

## Reducing Risks of Harmful Events in the Critically Ill

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## Conflict of Interest Disclaimer

- I have no financial interests or conflicts of interest related to this talk



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## The Affordable Care Act

- Most citizens will have health insurance
- Medicaid will be expanded to 133% of FPL
- Individuals with income 133% to 400% FPL eligible for insurance exchanges
- About 33 million new insured individuals
  
- These are clearly good things



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## The Affordable Care Act

- Increased coverage will increase cost
- Strategy for covering these costs:
  - Pressure on health care system to:
    - Improve health
    - Improve care
    - Lower costs
  - Reduced reimbursements
  - New fees and taxes
  - Eliminate fraud and waste



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## The Affordable Care Act

- Emphasis on measuring quality and reporting outcomes
  - Improve patient safety
  - Reduce medical errors
  - Prevent readmissions
- Manage costs
- Increase efficiency of care and services



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## Caring for the Critically Ill

- ICUs are a very high cost environment
  - High cost per day (FTEs and facilities)
  - High cost for treatments
  - High cost for labs and imaging
- High risk for preventable harm (% ICU)
  - Ventilator associated pneumonia (100%)
  - Catheter associated bloodstream infections (74%)
  - Catheter associated urinary tract infections (73%)
  - Medication errors



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## Caring for the Critically Ill

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- High risk for preventable harm
  - **Ventilator associated pneumonia**
  - **Catheter associated bloodstream infections**
  - Catheter associated urinary tract infections
  - Medication errors

## Epidemiology of CRBSI

- 250,000 nosocomial bloodstream infections per year
  - 64% of these are primary infections
- 51% nosocomial BSI occur in the ICU
  - Most are catheter associated
- About 80,000 CRBSI in ICUs each year
  - Related to 28,000 deaths
  - \$2.3 billion

## Epidemiology of CRBSI

- Attributable Mortality
  - Variable results: 4 to 40%
- Odds ratio, adjusted 2.0 – 2.6
- Attributable LOS
  - ICU LOS\* 2.4 (0.1 – 3.1) days
  - Hospital LOS\* 7.5 (4.0 – 11.0)
- Attributable Costs\* \$21,400 (\$12,000-\$32,800)

\*Warren et al, CCM 2006; 34:208

## Preventing CRBSI: Insertion

- Use CV catheter only when needed
- Excellent hand hygiene
- Maximal barrier precautions at insertion
- Disinfect skin with 2% chlorhexidine prep
- Sterile gauze or semipermeable transparent dressing

## Preventing CRBSI: Management

- Replacement of administration kits >72h
  - Exceptions: blood, blood products, lipids
- Clean injection ports with 70% EtOH or iodophor with each access
- Replace dressing when damp, soiled or not occlusive
- Remove catheters when no longer essential

## Reducing CRBSI in the ICU

- Pronovost et al. NEJM 2006;355:2725
  - Prospective cohort study
  - Before and after, observational design
  - 108 ICUs in Michigan
  - 1981 ICU months
  - 375,757 catheter days
  - Outcome: CRBSI / 1000 catheter days
  - Measured at three month intervals

## Reducing CRBSI in the ICU

Pronovost et al

- Intervention
  - Team leader and clinicians educated
  - Partner with infection control practitioner
  - Five evidence based procedures
    - Hand hygiene
    - Full barrier precautions at insertion
    - Skin cleaning with chlorhexidine
    - Avoid femoral site
    - Remove unnecessary catheters



## Reducing CRBSI in the ICU

Pronovost et al

- Intervention
  - Central line carts with all supplies
  - Checklist to assure compliance
    - Providers stopped if process not followed
  - Catheter removal discussed at daily rounds
  - Monthly feedback to teams
    - number and rates of CRBSI



