http://www.fotosearch.com/photos-images/worker_2.html

CDC Workplace Safety and Health

NIOSH

Assessing Occupational and Personal Risk Factors in Illness and Injury – Basic Approaches and Beyond

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Healthier Workforce Center for Excellence

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National Institute for Occupational Safety and Health

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

Why is a Comprehensive Approach to the Health of Working People Needed?

- Changing nature of work
- Aging workforce
- Worker shortages
- Chronic diseases on the rise
- Increasing health care costs
- Impact on national productivity

Profound Changes in the World of Work

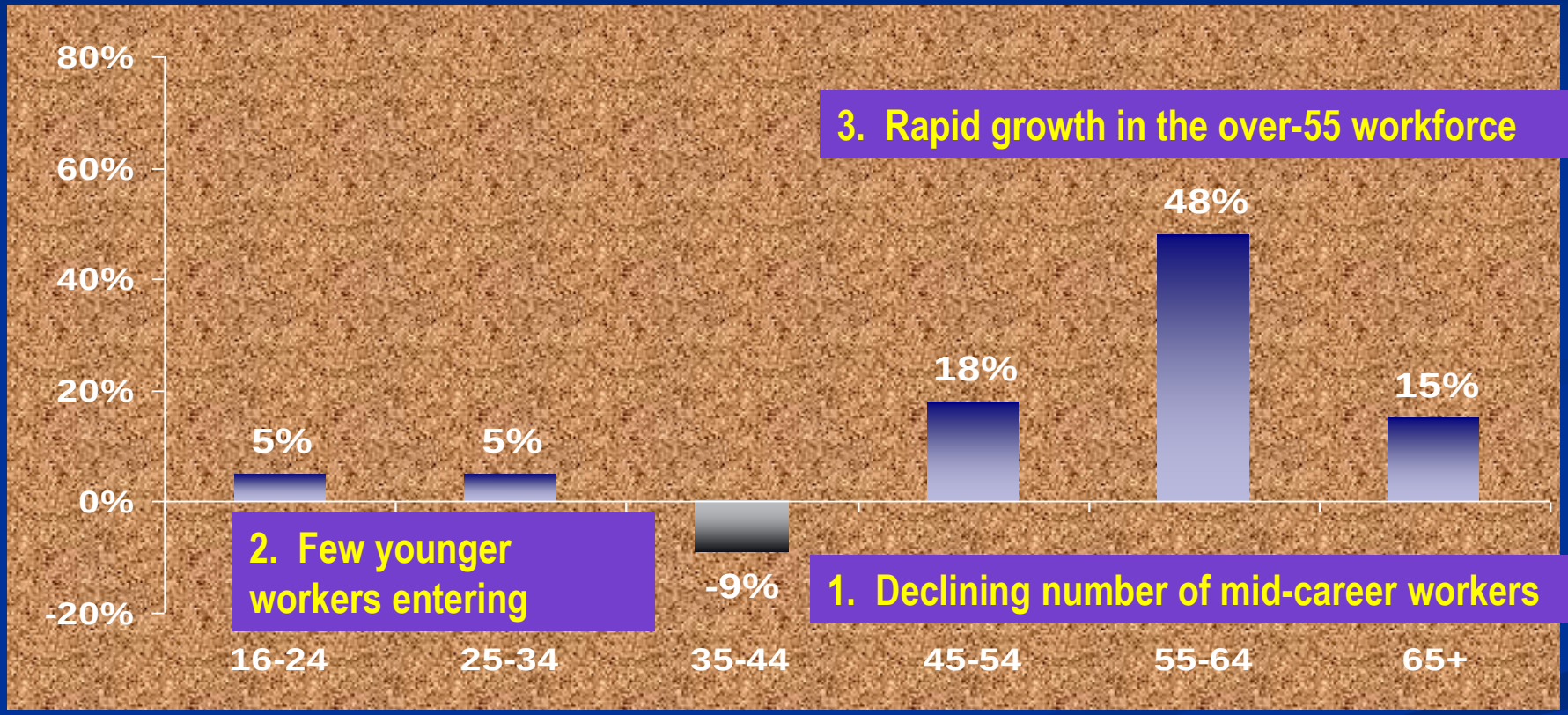
- **Work**
  - Physical → Mental
  - Production → Service
    → Health Care
  - New ways of organizing

