

Applying Medical Informatics to Medical Product Safety Monitoring

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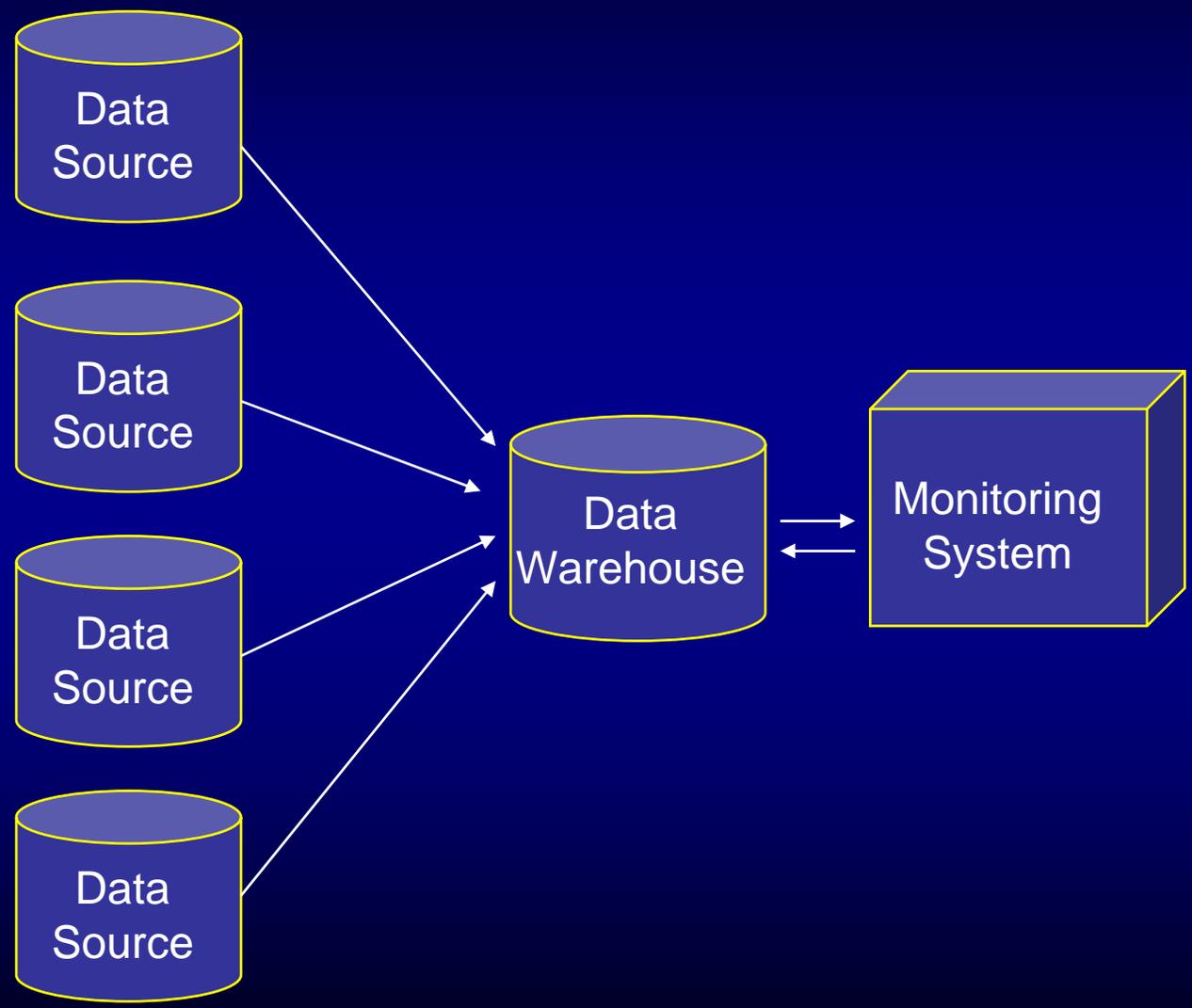


Informatics and Medical Product Safety Monitoring

- General design principles for an automated safety monitoring system
- Massachusetts cardiac quality dataset – example of mandatory clinical outcomes registry
- Pilot automated safety monitoring system

