#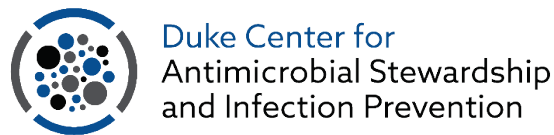 Use of Statistical Process Control Charts for Early Detection of Healthcare Facility-Associated Nontuberculous Mycobacterial Outbreaks

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Background

- Nontuberculous mycobacteria (NTM) are increasingly implicated in healthcare facility-associated (HCFA) infections and outbreaks.
- HCFA NTM infections cause substantial morbidity and mortality.
- Systematic methods for HCFA NTM cluster and outbreak detection do not exist, which leads to delayed outbreak recognition and mitigation.
- **OBJECTIVE:** Examine how statistical process control (SPC) methods perform in NTM outbreak detection.

Methods

- Academic transplant center
- SPC methods were applied to 3 prior hospital-associated NTM outbreaks:
  - Pulmonary *M. abscessus* complex (MABC) acquisition
  - Invasive MABC infection after cardiac surgery
  - Pseudo-outbreak of *M. avium* complex (MAC) at bronchoscopy suite
- SPC chart characteristics:
  - Chart type = Standardized moving average
  - Moving average span = 3 months
  - Baseline = 6-month window, 6-month lag
  - SPC detection = First data point above upper control limit
  - Control limits = 3 standard deviations from mean

Results

- SPC outbreak detection occurred 5, 4, and 9 months prior to traditional surveillance detection **(Figure)**.
- No false positive signals occurred during 95 cumulative months of post-outbreak surveillance, suggesting potential for low investigative burden.
- Prospective SPC surveillance using this chart type would have prevented an estimated 19 cases of pulmonary MABC, 9 cases of extrapulmonary MABC, and 80 cases of bronchoscopy suite MAC isolation **(Table)**.

Figure. SPC detection of two hospital-associated outbreaks of *M. abscessus* complex (MABC) (*Panel A*) and a bronchoscopy suite pseudo-outbreak of *M. avium* complex (MAC) (*Panel B*).
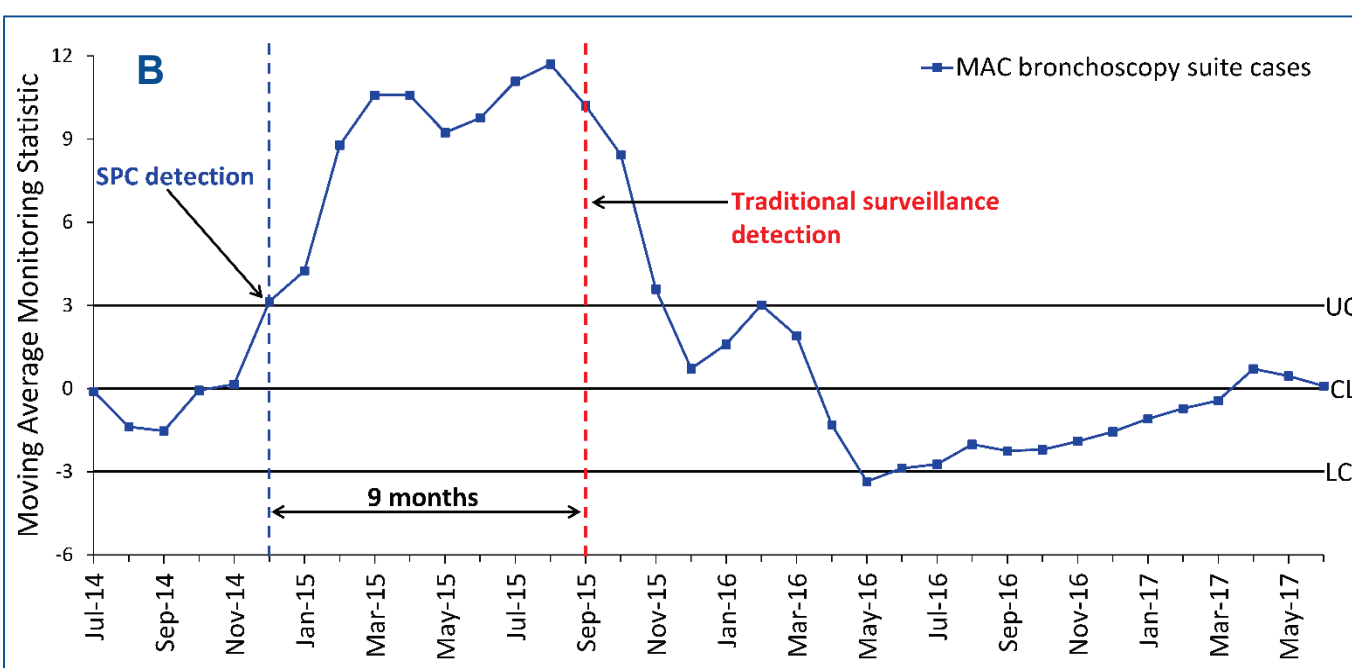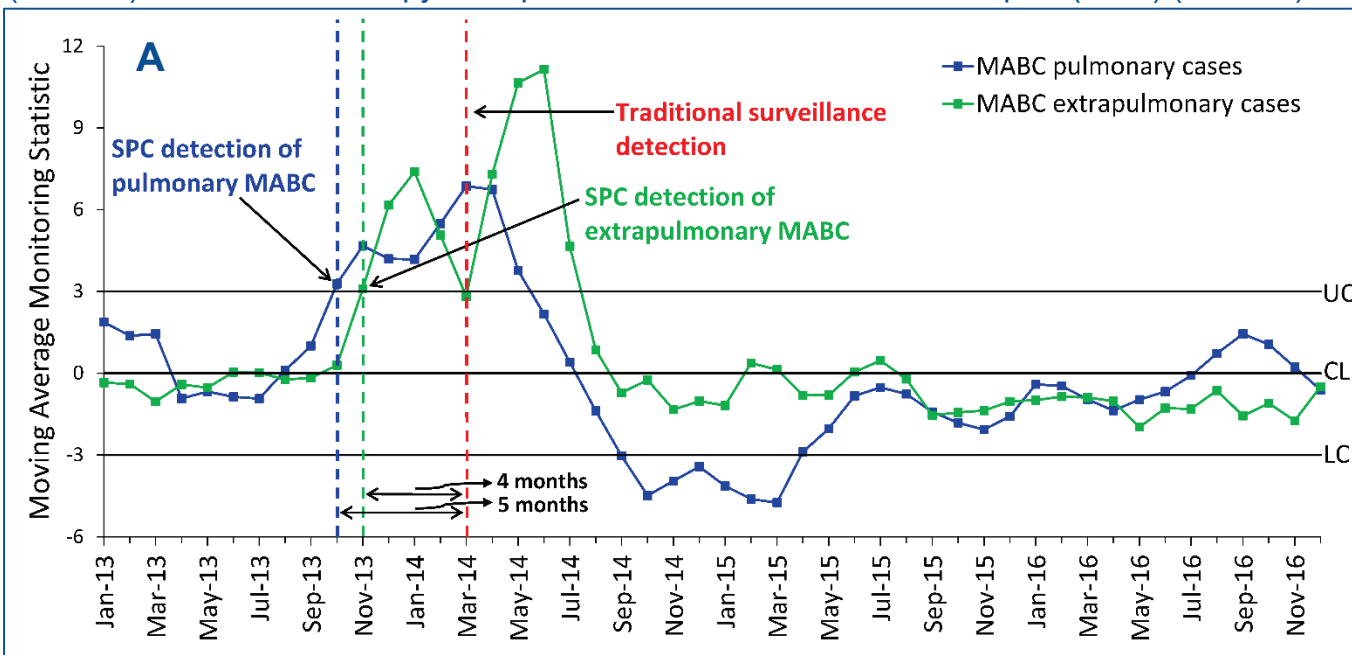