    ↓

    Contracting
    Downsizing
    Lean manufacturing
  - Work intensification
- **Workplace**
  - More small businesses
  - More telecommuting
  - New work plans
  - New work conditions
- **Workforce**
  - Older workers
  - More immigrants
  - More women
  - More turnover

Dramatically different patterns of growth across worker age groups

Percentage of growth in U.S. population by age: 2000-2010



Source: U.S. Census Bureau

The Economic Burden of Chronic Disease on THE UNITED STATES

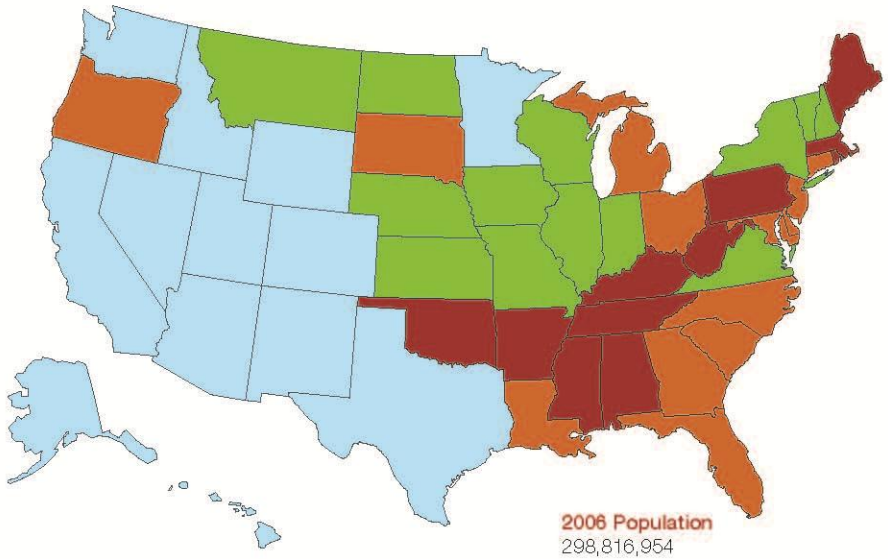
Current Toll on The United States TODAY

Over 162 million cases of seven common chronic diseases — cancers, diabetes, heart disease, hypertension, stroke, mental disorders, and pulmonary conditions — were reported in The United States in 2003. These conditions shorten lives, reduce quality of life, and create considerable burden for caregivers. The following map shows how states compare based on the prevalence of the seven common chronic diseases.

Reported Cases in The United States, 2003 (and as % of population*)

Cancers:	10,555,000	(3.7%)
Diabetes:	13,729,000	(4.9%)
Heart Disease:	19,145,000	(6.8%)
Hypertension:	36,761,000	(13.0%)
Stroke:	2,425,000	(0.9%)
Mental Disorders:	30,338,000	(10.7%)
Pulmonary Conditions:	49,206,000	(17.4%)

* As % of non-institutionalized population. Number of treated cases based on patient self-reported data from 2003 MEPS. Excludes untreated and undiagnosed cases.



Top Quartile
Second
Third
Bottom Quartile

Milken Institute State Chronic Disease Index
States in the top quartile have the lowest rates of seven common chronic diseases.

