Evidence for Cost-effectiveness Analysis: Non-cost Related Model Inputs

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Overview

- Cost-effectiveness model considerations and structure
- Evidence for major non-cost related model inputs
  1. Risk of blood and body fluid (BBF) exposure
  2. Likelihood of reporting BBF exposures
  3. Probability of hepatitis B surface antigen positive source patient
  4. Risk of hepatitis B virus transmission to exposed HCP
  5. Serologic evidence of protection after hepatitis B vaccine series
  6. Serologic evidence of protection after a “challenge” dose of hepatitis B vaccine

Cost-effectiveness Model Considerations

- Trainees
  - Working definition: persons entering school and/or obtaining new job skills that involve contact with patients or with blood or other body fluids (BBF) from patients in a healthcare, laboratory, or public-safety setting[1]
  - High continuing risk for BBF exposure; higher rates of BBF exposure than non-trainees

[1]Provisional Work Group definition adapted from MMWR. Updated U.S. Public Health Service Guidelines for the Management of Occupational Exposures to HBV, HCV, and HIV and Recommendations for Postexposure Prophylaxis. June 29, 2001/50(RR11);1-67.

Cost-effectiveness Model Considerations

- Age at vaccination
  - HCP vaccinated at age <1 year may experience earlier waning of antibody to hepatitis B surface antigen (anti-HBs) compared to HCP vaccinated at age ≥1 year
  - Increasing number of trainees vaccinated at age <1 year

Structure of Cost-effectiveness Model

- Primary analysis: Trainee (baseline)
  - Sensitivity analysis: Trainee (range)
- Secondary analysis: Non-trainee