## Reducing CRBSI in the ICU

Pronovost et al

- Results (CRBSI/1000 catheter days)
- Mean
  - Before 7.7 CRBSI/1000 days
  - 18 months 1.4 CRBSI/1000 days
- Median
  - Before 2.7 CRBSI/1000 days
  - 18 months 0.0 CRBSI/1000 days
- Incident rate ratio: 0.34 (0.23 – 0.50)



## Reducing CRBSI in the ICU

Marsteller et al

- Marsteller et al CCM 2012;40:2933
- Multicenter, phased, cluster-randomized controlled trial
- 45 ICUs from 35 hospitals in two systems
- Intervention:
  - Pronovost bundle, checklist, observer
  - Comprehensive, unit-based, safety program
  - Compare at 9 months, then all in



## Reducing CRBSI in the ICU

Marsteller et al

- Results (CRBSI/1000 catheter days)
- Mean
 

	Study	Control
– N (ICUs)	23	22
– Baseline	4.48	2.71
– 9 months	1.33	2.16
– 18 months	0.85	0.83
- Incident rate ratio: 0.19 (0.06 – 0.57)



## Reducing CRBSI in the ICU

Consistent results!

1 <sup>st</sup> Author	Design	Site	Base line	16-18 mo	34-36 mo
Pronovost NEJM/BMJ	B → A	MI	7.7	1.4	1.1
Marsteller CCM	RCT	System	4.5	0.9	
De Palo QSHC	B → A	RI	3.7	1.0	
Lin AJMQ	B → A	HA	1.5	0.6	



## Epidemiology of VAP

- Incidence of VAP
  - Observational (38): 10% (7 – 12%)
  - RCTs (51): 23% (29 -27%)
- Attributable Mortality\*
  - Variable results: 0 to 50%
  - Best studies: 6% to 12%
- Attributable LOS\* 6.1 (5.3 to 6.8) days
- Attributable Costs\* \$23,000  
(\$10,100 - \$50,700)

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## Preventing VAP

- General prevention
  - Non-invasive ventilation when possible
  - Strict hand hygiene
  - Avoid over sedation (protocols and daily sedation interruption)
  - Daily weaning readiness assessment
  - Weaning protocol
  - Extubate promptly



## Preventing VAP

- Prevent aspiration
  - Semi-recumbent position, 30° to 45°
  - Subglottic suctioning
  - ET cuff pressure at least 20cm H2O
- Reduce colonization of upper airway
  - Regular oral care with antiseptic solution
  - Selective digestive track decontamination\*



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## Preventing VAP

- Reduce colonization of upper airway
  - Avoid nasotracheal intubation
  - Regular oral care with antiseptic solution
  - Selective digestive track decontamination\*
- Reduce contamination from MV equipment
  - Remove condensate from vent circuits
  - Change circuit only when soiled
  - Disinfect and store equipment properly



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## Reducing VAP in the ICU

Berenholtz et al, Inf Control Hosp Epidemiol 2011;32:305

- Prospective cohort study
- Before and after, observational design
- 112 ICUs from 72 hospitals in Michigan
- 3228 ICU months
- 550,800 ventilator days
- Outcome: VAP / 1000 ventilator days
- Measured at three month intervals



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## Reducing VAP in the ICU

Berenholtz et al, Inf Control Hosp Epidemiol 2011;32:305

- Comprehensive unit-based safety program
- VAP bundle
  - Semirecumbent positioning
  - Stress ulcer prophylaxis
  - DVT prophylaxis
  - Sedation adjusted daily until patient can follow commands
  - Daily assessment of readiness to extubate



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## Reducing VAP in the ICU

Berenholtz et al, Inf Control Hosp Epidemiol 2011;32:305

- Mean VAP/1000d rate ratio
  - Before 6.9 1.0
  - 16-18 months 3.4 .51 (.41 - .64)
  - 28-30 months 2.4 .29 (.24 - .34)
- Median
  - Before 5.5
  - 16-18 months 0.0
  - 28-30 months 0.0