Source: Milken Institute

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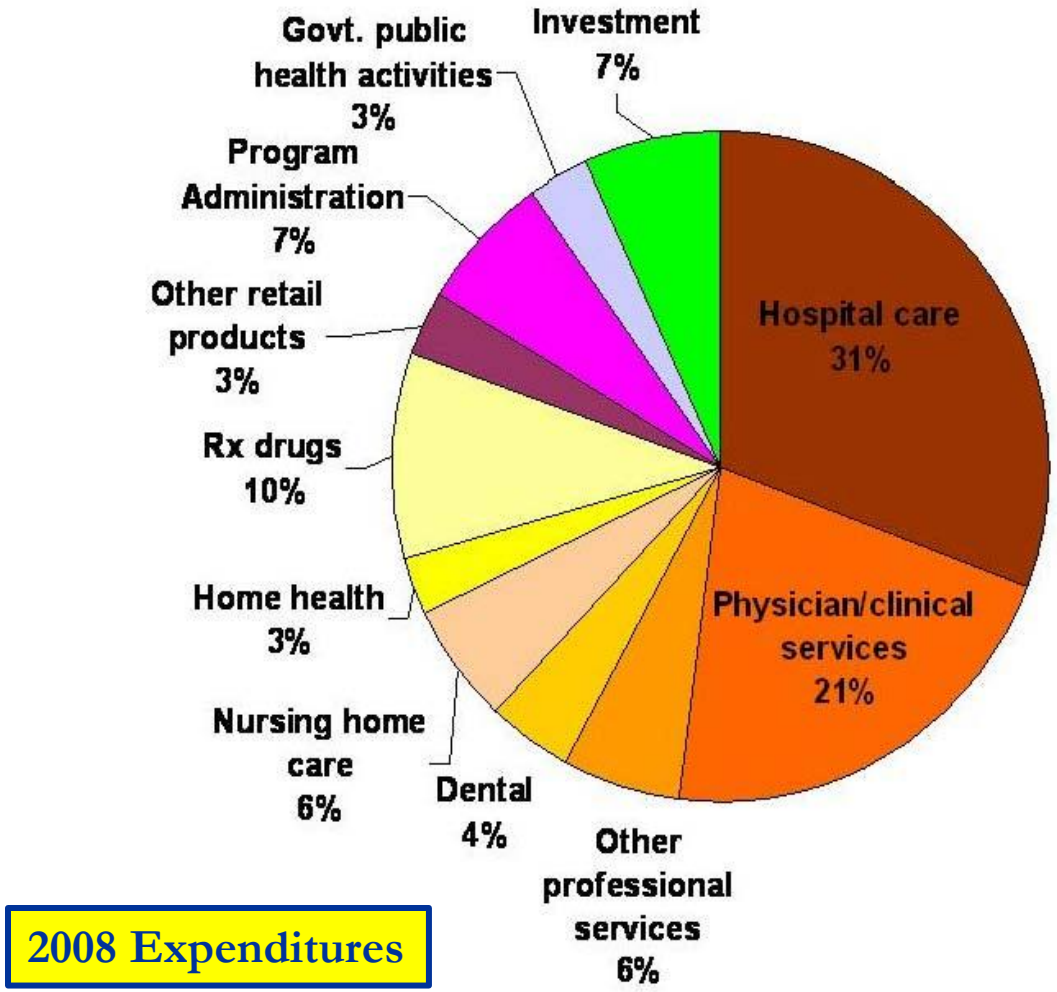
US Health Care Costs