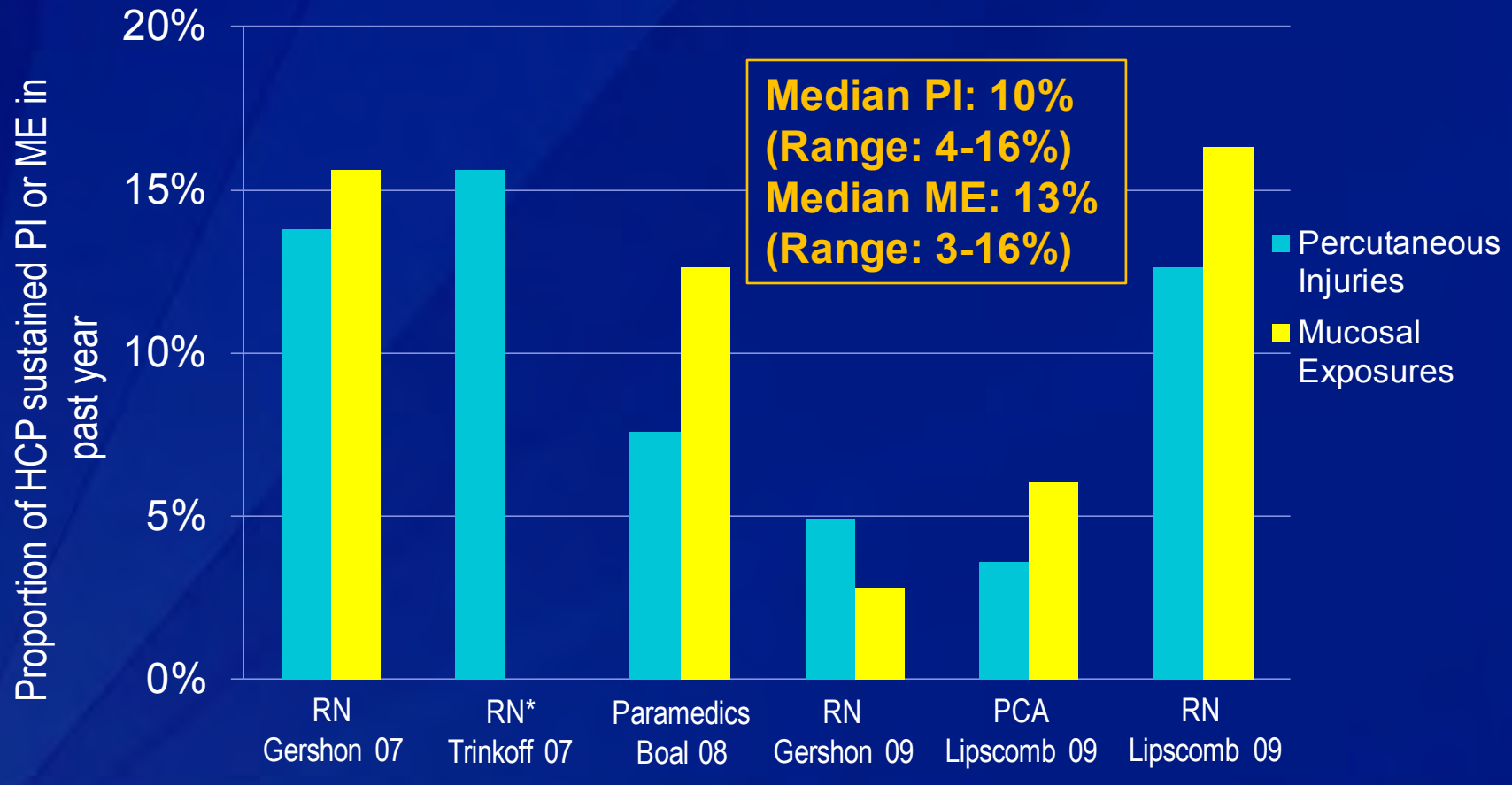
Overview

- Evidence for major non-cost related model inputs
  1. **Risk of blood and body fluid (BBF) exposure**

1. Risk of Blood and Body Fluid (BBF) Exposure

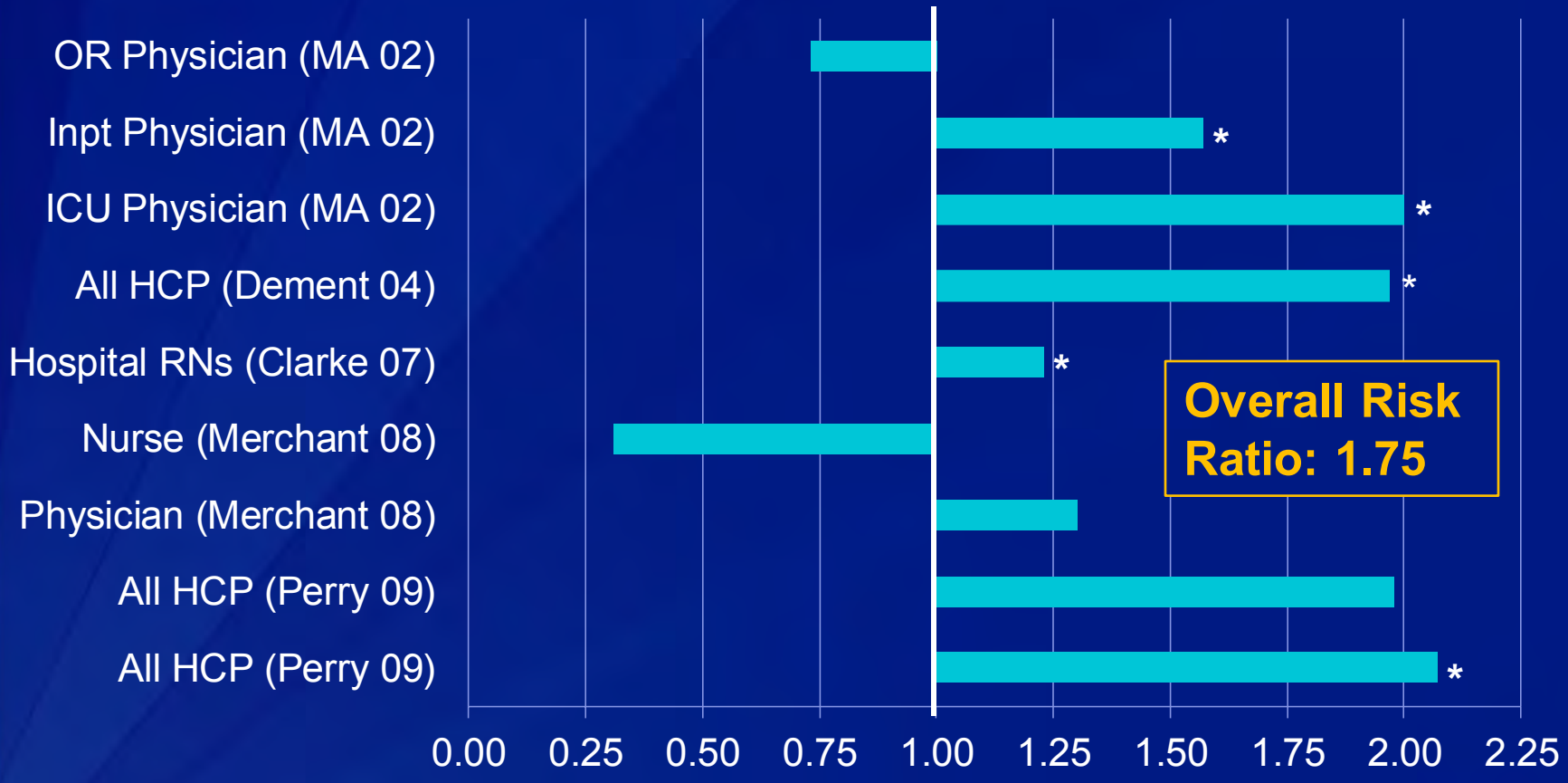
- Proportion of HCP who sustained ≥1 percutaneous injury (PI) or mucosal/non-intact skin exposure (ME) to blood, tissue, or other potentially infectious body fluid in past 12 months
  - PI: Needlestick, cut, or bite
  - ME: Contact with mucous membranes or non-intact skin (e.g., skin that is chapped, abraded, or with dermatitis)
- Literature review, 2002-present