## Reducing VAP in the ICU

CCCTG CCM 2013;41:15

- Two year, prospective time series study
- 11 ICUs
- 1320 patients (330/ 6 months)
- 14 VAP guideline recommendations
- Multifaceted intervention
  - Education, reminders, opinion leaders, and implementation teams
- Outcomes concordance and VAP rates



## Reducing VAP in the ICU

CCCTG CCM 2013;41:15

- VAP rate (events/330 patients)
- Periods
  - 1 - 6 months 47/330 14.2%
  - 7 - 12 months 34/330 10.3%
  - 13 - 8 Months 38/330 11.5%
  - 19 - 24 months 29/330 8.8%
  - 38% reduction in VAP (p = 0.03)



## Reducing VAP in the ICU

Pogorzelska et al, I J Qual Hlth Care 2011;23:538

- Cross sectional survey of VAP bundle use
- 415 ICUs in 250 hospitals
- Mean VAP rate = 2.7/1000 vent days
  - 284 (68%) had VAP bundle policy
  - 188 (45%) monitored compliance
  - 73 (18%) reported high compliance
- Unless policy **AND** monitoring **AND** high compliance, **no effect on VAP rate**



## Cost of VAP/CRBSI prevention

Waters et al, Am J Med Qual 2011;26:333

- 6 hospitals from the Keystone ICU project
- Cost of program/hosp: \$161,584
- CRBSI averted/hosp: 29.9
- VAP averted/hosp: 18.0
- Cost per infection averted: \$3,375
- Estimated cost savings
  - Per VAP: \$23,000 (\$10,100 - \$50,700)
  - Per CRBSI: \$21,400 (\$12,000-\$32,800)



## Concerns about the bundles

- Need RCTs of bundles to demonstrate effect on mortality, LOS, cost
- Do we have the “right stuff” in the bundle
  - VAP: subglottic suction, daily oral care, SDD, silver impregnated tubes, etc.
  - BSI: daily chlorhexidine baths, antibiotic impregnated lines, etc.
- Should be part of a comprehensive safety and quality program



## VAP/CRBSI prevention:

### Does it save lives?

- Population attributable fraction
  - Fraction of patients who would not have died if the infection had not occurred.
- Januel et al Inf Cont Hosp Epidemiol 2010;31:388
  - 14.6% of deaths for VAP/CLBSI/BSI
  - 6.1% VAP alone and 3.2% CLBSI alone
  - 10.1% VAP & other and 6.1% CLBSI & other
  - Only 1.7% of deaths due other BSI or CAUTI
- Bekaert et al AJRCCM 2011;184:1133
  - 5.9% (2.5-9.1%) VAP at 60 days

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## VAP prevention:

### Does it save lives?

- Muscedere, Day, Heyland CID 2010;51:S120
  - Excellent meta-analysis
  - 9 trials evaluating ICU mortality using a case control methodology, random effects model
  - Odds ratio (ICU mortality associate with VAP)
    - 1.94 (1.34 – 3.03)
  - Absolute attributable mortality
    - 13.5% (4% - 23%)

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## VAP prevention:

### Does it reduce LOS and vent days?

- Muscedere, Day, Heyland CID 2010;51:S120
  - Excellent meta-analysis of VAP
  - 14 case-control studies
  - Attributable prolongation of ICU stay
    - 8.7 (4.5 - 13.0) days
  - Attributable prolongation of hospital stay
    - 11.5 (9.9 - 13.0) days
  - Attributable prolongation of vent days
    - 7.6 (3.1 – 12.0) days

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## CRBSI prevention:

### Does it reduce costs?

- Vrijens et al J Hosp Inf 2010;75:158
  - Attributable prolongation of hospital stay
    - 9.9 (7.8 – 11.9) Days
  - Attributable cost
    - €4900 (€ 4035 - € 5750)

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HAI	# Preventable	# Lives saved
CLABSI	44,762 – 164,127	5,520 – 20,239
VAP	95,078 – 137,613	13,667 – 19,782
CAUTI	95,483 – 387,556	2,225 – 9,031
SSI	75,525 – 156,862	2,133 – 4,431
Total	310,849 – 782,152	23,545 – 53,482

Umscheid et al, Inf Cont Hosp Epidemiol 2011;32:101

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HAI	# Preventable Costs (x \$1B)
CLABSI	\$0.96 – 18.2
VAP	\$2.19 – 3.17
CAUTI	\$0.12 – 1.82
SSI	\$0.17 - 0.35
Total	\$3.4 – 23.5

Umscheid et al, Inf Cont Hosp Epidemiol 2011;32:101

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## VAP/CRBSI prevention: Should we do it?