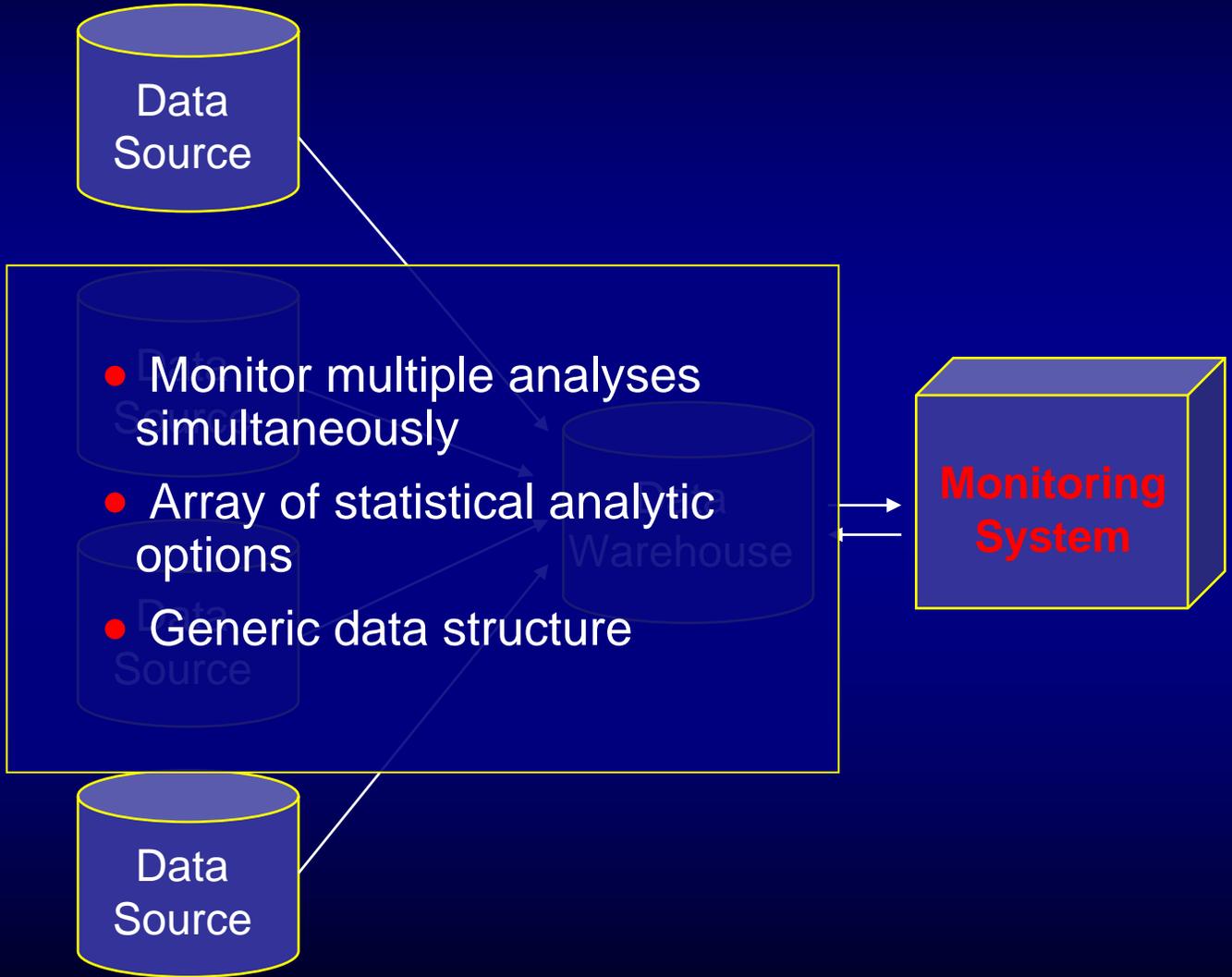


Idealized Safety Monitoring System



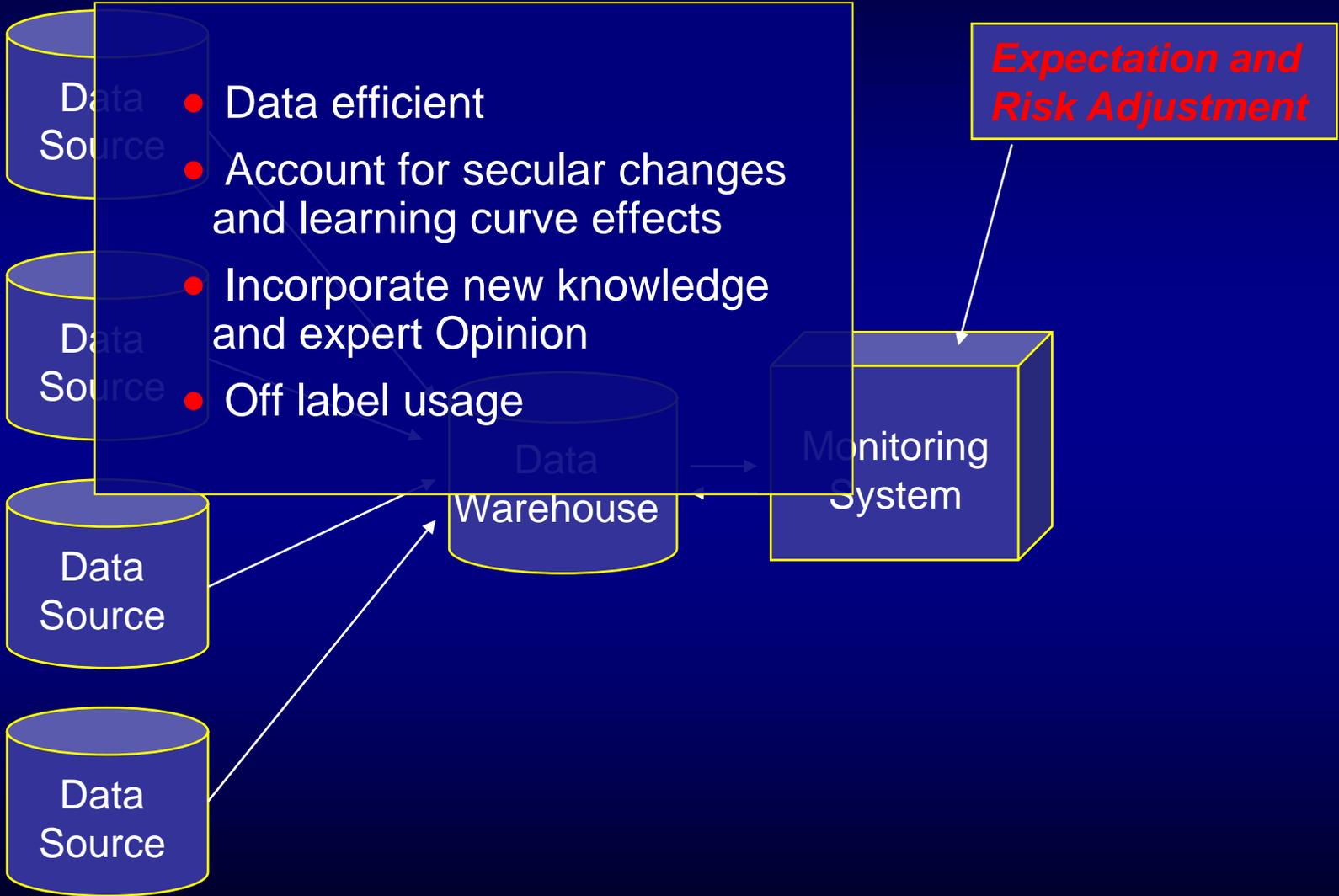


Idealized Safety Monitoring System



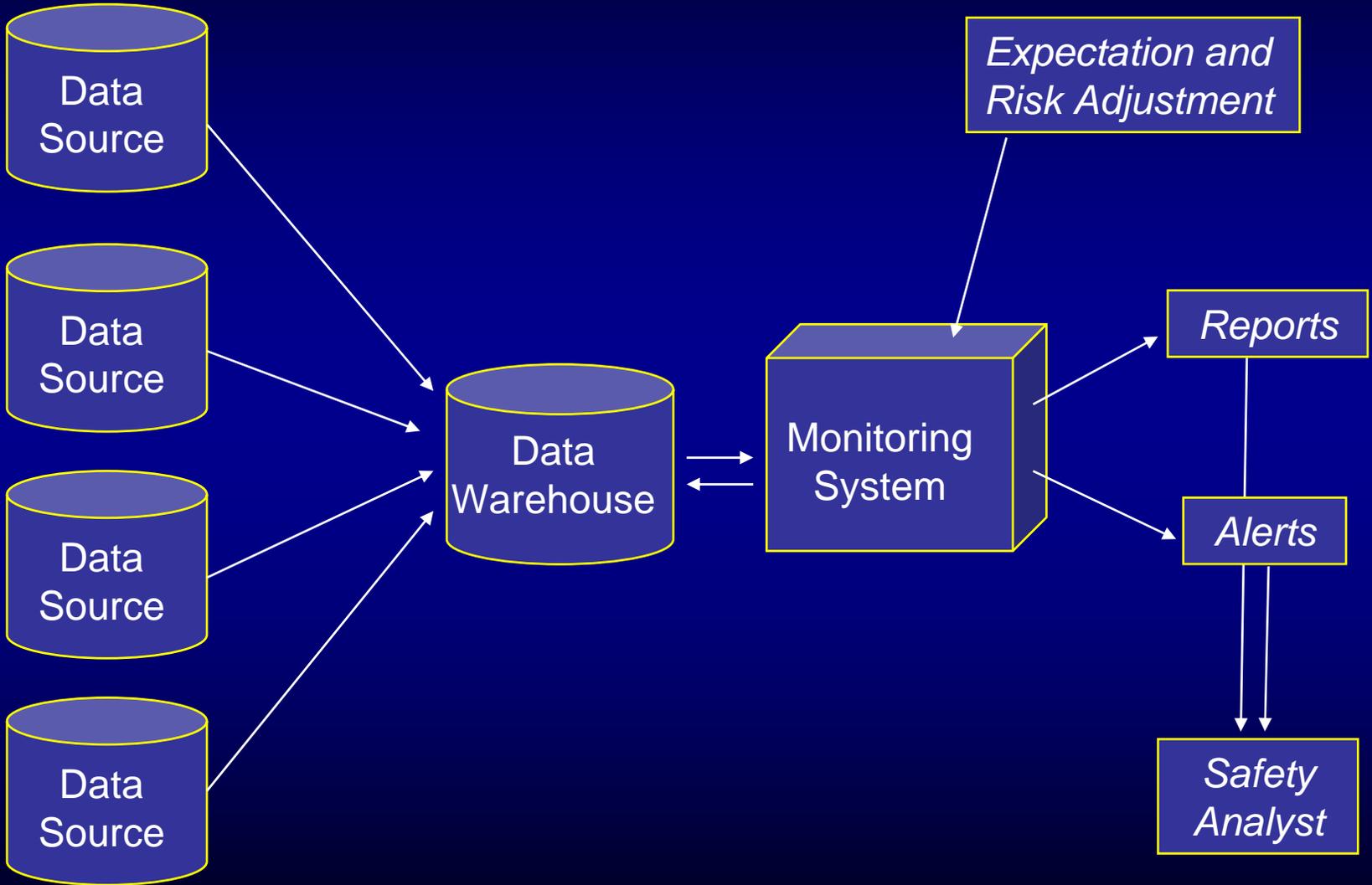


Idealized Safety Monitoring System



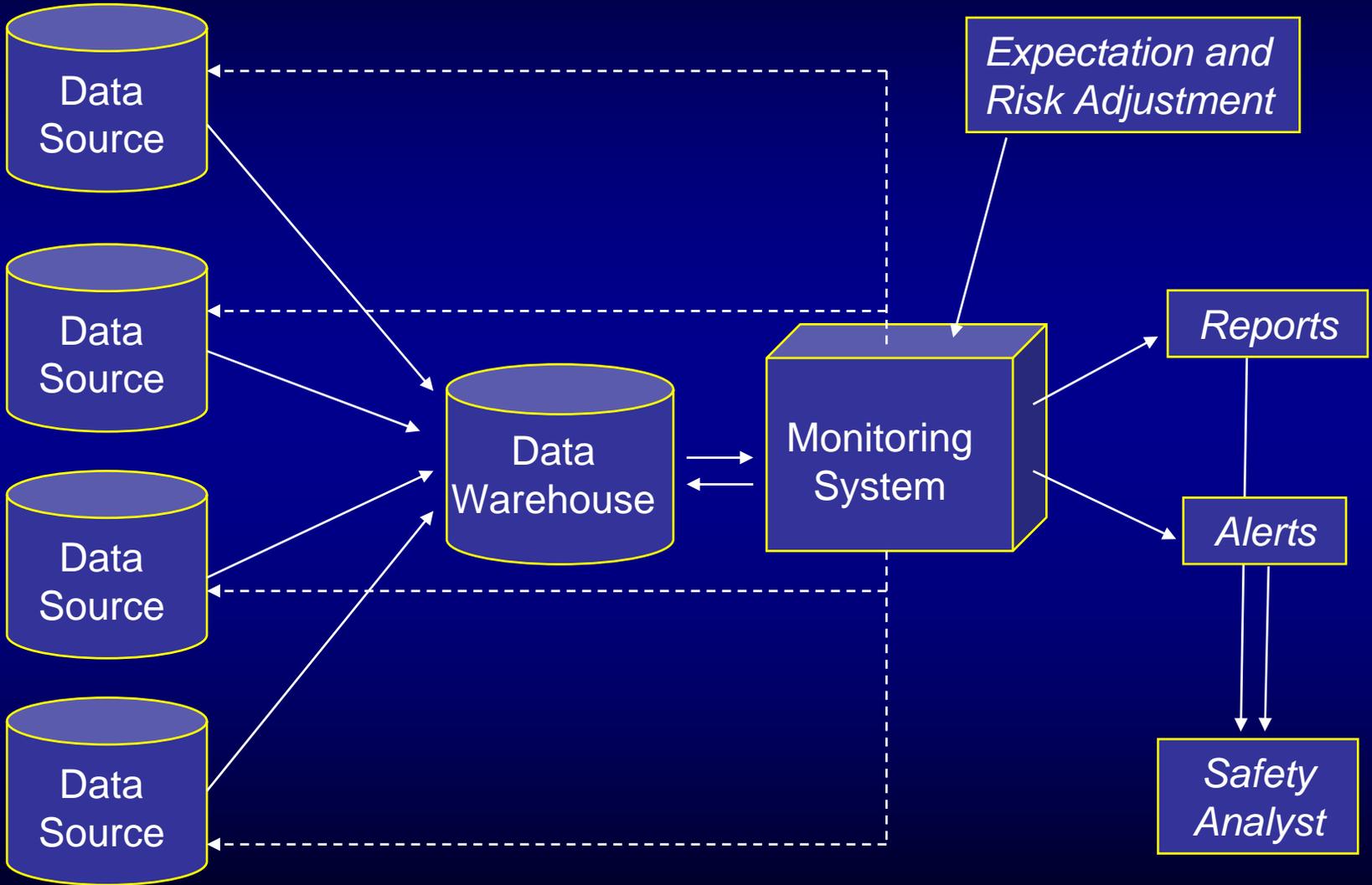


Idealized Safety Monitoring System



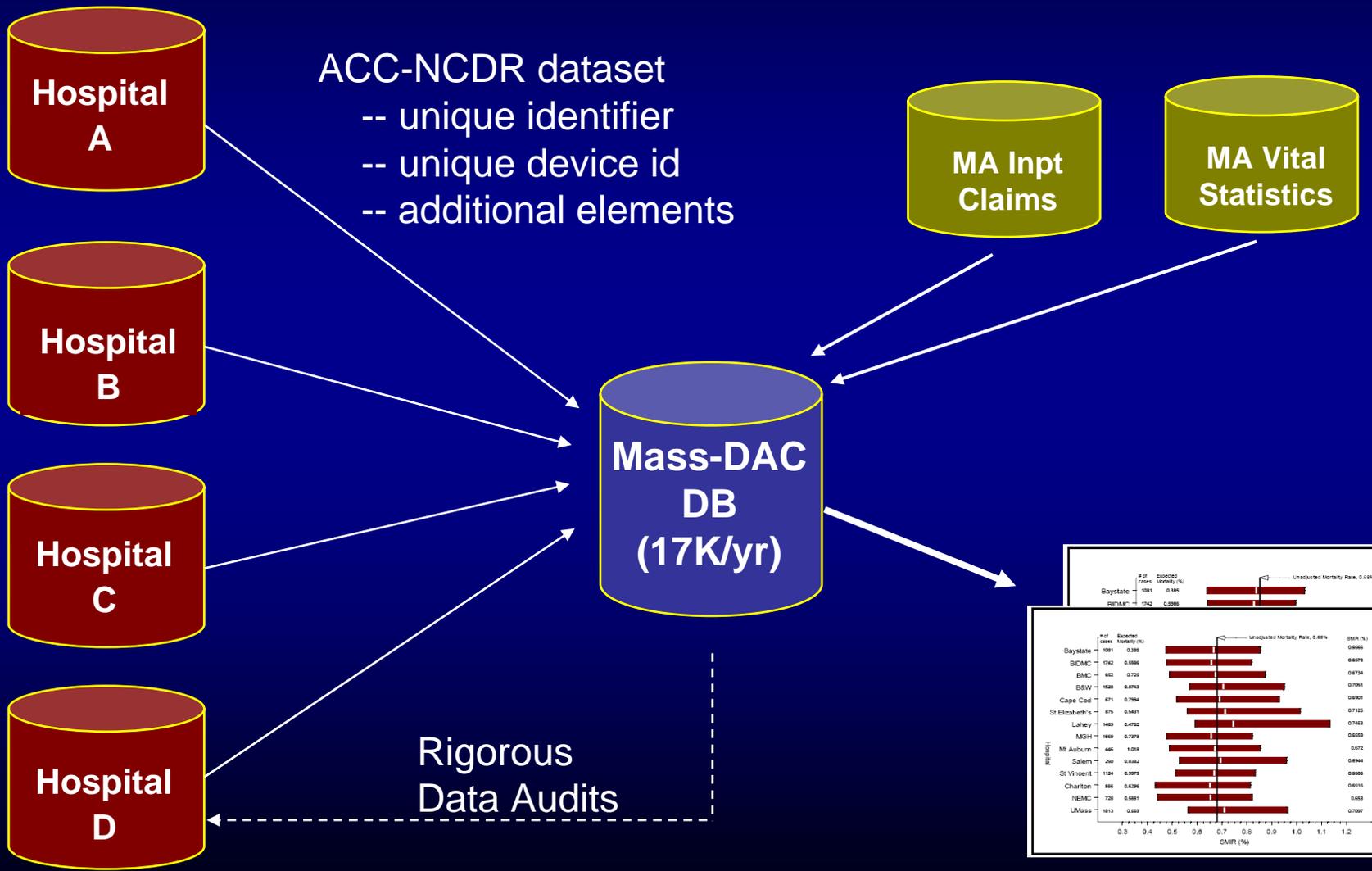