1. Annual Proportion of BBF Exposures to Non-trainee HCP by Exposure Type, 2002-present



RN: registered nurses (non hospital based, home healthcare); PCA: patient care assistants
*Data unavailable for mucosal exposures

1. Risk Ratio for BBF Exposure: Trainees vs. Non-trainees



RN: registered nurses, OR: operating room, Inpt: inpatient, ICU: intensive care unit
*Percutaneous injuries only

1. Estimated Risk of Blood and Body Fluid (BBF) Exposure

- Percutaneous injury
  - Trainee: 18%
    - Sensitivity: 6% – 27%
  - Non-trainee: 10%
- Mucosal exposure
  - Trainee: 22%
    - Sensitivity: 5% – 29%
  - Non-trainee: 13%

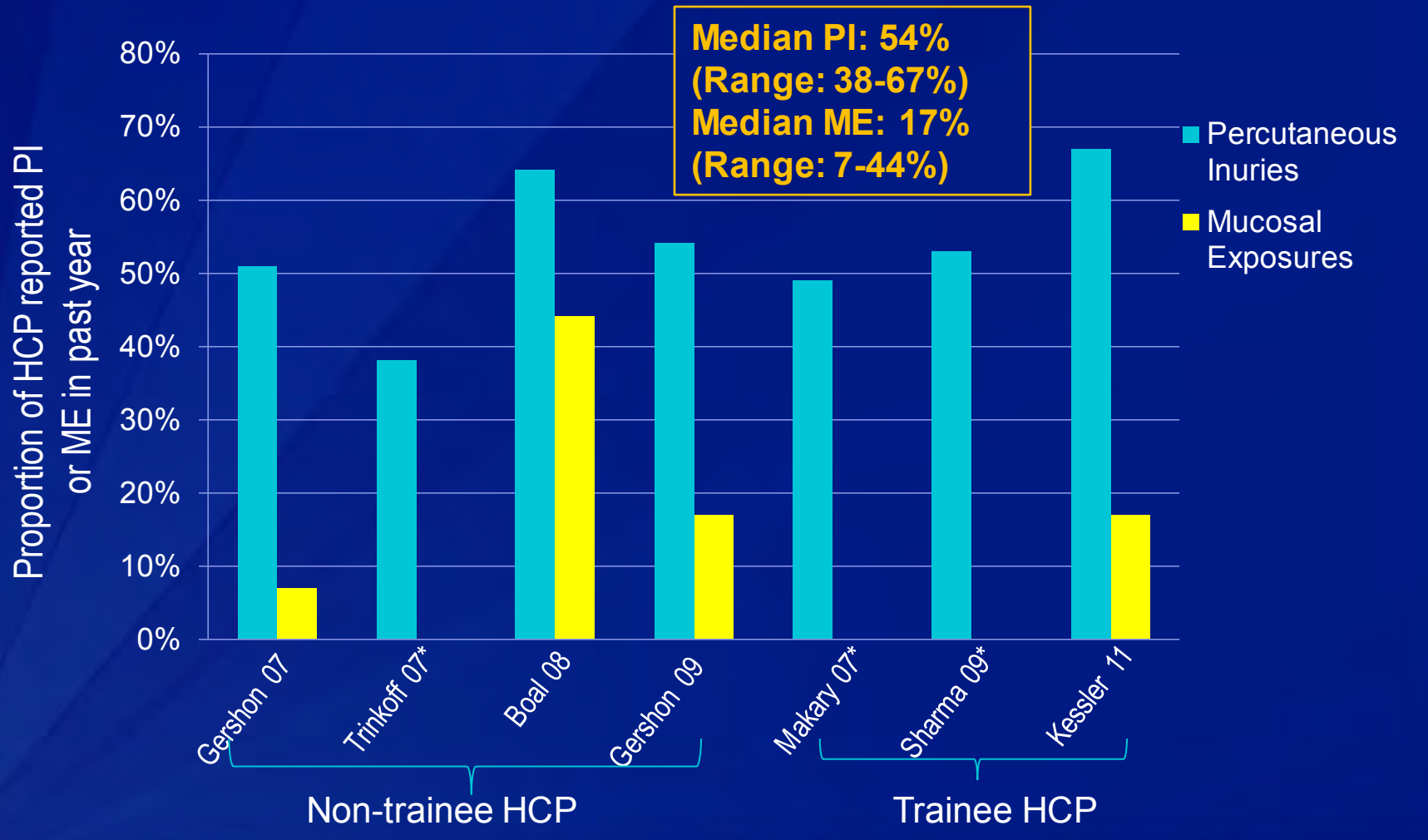
Overview

- Evidence for major non-cost related model inputs
  1. Risk of blood and body fluid (BBF) exposure
  2. **Likelihood of reporting BBF exposures**