Increase in Costs	
1980	$253 billion
1990	$714 billion
2008	$2.3 trillion



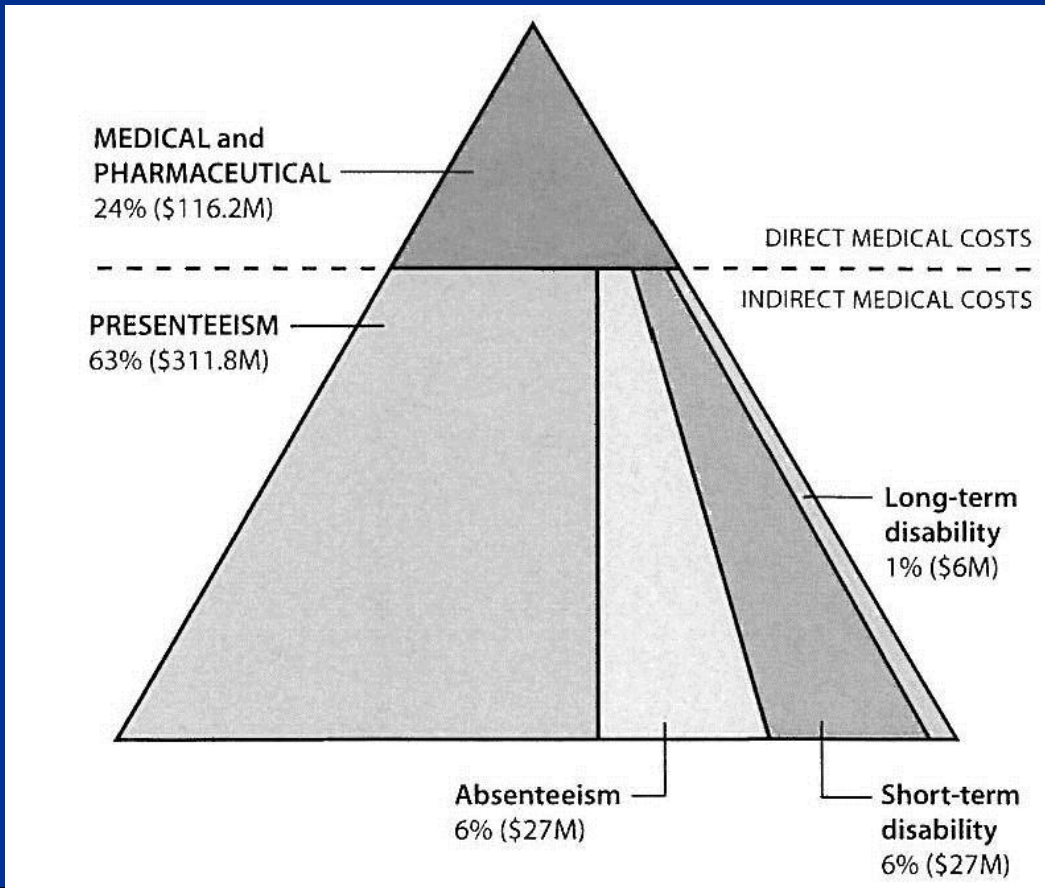
2008 Expenditures

Total = $2.3 Trillion

Source: kaiseredu.org

Productivity

- Dependency Ratio:
  - Ages 0-15 + Ages 65>/Ages 16-65
- Productivity Factors
  - Workplace
  - Environmental
  - Occupational
  - Health
  - Host, SES, demographic
- Presenteeism



Source: Bank One

Figures are based on annual data for 2000. Workers' compensation accounted for less than 1% of indirect medical costs.

Broader Consideration of the Role and Impact of Work

- Many of the most prevalent and significant health conditions in workers not caused solely by workplace hazards
- Examples include stress-related conditions, cardiovascular, psychological, and musculoskeletal disorders, obesity, depression, substance abuse, and violence
- Separation of "work" and "non-work" is in some ways artificial
  - Due to labor or employment contrast
  - Compartmentalization leads to under-reporting

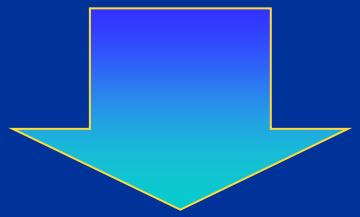
Challenges in Accounting for All Recognized Occupational Disease

- Underreporting by employees and health care providers of occupational injuries and illnesses
- Inadequate health care provider recognition of occupational injuries and illnesses
- Failure by employers and/or health care providers to report cases according to applicable state laws
- Difficulties in attributing disease with long latency from time of exposure to disease manifestation and/or from multifactorial causes *(e.g., self-employed, military)*
- Variations in coding the causes of injury, illness, or death
- Differences in underlying populations at risk *("denominators")*

[Adapted from CSTE, 2004]

Transition

Recognizing occupational hazards



Recognizing all factors that affect workers' health

(Example: Obesity and occupational hazards)