Idealized Safety Monitoring System





Mass-DAC Data Sources



Mass-DAC Registry Features

Strengths:

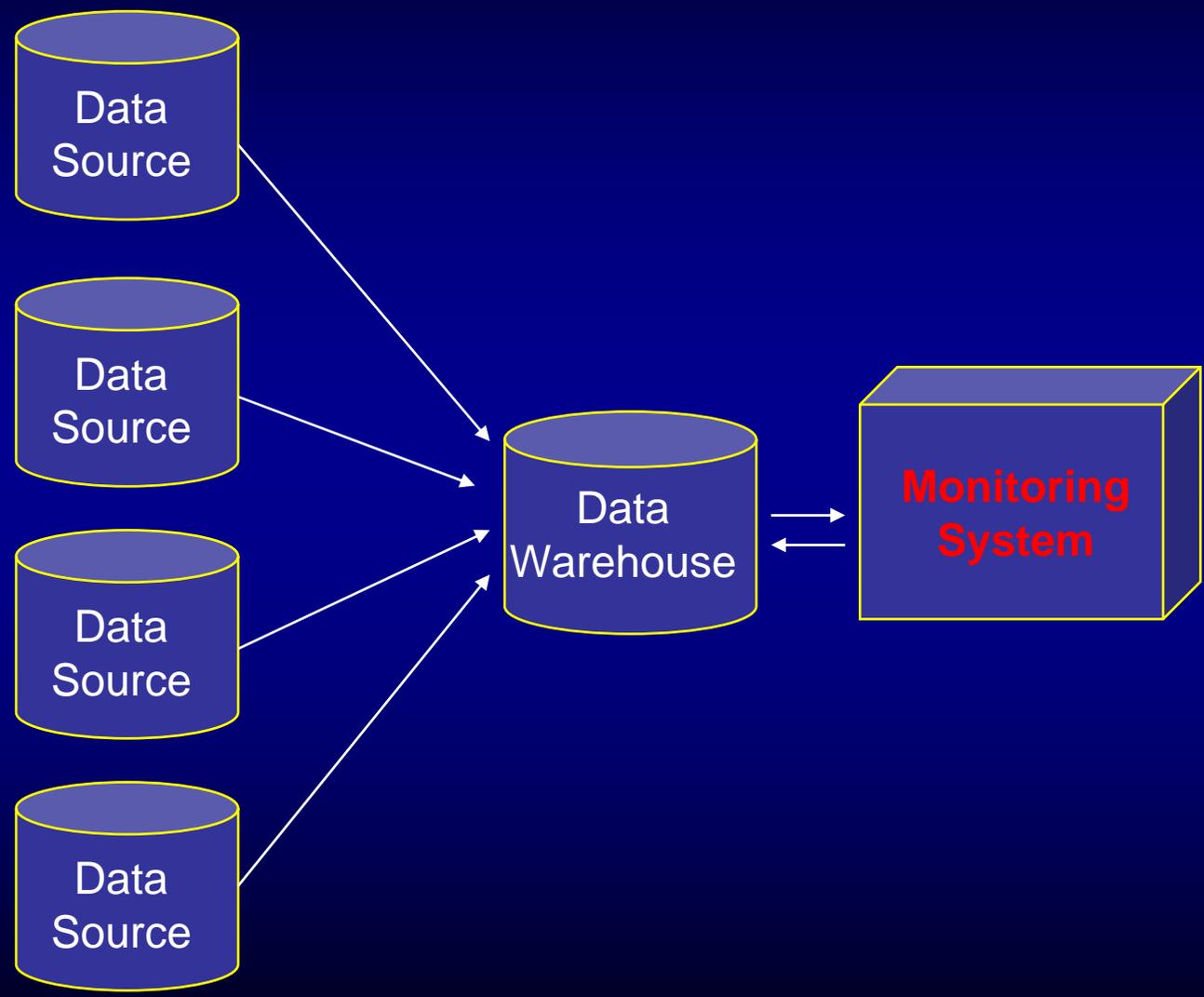
- All cases performed in state included – limits selection bias
- Granular and adjudicated dataset
- Rigorous statistical review

Limitations:

- Scope: Coronary intervention and CABG data only
- Dataset breadth: un-modeled covariates
- Temporal availability: 12-18 month analysis interval



Designing a Pilot Surveillance System



Pilot System Design Features

1. Generic data structure – outcomes vs. expectations for devices, drugs, quality of service
2. Support arbitrary number of simultaneous prospective analyses
3. Flexible expectation development and inference methods: classical and Bayesian
4. Real-time analysis and notification of outlier results – Flexible Alerting system
5. Web-based, multi-user, multi-centric implementation

DELTA: *D*ata *E*xtraction and *L*ongitudinal *T*ime *A*nalysis
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DELTA – Analytic Modules

Expectation

Uniform

Stratified

Risk Adjusted

Classical

Statistical Process Control (SPC)