2. Likelihood of Reporting Blood and Body Fluid Exposures to Occupational Health

- Proportion of blood and body fluid (BBF) exposures reported to occupational health clinic or emergency department in past 12 months
- Literature review, 2002-present

2. Annual Proportion of BBF Exposures Reported to Occupational Health by Exposure Type, 2002-present



RN: registered nurses. *Data unavailable for mucosal exposures

2. Estimated Likelihood of Reporting Blood and Body Fluid Exposures

- Percutaneous injuries
  - Trainee: 54%
    - Sensitivity: 38% – 67%
  - Non-trainee: 54%
- Mucosal exposures
  - Trainee: 17%
    - Sensitivity: 7% – 44%
  - Non-trainee: 17%

Overview

- Evidence for major non-cost related model inputs
  1. Risk of blood and body fluid (BBF) exposure
  2. Likelihood of reporting BBF exposures
  3. **Probability of hepatitis B surface antigen positive source patient**

3. Probability of Hepatitis B Surface Antigen (HBsAg)-positive Source Patient

- Proportion of source patients testing hepatitis B surface antigen (HBsAg) positive
  - HBsAg: marker of chronic or acute infection
- Weighted average of 7170 exposures at 3 US healthcare systems, 2000-2012[1]
  - BBF source patient identified in estimated 94% of occupational exposures
  - Trainee/non-trainee: 0.9%

[1]UNC Healthcare, UPMC Health System, Alaska Native Tribal Health Consortium (unpublished data)

3. Probability of Hepatitis B Surface Antigen (HBsAg)-positive Source Patient

Prevalence of Chronic Hepatitis B among Selected Populations

Population	Prevalence	Source
US population (overall)	0.3%	Wasley 2010
Alaska Natives	1% - 2%	Personal communication
Inmates	1% - 4%	MMWR 2003/52 (RR01)
Injection drug users	3%	MMWR 2006/55 (RR16)
US immigrants	4% - 11%	Mitchell 2011
HIV-positive persons	6% - 14%	MMWR 2006/55 (RR16)
API in NYC	12% - 24%	Wang 2011

- Sensitivity analysis: 0.3% - 10%

API: Asian Pacific Islanders; Personal communication: Brian McMahon & Brenna Simons

Overview

- Evidence for major non-cost related model inputs
  1. Risk of blood and body fluid (BBF) exposure
  2. Likelihood of reporting BBF exposures
  3. Probability of hepatitis B surface antigen positive source patient
  4. **Risk of hepatitis B virus transmission to exposed HCP**

4. Risk of HBV Transmission to Exposed HCP

- Probability of serologic evidence of HBV infection among susceptible HCP after sustaining blood or body fluid exposure contaminated with HBV, in the absence of post-exposure management

4. Risk of HBV Transmission to Exposed HCP

- Weighted sum, accounting for:
  - Probability of hepatitis B e antigen (HBeAg)* positive, given HBsAg positive source patient: 34.5%[1]
    - Probability of infection from percutaneous injury: 50%[2]
  - Probability of HBeAg negative, given HBsAg positive source patient: 65.5%[1]
    - Probability of infection from percutaneous injury: 30%[2]

[1]Cruz 1987, Friedman 1998, Kohn 1996, Kumar 1987, McMahon 1993
[2]MMWR June 29, 2001/50 (RR11), assumes percutaneous injury
*Marker of high viral replication/highly infectious patient

4. Risk of HBV Transmission to Exposed HCP

- Percutaneous injuries
  - Trainee: 37%
    - Sensitivity: 25% – 46%
  - Non-trainee: 37%
- Mucosal exposures[1]
  - Trainee: 19%
    - Sensitivity: 13% – 23%
  - Non-trainee: 19%