- Does VAP/CRBSI prevention save lives?  
– YES
- Does VAP/CRBSI prevention reduce time in the ICU and in the Hospital?  
– YES
- Does VAP/CRBSI prevention reduce health care costs?  
– YES

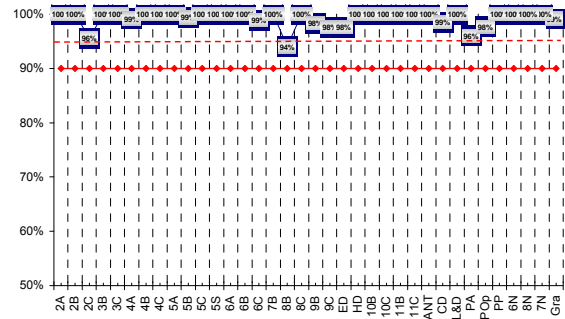
## VAP/CRBSI prevention: Should we do it?

If we can do it ...  
... we should do it.

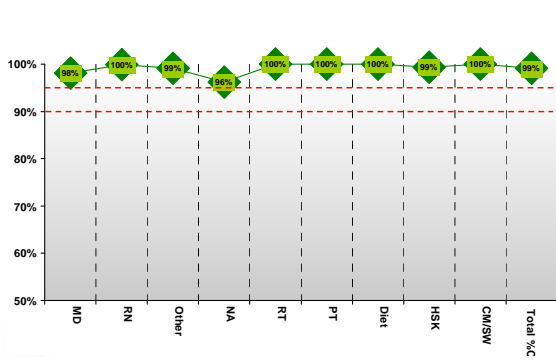
## Reducing HAI at MetroHealth

1. Hand Hygiene – late 2010 to present
2. Isolation Procedures – 2011 to present
3. Environmental Cleaning – 2010 to present
4. Sterilization PI – 2011 to present
5. High Level Disinfection PI - 2011 to present
6. Flash Sterilization PI – 2011 to present
7. Antibiotic Stewardship – 2012 to present
8. Evidence Based HAI protocols -3<sup>rd</sup> qtr 2012
9. Mandatory influenza vaccination 2012 to present
10. Culture of Safety – 2010 to present
  - BOT and CEO buy-in
  - System wide awareness and involvement
11. Clear Goals – 2013 and beyond

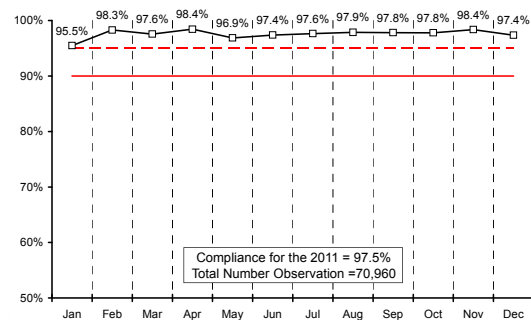
Hand Hygiene Compliance  
Rolling 8 weeks Data Report  
January 20, 2013 to March 6, 2013