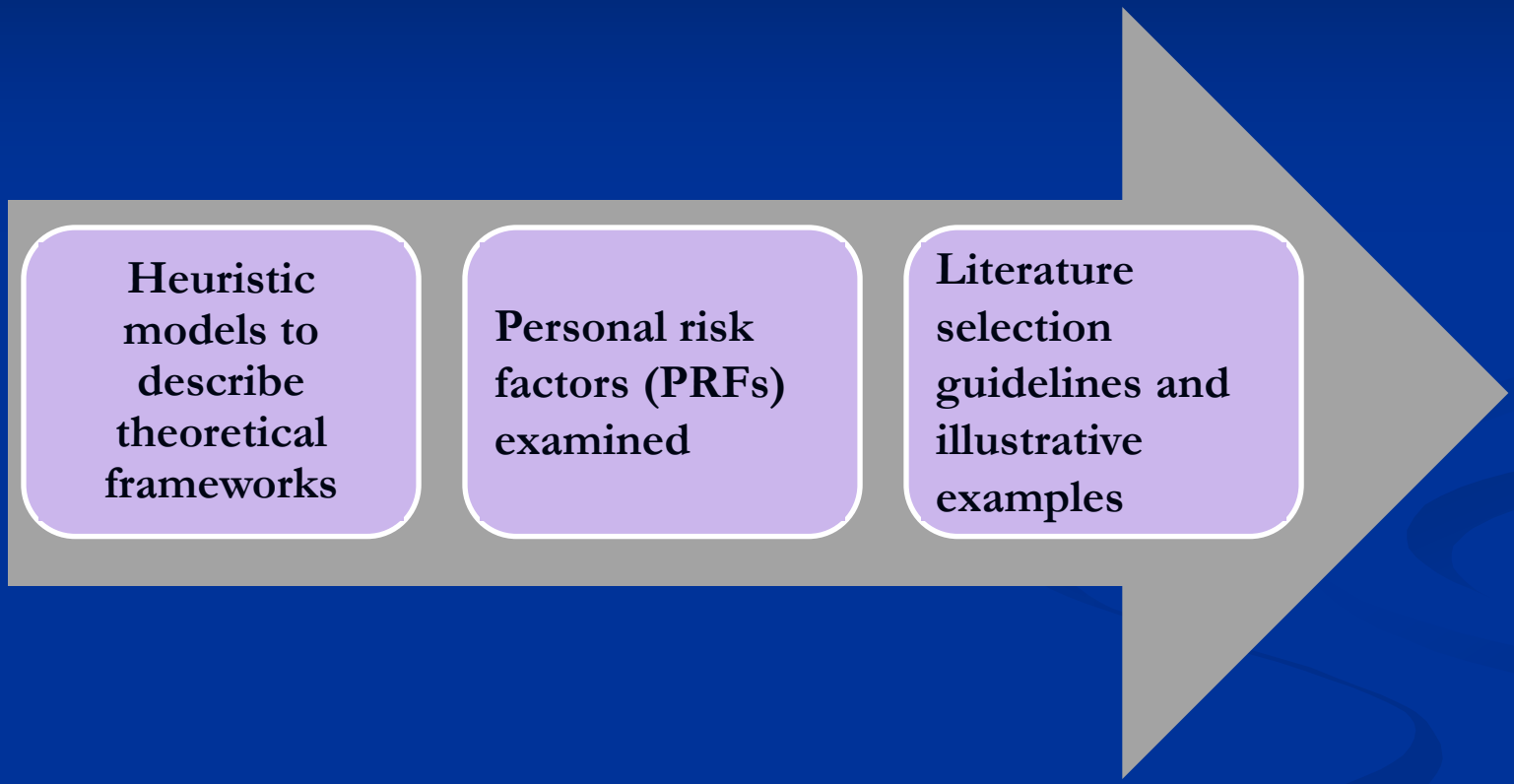
Interaction of Occupational and Personal Risk Factors in Workforce Health and Safety

Paul A. Schulte, PhD, Sudha Pandalai, MD, Victoria Wulsin, MD, and HeeKyoung Chun, ScD

Most diseases, injuries, and other health conditions experienced by working people are multifactorial, especially as the workforce ages. Evidence supporting the role of work and personal risk factors in the health of working people is frequently underused in developing interventions. Achieving a longer, healthy working life requires a comprehensive preventive approach. To help develop such an approach, we evaluated the influence of both occupational and personal risk factors on workforce health. We present 32 examples illustrating 4 combinatorial models of occupational hazards and personal risk factors (genetics, age, gender, chronic disease, obesity, smoking, alcohol use, prescription drug use). Models that address occupational and personal risk factors and their interactions can improve our understanding of health hazards and guide research and interventions. (*Am J Public Health.* 2012;102:434–448. doi:10.2105/AJPH.2011.300249)

effectiveness of health protection and health promotion interventions. Specific problem-driven research focuses on a marginal effect that is averaged over the other risk factors in a given context. Such problem-driven research, although beneficial in understanding a specific risk factor, has led to a lack of comprehensive research on the combined role of PRFs and occupational risk factors (ORFs) in work-related illness and injury. ORFs and PRFs are not only potential confounders or effect modifiers of associations of each risk factor with disease, but they may also be on a causal pathway to each other. For example,