[1]Mucosal exposures estimated at half the risk of percutaneous injuries

Overview

- Evidence for major non-cost related model inputs
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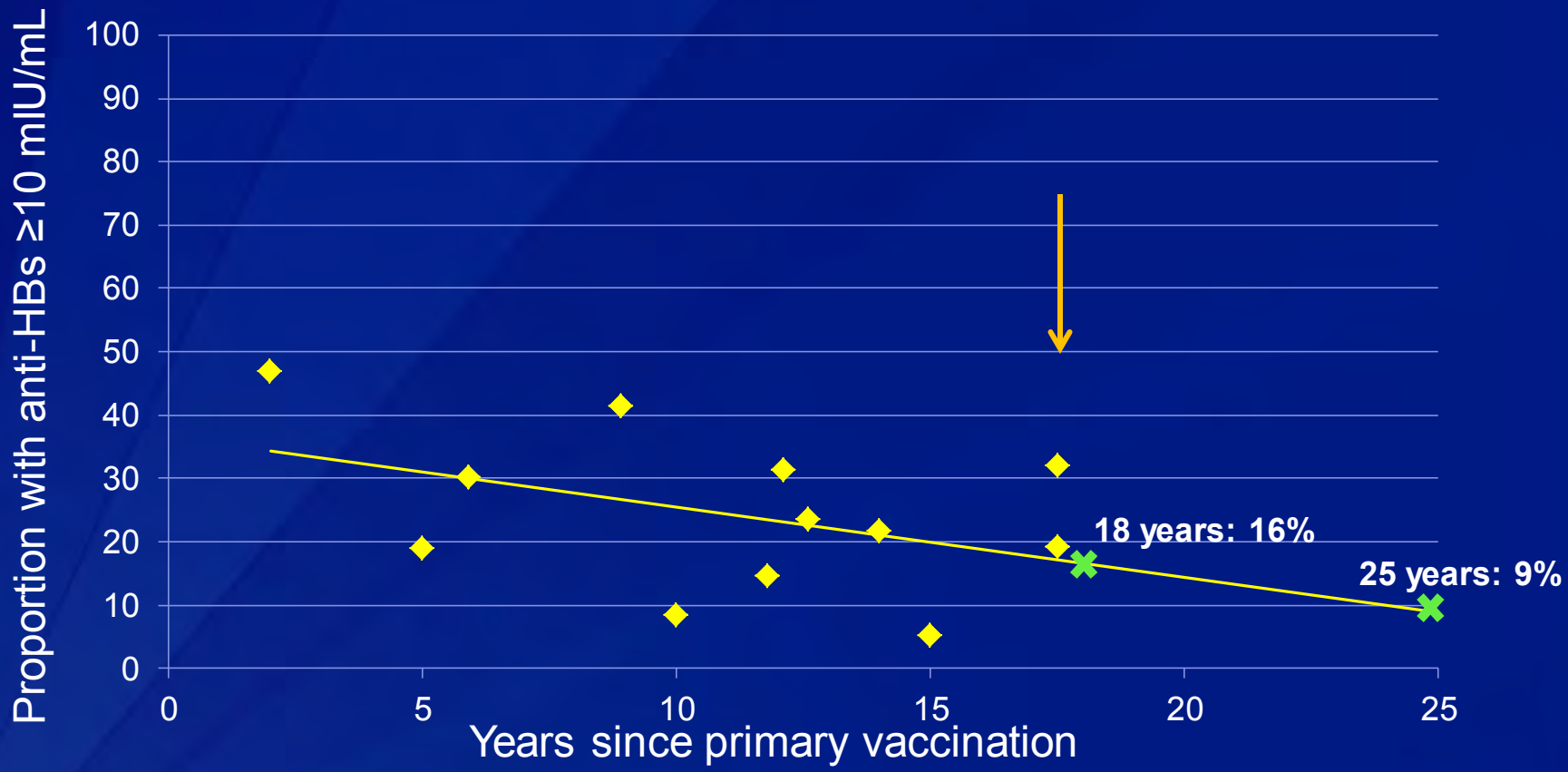
  4. Risk of hepatitis B virus transmission to exposed HCP
  5. **Serologic evidence of protection after hepatitis B vaccine series**

5. Serologic Evidence of Protection after Hepatitis B Vaccine Series

- Proportion of HCP with antibody to hepatitis B surface antigen (anti-HBs) ≥10 mIU/mL by:
  - Time since vaccination*
  - Age at vaccination: <1 year vs. ≥1 year
- Literature review: US studies, 1985-present
- Extrapolated available data to focus on 18 to 25 years since vaccination (common ages of matriculation)