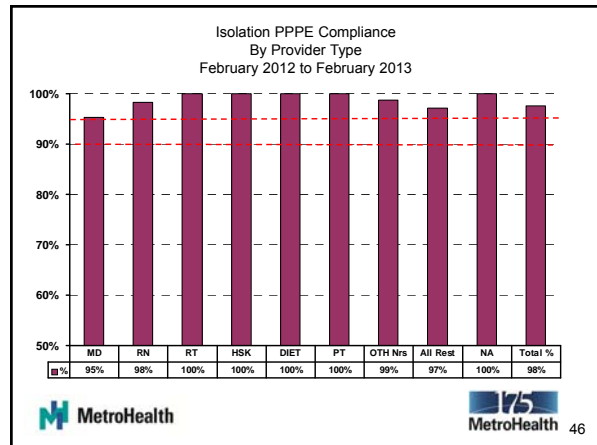
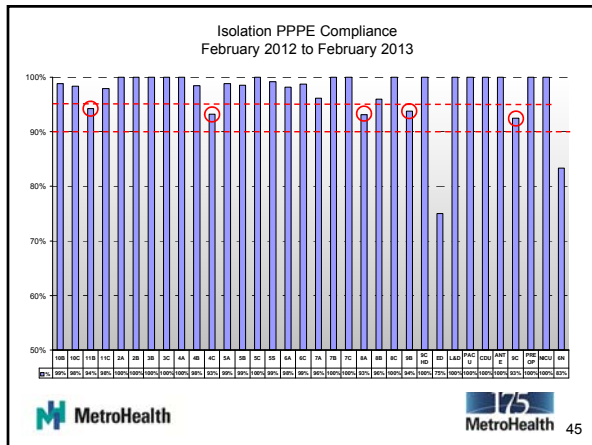
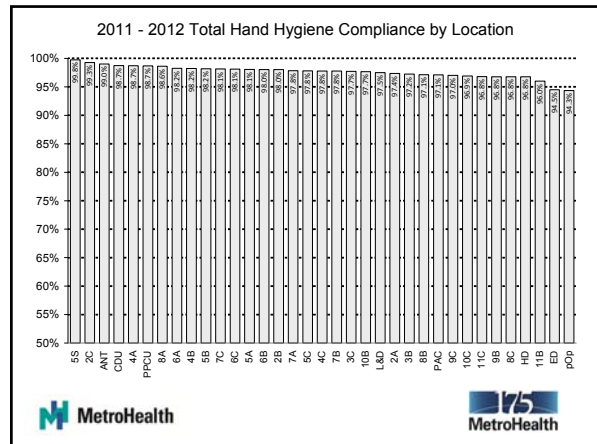
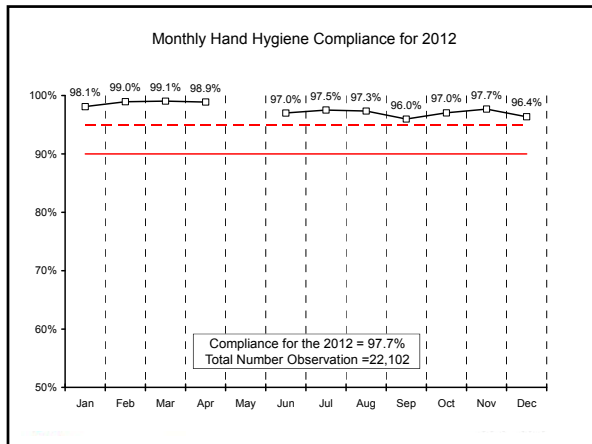


Hand Hygiene Compliance  
Rolling 8 weeks Data Report  
January 20, 2013 to March 6, 2013



Monthly Hand Hygiene Compliance for 2011



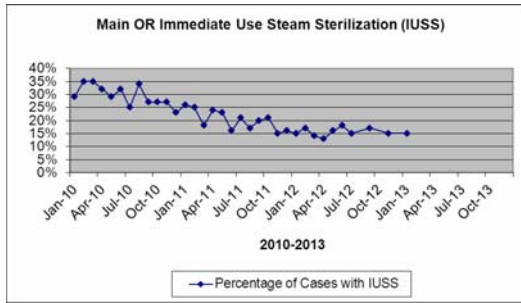


- ### Room Cleaning
- Upgraded discharge & daily room cleaning
    - Consistent processes and equipment
  - Improved OR and equipment cleaning
  - Improve monitoring of performance
    - Consistent monitoring, testing and inspection
    - Excellent teaming between IC and EVS
  - Enhanced cleaning of MDR rooms at D/C
    - Hydrogen peroxide vapor for MDR rooms
  - Improved patient safety
  - Improved perceptions of cleanliness