Developing a Comprehensive Approach to the Health of Working People

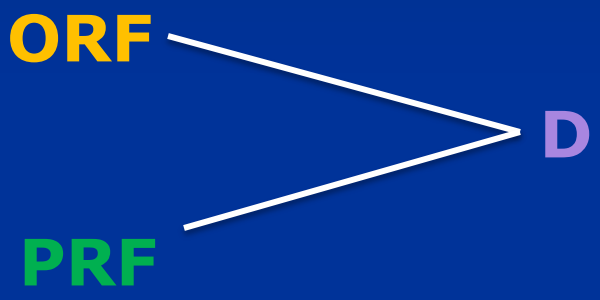


Schulte et al. 2012

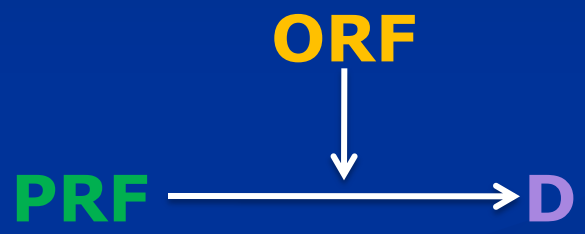
The role of comprehensive modeling in research, intervention, and other issues pertinent to illness and injury in the US workforce

Models* for the Effects of Occupational Risk Factors (ORFs) and Personal Risk Factors (PRFs)

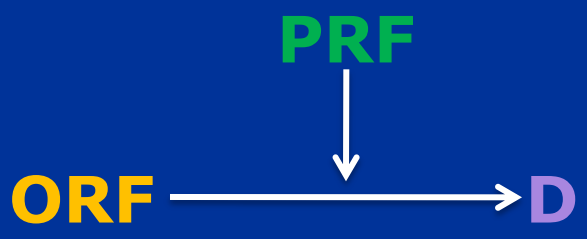
Model 1



Model 3



Model 2



Model 4

* Adapted from previous work [Schulte et al. 2012, Schulte et al. 2007, Schulte et al. 2009, Ottman 1990]

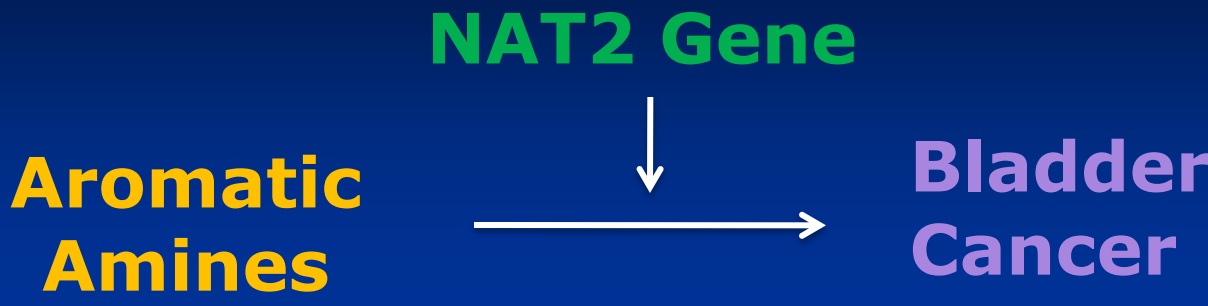
Personal Risk Factors

- Genetics
- Age
- Gender
- Chronic Disease
- Obesity/Overweight
- Smoking
- Alcohol
- Prescription Drug Use

Literature Selection

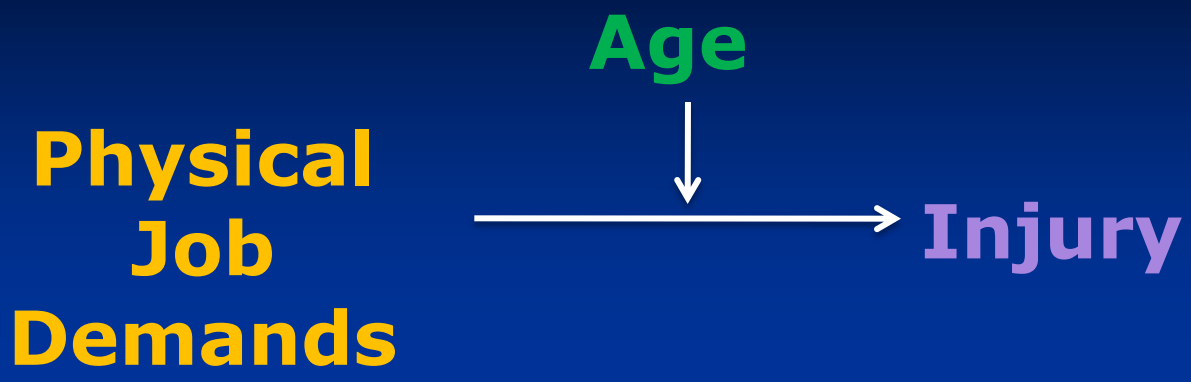
- Publications included in review
  - Peer reviewed
  - English or English translation
  - Full text
  - Original research papers, meta-analyses, or systematic reviews
- Hypothesis testing
- Statistically significant size effects based on RR or OR values
- PubMed search of combinations of terms for PRFs, work, employment, etc.