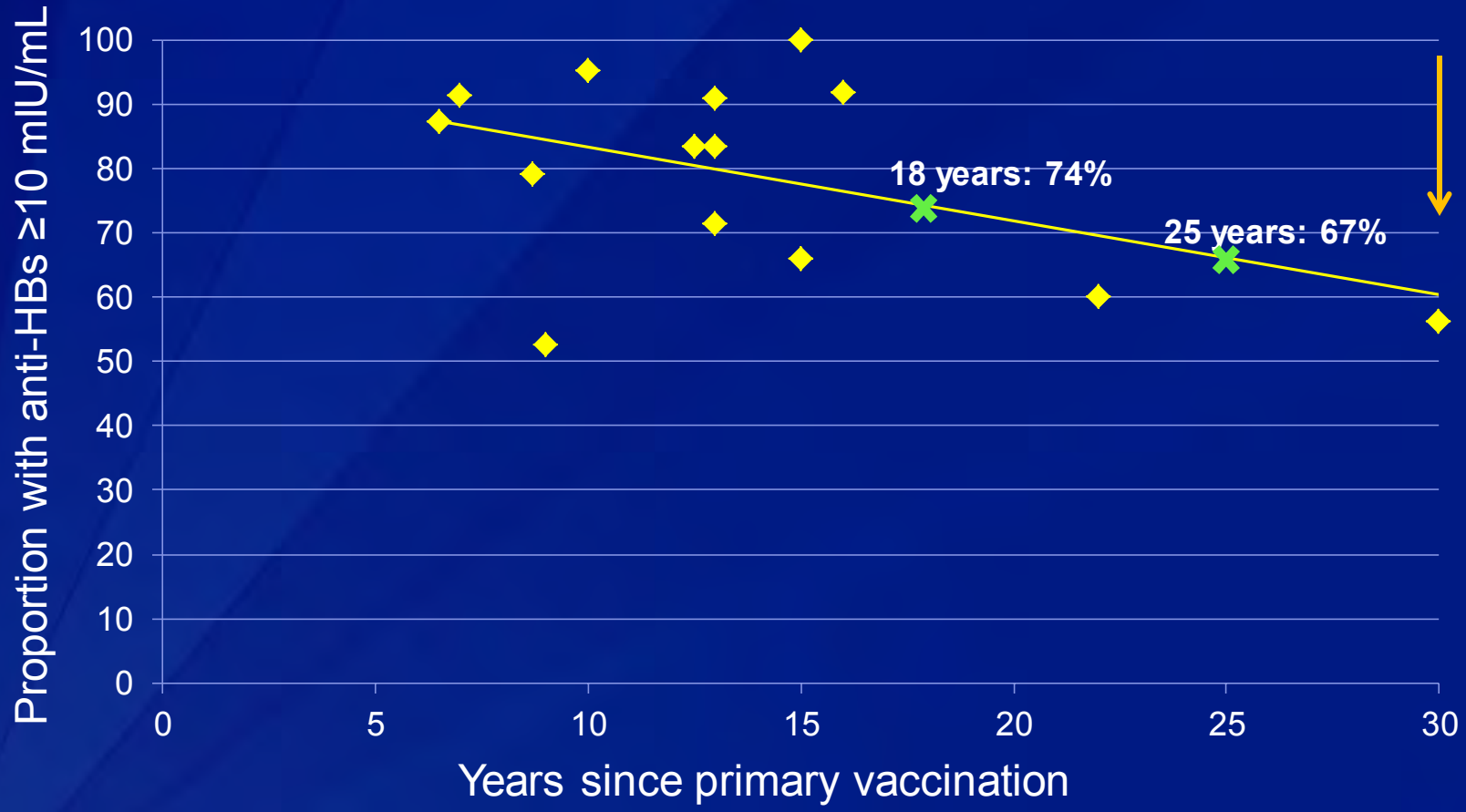
*Complete series of HepB

5. Serologic Evidence of Protection by Years Since Vaccination at Age <1 Year



Source: Dentinger 2005, Hammitt 2007, Middleman 2012, Petersen 2004, Samandari 2007.
Note: US studies only.

5. Serologic Evidence of Protection by Years Since Vaccination at Age ≥1 Year



Source: Funderburke 2000, McMahon 2005, McMahon 2009, McMahon 2011, Stevens 1992, Tohme 2011, Watson 2001, Williams 2001, Williams 2011. Note: US studies only.

5. Serologic Evidence of Protection* after Hepatitis B Vaccine Series

- Trainee: 20%
  - Weighted toward proportion of HCP vaccinated at age <1 year with serologic evidence of protection
  - Sensitivity: 10% - 50%
- Non-trainee: 80%
  - Proportion of HCP vaccinated at age ≥1 year with serologic evidence of protection