- ### Sterilization and High Level Disinfection
- Sterilization
    - Sterilization at 15 sites on and off campus
    - Developed standards, audit performed
    - 10 sites closed due to inadequate facilities, equipment or processes
    - 5 remain with >90% compliance with standards
  - High Level Disinfection
    - 13 of 15 sites meeting standards
    - 1 closed, 1 resolving issues with ventilation



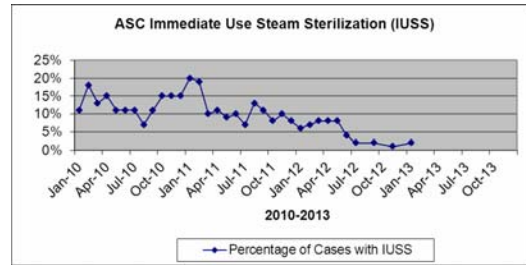
## Flash Sterilization



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## Flash Sterilization



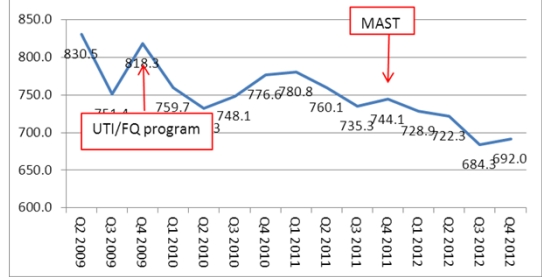
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## Antibiotic Stewardship Team (2012)

- Goals
  - Increase appropriate use of antibiotics
  - Use fewer antibiotics
  - Reduce days on multiple antibiotics
- Benefits
  - Fewer patients with MDRO
  - Reduce cost of isolation and Tx of MDRO
  - Reduce infections caused by MDRO
  - Reduce antibiotic costs