Stratified SPC

Logistic Risk Adjustment (LR)

CUSUM

SPRT

Inference

Bayesian

Bayesian Updating System (BUS)

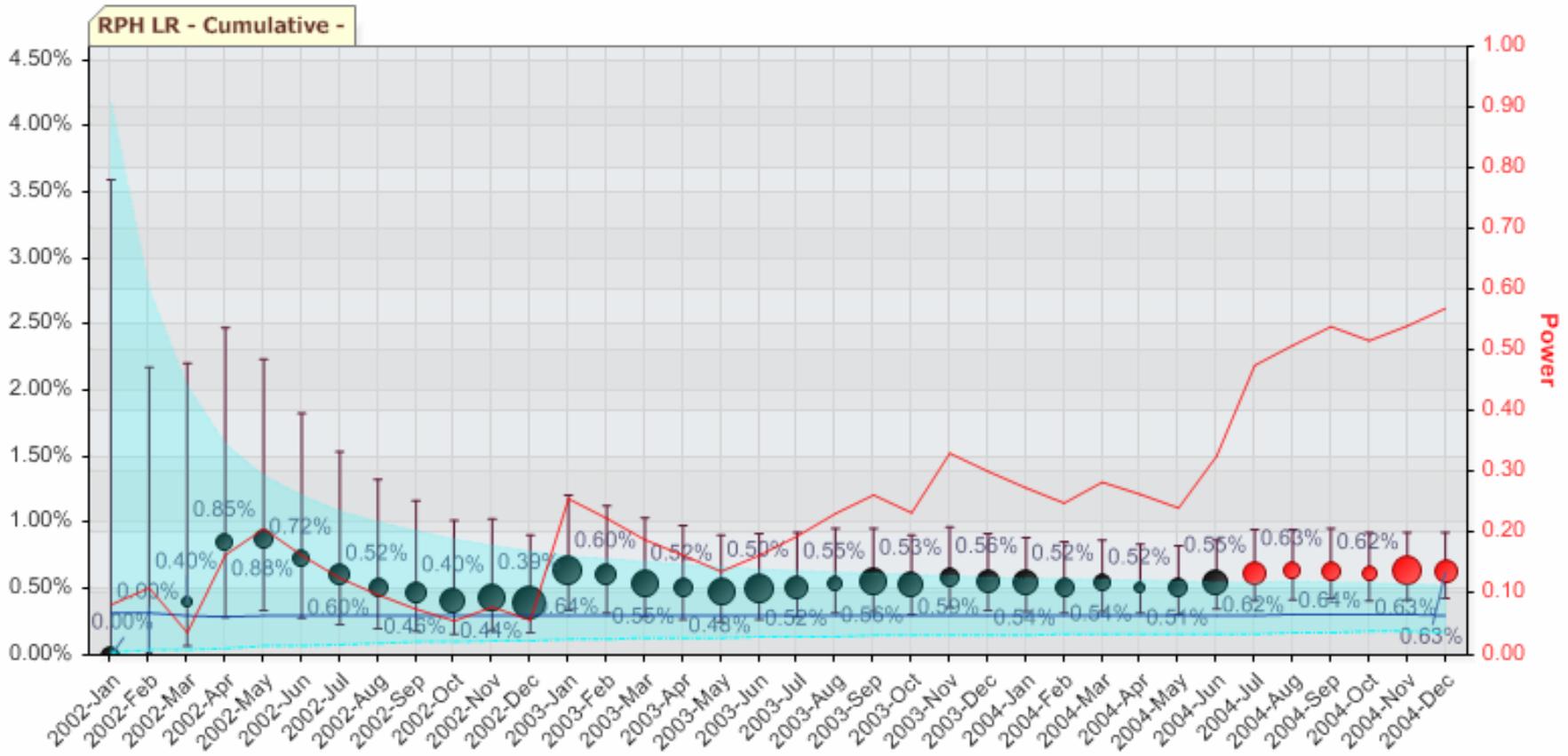
Stratified BUS

Multivariate Bayesian Updating (MBU)

		Expectation		
		Uniform	Stratified	Risk Adjusted
Inference	Classical	Statistical Process Control (SPC)	Stratified SPC CUSUM	Logistic Risk Adjustment (LR) SPRT
	Bayesian	Bayesian Updating System (BUS)	Stratified BUS	Multivariate Bayesian Updating (MBU)