*Anti-HBs ≥10 mIU/mL

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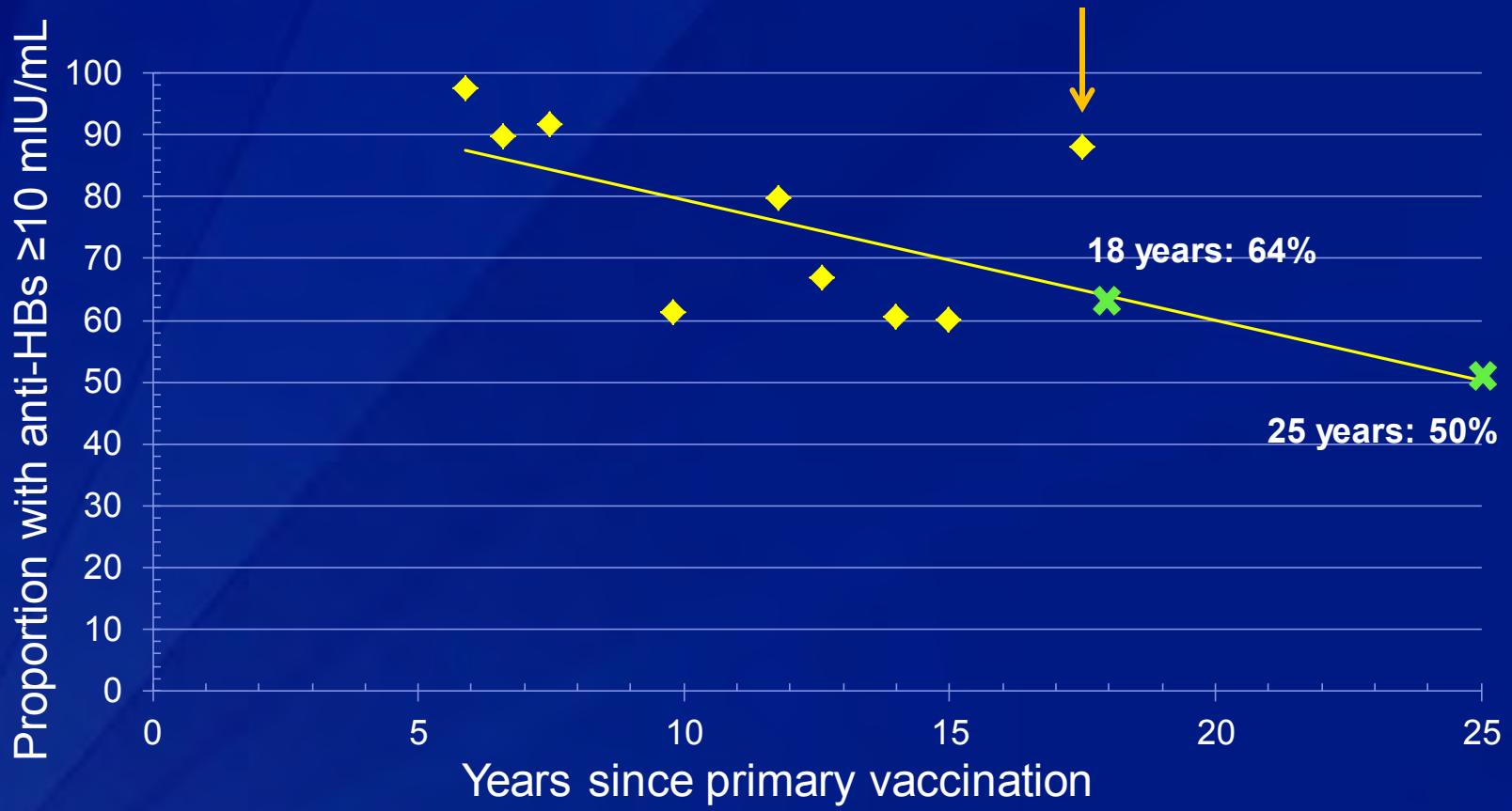
  6. **Serologic evidence of protection after a "challenge" dose of hepatitis B vaccine**

6. Serologic Evidence of Protection after Challenge Dose of HepB

- Proportion of HCP who:
  - Had less than 10 mIU/mL anti-HBs at an extended follow-up period*, and
  - Responded with anti-HBs ≥10 mIU/mL at post-vaccination testing 1-2 months after an additional "challenge" dose of HepB, by
  - Time since vaccination
  - Age at vaccination: <1 year vs. ≥1 year
- Literature review: US studies, 1985-present
- Extrapolated available data to focus on 18 to 25 years since vaccination