Personal Risk Factor of Genetics



- Genetics modify an ORF - disease association (M2)
- NAT2 gene polymorphisms
  - Occupational aryl amine exposure - ↑ risk of bladder cancer [Vineis et al. 2001; Hung et al. 2004; Kellen et al. 2007]
  - Isolated benzidine exposure (no aryl amines such as 2-naphthylamine or 4-aminobiphenyl) - protective? [Carreon et al. 2006]
- Genetic variation in the same gene can impact disease outcome differentially based on exposure [Carreon et al. 2006]

Personal Risk Factor of Age

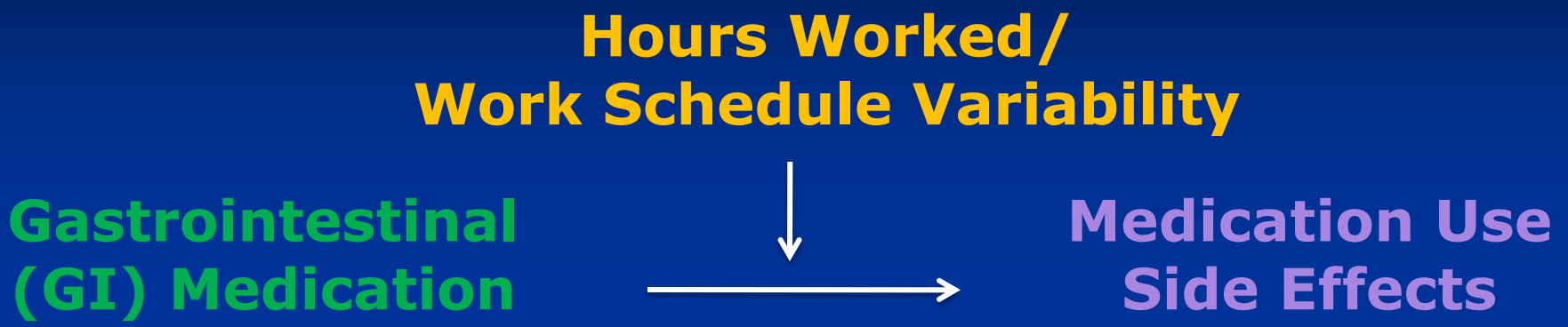


- Age modifies and ORF-occupational disease association (M2)
- Risk of injury associated with physical job demands (vibration, high-force, awkward postures, high pace work, high physical workload, etc) increases with age =/>45 (controlling for other lifestyle factors) [Chau et al. 2009]

