paid work, or recreational activities such as hunting or swimming. Farm deaths that occur in the farm house or home premises are not identifiable because death certificate coding rules denote the location of these deaths as "home." Intentional deaths and transportation events are not identifiable as having occurred on a farm because the location variable is not coded for these events.

Death Certificates: NIOSH collects death certificates from all 50 states, excluding the District of Columbia and New York City that meet the following criteria: 1) location of Injury denoted as "Farm;" 2) age of the victim less than 20 years; and 3) the immediate, contributing, or underlying cause of death having a ICD-9 code E-800-E999, or ICD-10 code V01-Y98. The main difference between the death certificate data collected by NIOSH and the NCHS VMS is the inclusion of on-farm motor vehicle and intentional deaths by the NIOSH surveillance effort.

FACE: The Fatality Assessment and Control Evaluation (FACE) project uses a case-based surveillance approach to: identify work environments which place workers at high risk for fatal injury; identify potential risk factors; and formulate and disseminate prevention strategies to those who can intervene in the workplace. Investigation findings and prevention recommendations are incorporated into health communication documents for broad dissemination and are used by employers to increase worker safety, by manufacturers to modify machinery and equipment to increase worker safety, and by the Occupational Safety and Health Administration (OSHA) and other organizations in the promulgation of safety standards and compliance directives. Youth less than 18 years of age, including teens working on farms, are a target population of the FACE program.

Nonfatal Injury Surveillance

NIOSH conducts surveillance of nonfatal injuries to youths less than 20 years old that occur on farms by using three separate data sources: 1) Consumer Products Safety Commission (CPSC) National Electronic Injury Surveillance System (NEISS); 2) U.S. Department of Labor (USDOL) National Agricultural Worker Survey (NAWS); and 3) NIOSH Childhood Agricultural Injury Survey (CAIS).

NEISS: NEISS collects nationally representative, timely, nonfatal occupational injury surveillance data by using a sample of U.S. hospital emergency departments (EDs). NIOSH funds CPSC to identify work-related cases from a subsample of EDs in the NEISS system. NIOSH uses these data to obtain demographics of the injured workers, and a description of the injury event. National estimates of all work-related traumatic injuries can be made, as well as estimates for injuries to special populations (e.g., children, women, African-Americans), injury events (e.g., falls), and types of injuries (e.g., eye injuries). NIOSH uses NEISS to identify farm-related youth injuries through the use of the location code included in the surveillance system.

NAWS: NAWS is a personal interview survey of 3,400 predominantly migrant and seasonal farm workers across the United States each year. In 1999, the NIOSH pilot tested the use of a farm injury module within NAWS. The module was asked of all farm workers in the NAWS sample, including workers under age 20. Workers were asked about occupational injuries that occurred to them on a farm in the last 12 months. In addition, NAWS provides demographic and work profiles for all farm workers participating in the survey. Initial results from NAWS led NIOSH to provide USDOL additional funds to collect the injury module in the 2002–2004 NAWS. NIOSH continued funding the NAWS injury module for the years 2008-2010. These data are currently being analyzed.

CAIS: CAIS is a survey-based surveillance system of farm operators conducted for NIOSH by the U.S. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS). CAIS covers youths who live on, work on, or visit farms in the United States. Each round of CAIS is based on a telephone survey of 50,000 farm operations selected at random across the United States. Farm operators are asked about the total number of nonfatal injuries that occurred to

youths under age 20 on their farms in the preceding calendar year. Details about all injuries are collected for positive responses. Demographic data on farm household youths and youths directly hired to work on the farm are also collected. To date, CAIS data have been collected for calendar years 1998, 2001, 2004, 2006, and 2009. The sixth CAIS survey will be collected in 2012. To address a lack of coverage of minority farming operations (both racial minorities and Hispanics) in the CAIS, NIOSH has collaborated with NASS to conduct the same injury survey specifically for minority farm operations (M-CAIS). To date, M-CAIS data have been collected for calendar years 2000, 2003, and 2008. The fourth M-CAIS is scheduled to be collected in 2014.

Hazard Surveillance

NIOSH conducts hazard surveillance of farming operations through the NIOSH Farm Hazard Survey (FHS). The FHS is a telephone survey of 25,000 farm operators conducted for NIOSH by USDA, NASS. The first FHS was conducted in 2006, with the second round collected in 2011. Farm operators were asked questions about safety and health issues associated with their farm. These issues ranged from questions about farm tractor use, Roll-over Protective Structure (ROPS) use on tractors, guarding and shielding on machinery used on the farm, use of hearing protection and other protective equipment by the farm operator, and chemical exposures to the farm operator in the previous year. Information on the number of youth living on the farm is included in the FHS, which allows for assessing farm hazards these youth may be exposed to.

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