*After receiving complete series of HepB

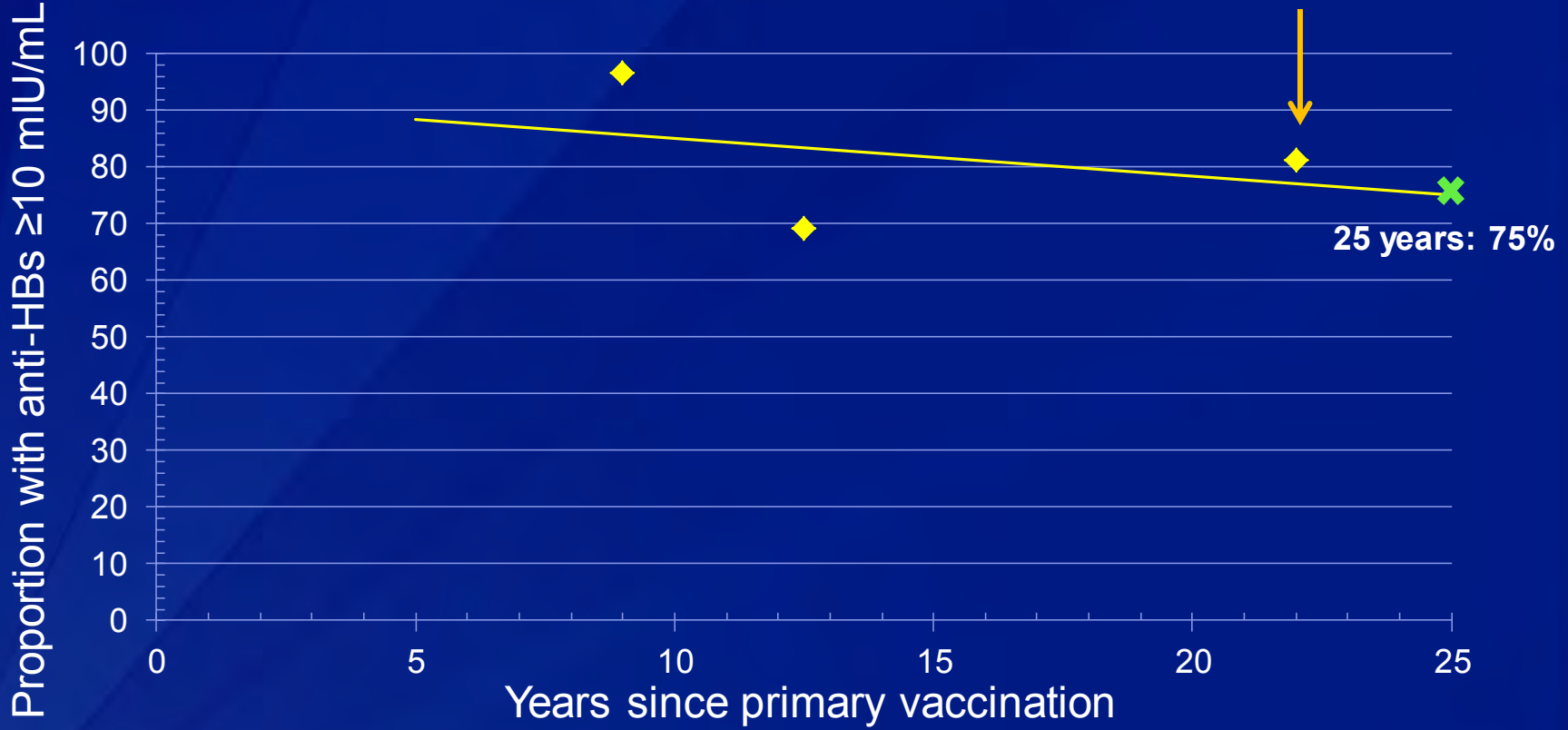
6. Serologic Evidence of Protection after Challenge Dose* by Years Since Vaccination at Age <1 Year



*1 additional dose among subjects vaccinated in the remote past w/ anti HBs <10mIU/mL at follow up

Source: Hammitt 2007, Middleman 2012, Petersen 2004, Samandari 2007.
Note: US studies only.

6. Serologic Evidence of Protection after Challenge Dose* by Years Since Vaccination at Age ≥1 Year



*1 additional dose among subjects vaccinated in the remote past w/ anti HBs <10mIU/mL at follow up

Source: McMahon 2009, Tohme 2011, Williams 2001.
Note: US studies only.

6. Serologic Evidence of Protection* after Challenge Dose of HepB

- Trainee: 60%
  - Estimated proportion of HCP vaccinated at age <1 year with serologic evidence of protection
  - Sensitivity: 35% - 70%
- Non-trainee: 75%
  - Estimated proportion of HCP vaccinated at age ≥1 year with serologic evidence of protection

*Anti-HBs ≥10 mIU/mL

Summary

- Risk of blood and body fluid exposure 1.75X higher for trainees vs. non-trainees
- 17-54% trainees and non-trainees report exposures
- ~0.9% source patients HBsAg-positive in recent estimates; prevalence varies by patient population

Summary

- Proportion with serologic evidence of protection at time distant from vaccination less among HCP vaccinated at age <1 year
- “Challenge” dose of hepatitis B vaccine induces memory response in 60-75% of vaccinees, regardless of age at vaccination

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