Personal Risk Factor of Chronic Disease

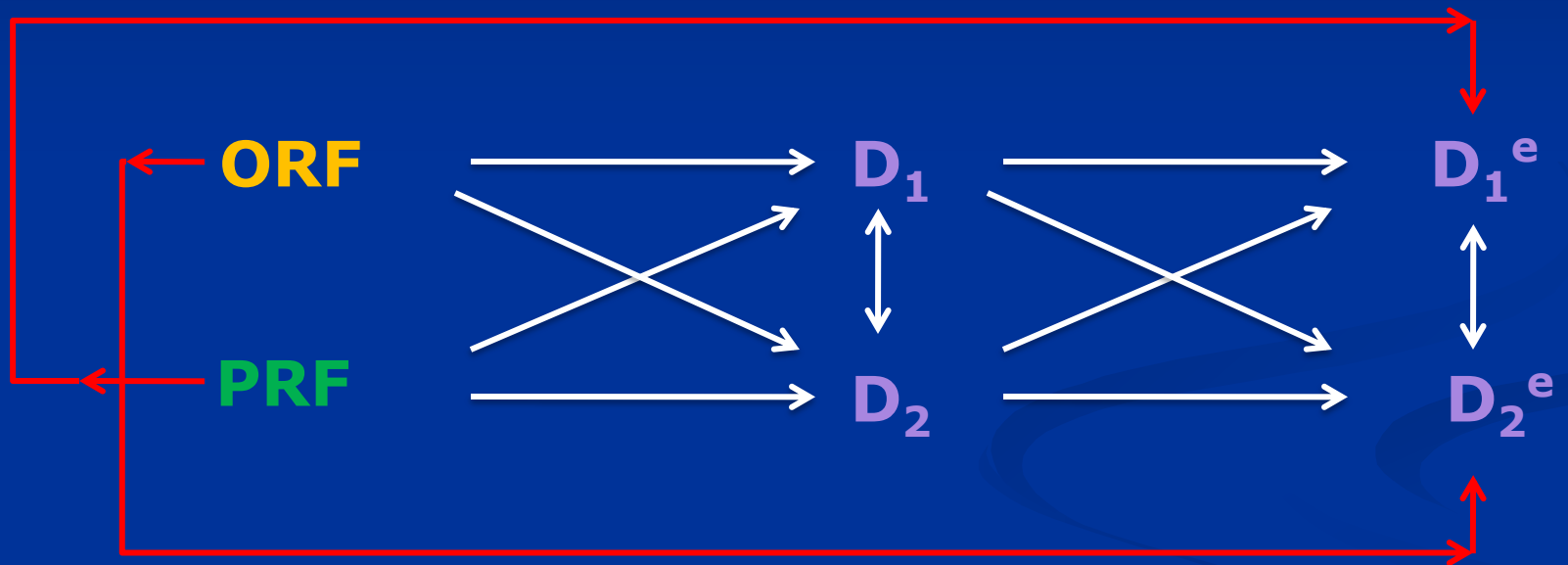
- Chronic condition/disease is risk for one disease/disease state; ORF is risk for 2nd -> interact (M4)
- Atopy can lead to asthma [Kitsch et al. 2000, Lombardo and Balmes, 2000, Kline et al. 2004]
  - Psyllium workers, bakers, and laboratory animal handlers with atopy are at greater risk of IgE dependent asthma than those without
- Occupational dust is a risk for COPD [Miller and MacCalman, 2009]
- COPD can compound asthma [Kitsch et al. 2000]

Personal Risk Factor of Prescription Drug Use



- An ORF modifies a prescription drug-occupational disease association (M3)
- Hours worked/work schedule variability, after controlling for noise level, was found to be associated with increased GI medication use [Caruso et al. 2004]
- Increased GI medication use may lead to increased side effects [Sostres et al. 2009]

Expanded Complex Disease Effects Model *



*Adapted from previous work [Schulte et al. 2007, Schulte et al. 2009 , and Ottman 1990]

Models and Examples Constructed

- Thirty-two examples (illustrating four heuristic models)
  - Extensive catalogue of occupational and personal risk factors in workers
  - Provides a roadmap for melding scientific and clinical knowledge that may have been divided by disciplinary boundaries
- Modeling independent vs modifying effects
  - Placement of ORF/PRF/disease process in a particular model subject to current level of knowledge

Additional Considerations

- Worker Population Characteristics
  - Healthy Worker Effects
  - Aging
- Disease Characteristics
  - Latency
  - Multi-factored

Personal Risk Factor of Obesity/Overweight

- An ORF modifies an obesity/overweight-occupational disease process (M3)
- Obesity increases asthma risk [Toren et al. 2000]
- Exposure to work asthmatogens may exacerbate obesity-related asthma [Suarthana et al. 2009, Schulte et al. 2007, Marabini et al. 2003]

Comprehensive Modeling and Workplace Disease and Injury

- Different exposures leading to multiple adverse outcomes compound an individual workers' medical burden
- New categories of PRF-ORF interactions
  - Relevant for hypothesis generation, study design, risk evaluation/assessment, intervention, and health promotion in the workplace
- Value in comprehensive modeling to drive more fully developed approaches to reduce/potentially eliminate occupational illness and injury

Overarching Issues for the US Workforce

- Evaluation of ORFs and PRFs should be reinforced by other logistical considerations
  - Medical E-records, worker's compensation issues
- Incorporation of multi-level analyses of group or macro-level variables
- Comprehensive modeling as part of a foundation for an integrated worklife approach
  - Worksite/employer funded wellness programs
  - Evaluation of ELSI (ethical, legal, social issues)

Thank You

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