## All antibiotic DOT/1000 pt days



DOT = Days of Therapy

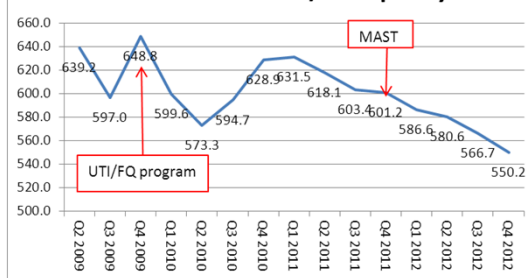
FQ = fluoroquinolone



2011 to 2012: saved \$325,000; ↓21%



## All IV antibiotic DOT/1000 pt days

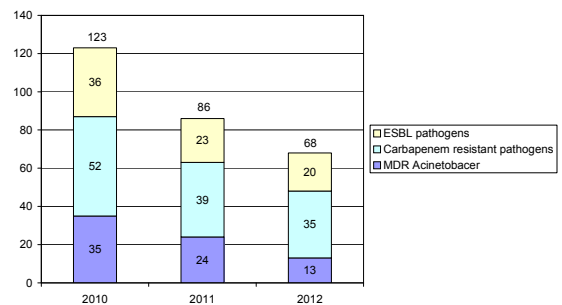


DOT = Days of Therapy

FQ = fluoroquinolone



## Hospital-Acquired, Serious Resistant Organisms, 2010 to 2012



45% reduction 2010 to 2012

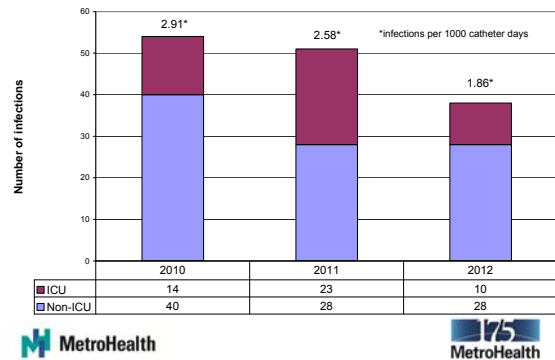


## HAI Prevention Processes (2012)

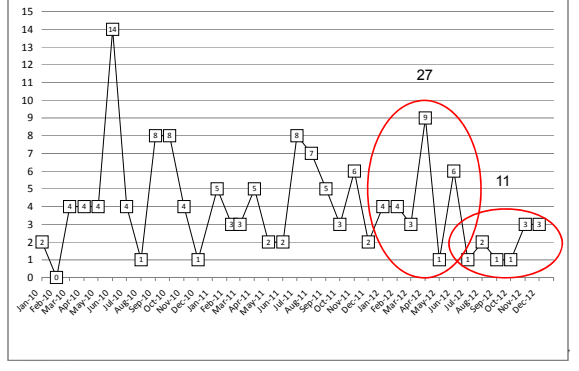
- Catheter-related bloodstream infections (CLBSI)
  - Central line insertion supply kit
  - Central line insertion check list
  - Consistent daily insertion site care
- Ventilator Associated Pneumonia (VAP)
  - VAP prevention bundle & order set
- Symptomatic catheter-associated urinary tract infections (CAUTI)
  - UTI prevention bundle



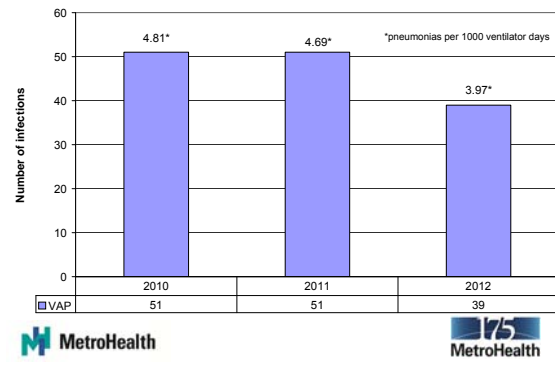
## Catheter Related Bloodstream Infections (CLBSI), 2010 to 2012



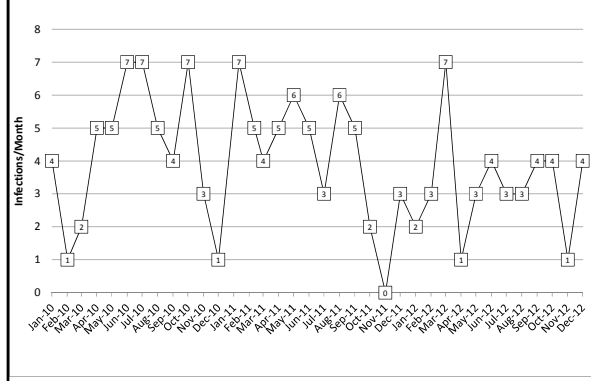
## Total Hospital Acquired Catheter Related Bloodstream Infections (ICU and non-ICU, 2010 to 2012)



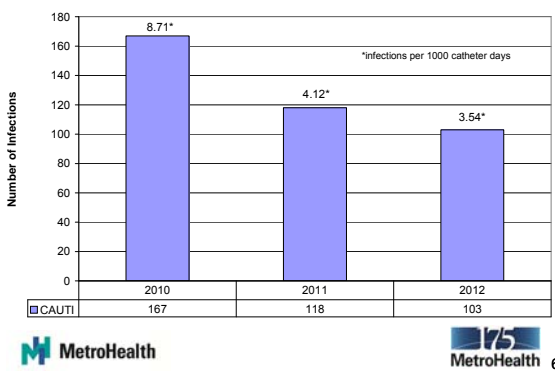
## Ventilator Associated Pneumonia (VAP) 2010 to 2012