DELTA – Monitoring Example

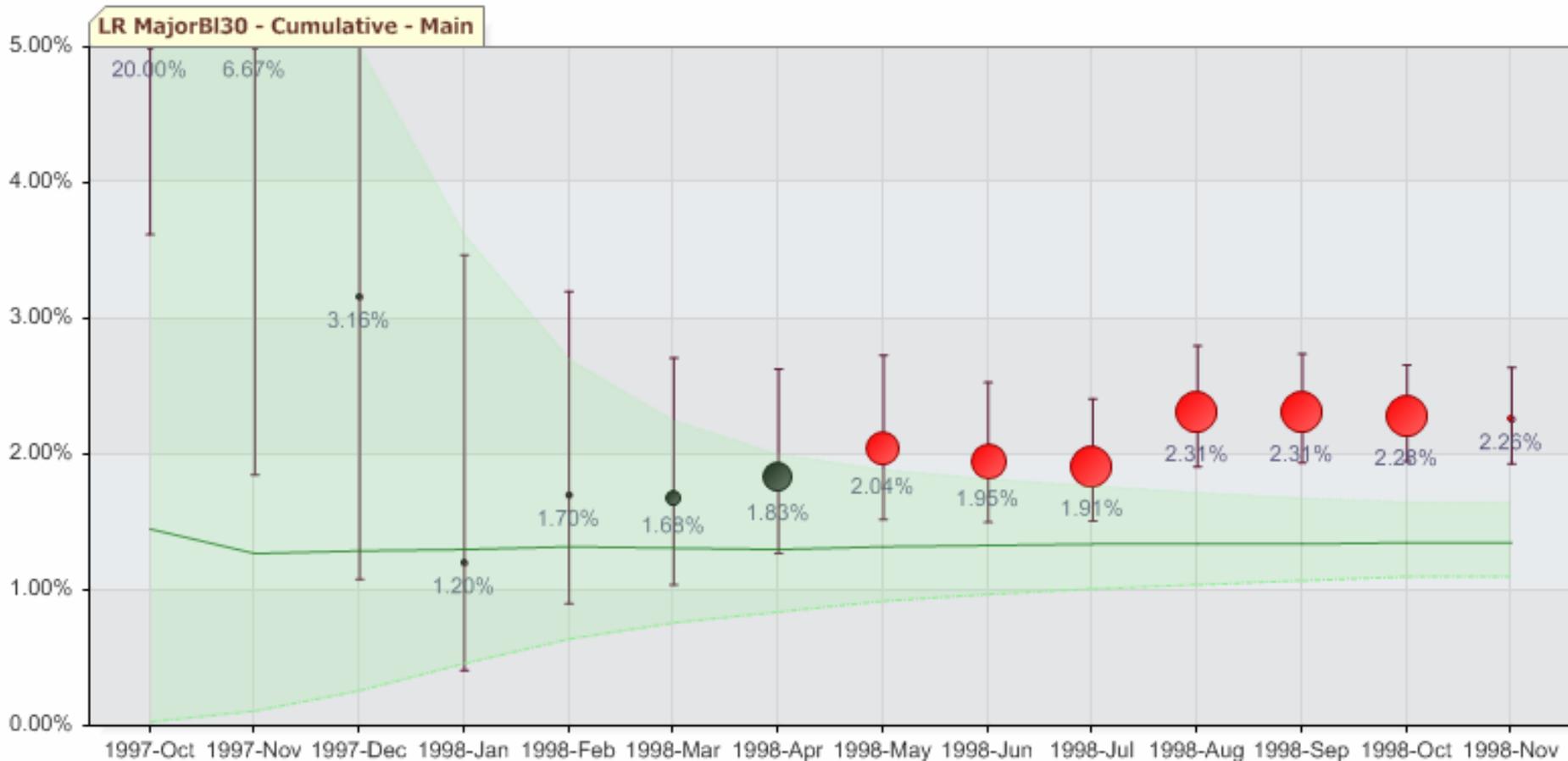
Cumulative risk of retroperitoneal hemorrhage following use of vascular closure device. Statistical power shown.



Source: BWH DELTA program preliminary data

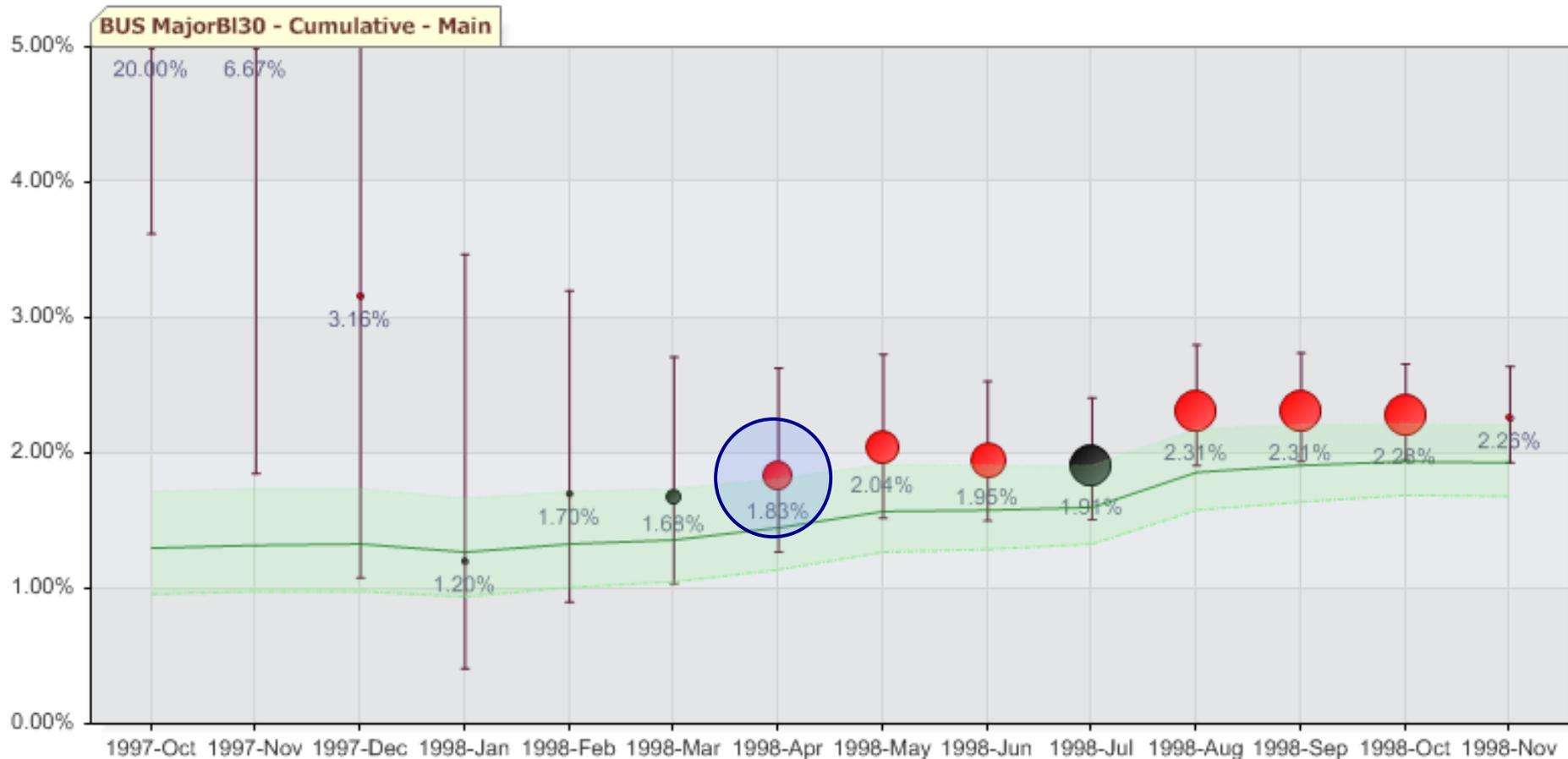
Validation in Clinical Trials Monitoring