Table. Estimated cases of hospital-associated NTM that would have been prevented by prospective surveillance using a moving average statistical process control (SPC) chart.

Outbreak Characteristic	Pulmonary MABC (Outbreak #1)[a]	Cardiac Surgery MABC (Outbreak #2)[b]	Bronchoscopy Suite MAC (Outbreak #3)[c]
Case rate from time of SPC detection to time of traditional detection (A)	2.13	1.48	8.17
Case rate during 12-month post-outbreak time period (B)	0.48	0.54	1.79
Case rate difference (A-B)	1.66	0.94	6.38
Patient-days (outbreaks #1, #2) or bronchoscopies performed (outbreak #3) from time of SPC detection to time of traditional detection (C)	117,246	94,342	1,261
Estimated total cases prevented by SPC surveillance ([A-B]*C)	19.4	8.9	80.4

Case rates are given per 10,000 patient days (Outbreaks #1 and #2) or per 100 bronchoscopies performed (Outbreak #3).
Abbreviations: MABC, *Mycobacterium abscessus* complex; MAC, *Mycobacterium avium* complex (MAC).
[a]Outbreak #1 case definition: hospitalized patient with positive respiratory culture for MABC on day ≥3 of hospitalization.
[b]Outbreak #2 case definition: inpatient or outpatient with any positive non-respiratory culture for MABC.
[c]Outbreak #3 case definition: patient with positive bronchoalveolar lavage culture for MAC obtained at a bronchoscopy suite.

Conclusions

- A single moving average SPC chart detected all 3 hospital-associated NTM outbreaks an average of 6 months earlier than traditional surveillance.
- SPC has potential to improve NTM surveillance and prevent NTM infections:
  - Early cluster detection → early mitigation → prevention of NTM infections
- Next steps:
  - Optimize SPC methods to maximize speed and accuracy of HCFA NTM cluster detection.
  - Evaluate performance of optimized SPC methods when used for prospective HCFA NTM surveillance.