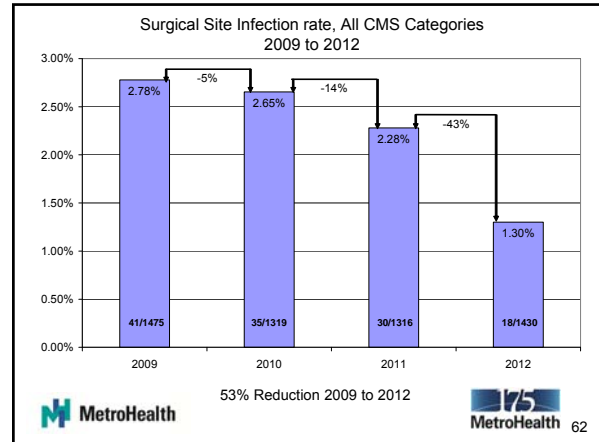
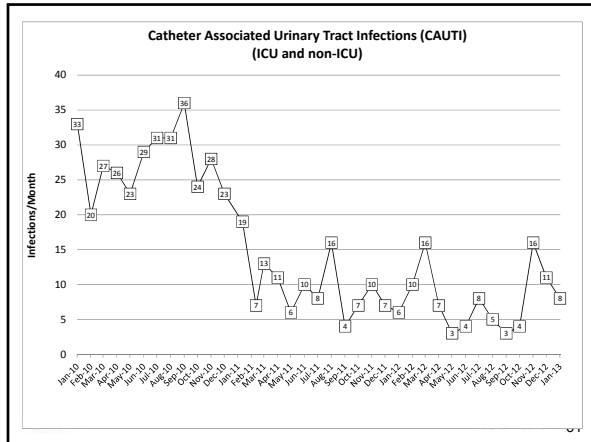


## Ventilator Associated Pneumonia 2011 to 2012





## Catheter Associated Urinary Tract Infection (CAUTI) 2010 to 2012







## Mandatory Influenza Vaccination

- Vaccinations
  - 6,185 employees + 863 volunteers/contractors
  - 7,048 vaccinated (99.5%)
- Exemptions given to 33 employees (0.5%)
  - Serious allergic reactions to vaccine
  - Serious acute reactions to vaccine
  - Guillian-Barre Syndrome
  - Deeply-held religious, ethical or moral beliefs
- Employees with exemptions wear masks during flu season

## Conclusions


- The ICU is a costly site of care with high risk of hospital acquired infections (HAI).
- 80 to 90% of the cost and harm to patients from HAI is related to VAP and CRBSI.
- 60 to 80% of VAP and CRBSI are preventable.
- Prevention of VAP/CLBSI will save **many lives and substantial resources**.
- All ICUs should implement high compliance VAP and CLBSI prevention programs ASAP.


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## Vision, Goals, and Objectives

- **Vision:**
  - The MetroHealth System will be in the top 5% of US hospitals for patient and employee safety.
- **Goals:**
  - MetroHealth will eliminate preventable harm for the most common categories of harmful events\* by 12/31/2015.
- **Objectives:**
  - Evidence based prevention programs for these harmful events\* will be implemented by 12/31/13.
  - Compliance with these programs will be consistently above 90% for all prevention programs by 12/31/14.
  - The number and rate of harmful events will be monitored to assure optimal reduction of harmful events\* to a rate consistent with the elimination of preventable harmful events by 12/31/15.



Approved BOT 2/26/2013



## Targeted Preventable Harmful Events\*

- Ventilator associated pneumonia
- Central line associated bloodstream infections
- Symptomatic catheter associated urinary tract infections
- Surgical site infections
- Patient falls with significant injury
- Hospital acquired pressure ulcers, stage 3 & 4
- Drug errors with significant harm
- Significant adverse events at childbirth
  - Reduce early elective deliveries
- Hospital acquired thrombotic and embolic events
- Employee days of work missed due to work-related injury