Risk of major bleeding following exposure to novel oral anticoagulant. Alerts fire after month 7 of study....

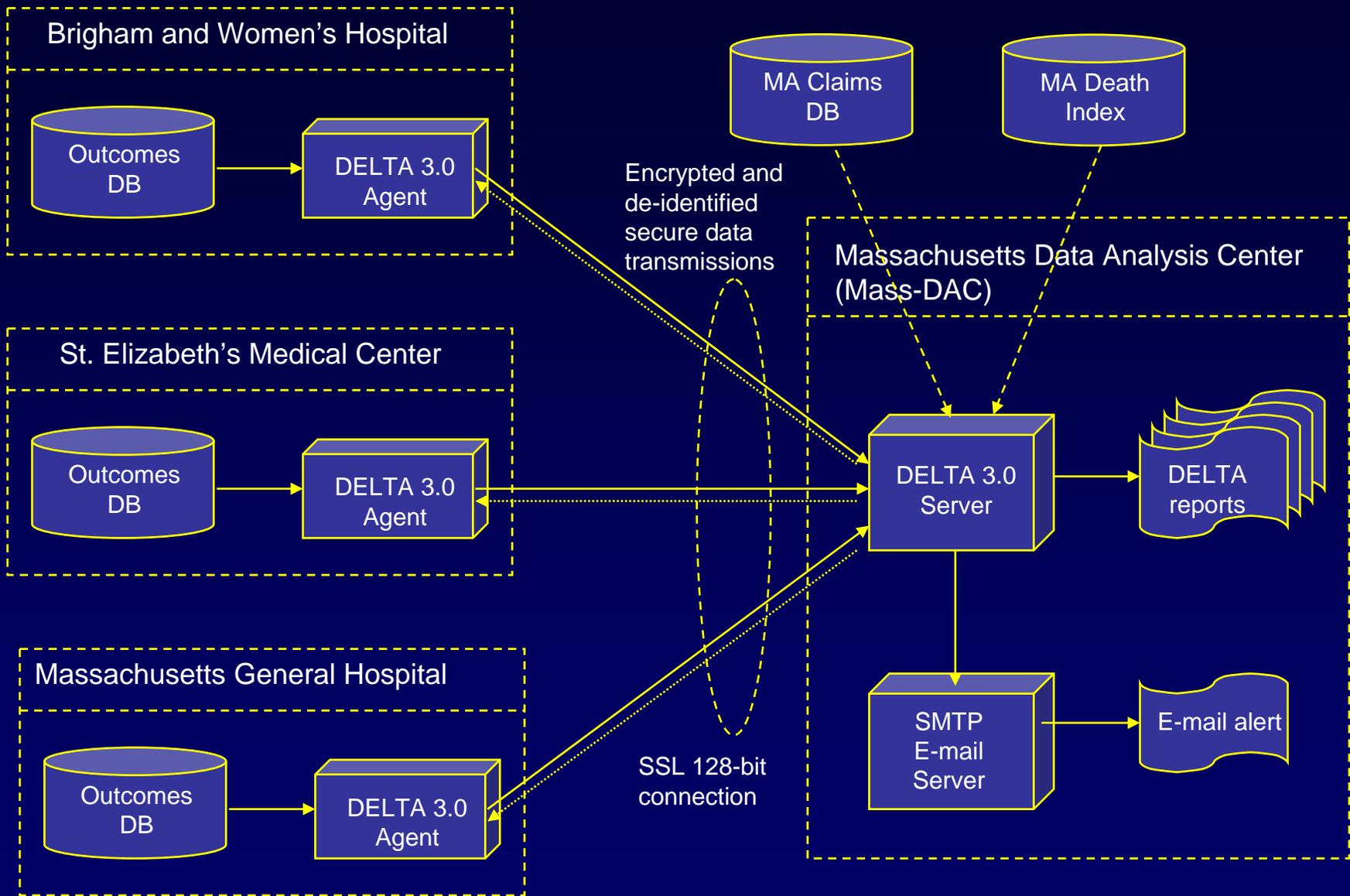


Validation in Clinical Trials Monitoring

Bayesian Updated Analysis of risk of major bleeding in clinical trial of novel anticoagulant. Alerts fire after month 6 of study.



DELTA 3.0 Network – NIH Application





Summary

- Detection of low frequency medical product safety signals challenges traditional approaches
- Idealized safety monitoring system supports generic data structure, prospective monitoring and dynamic feedback
- Mass-DAC represents a high quality prospective mandatory registry of “real world” cardiac patients
- Ongoing evaluation of automated safety surveillance using DELTA system and Mass-DAC network.



Thank You

DELTA co-investigators:

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Lucila Ohno-Machado, MD PhD

Coping Systems, Inc.