Characterizing Cyclical Software Error Patterns in the National Health and Nutrition Examination Survey

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Introduction
Methods for Data Analysis
Findings
Conclusions
Recommendations/Next Steps
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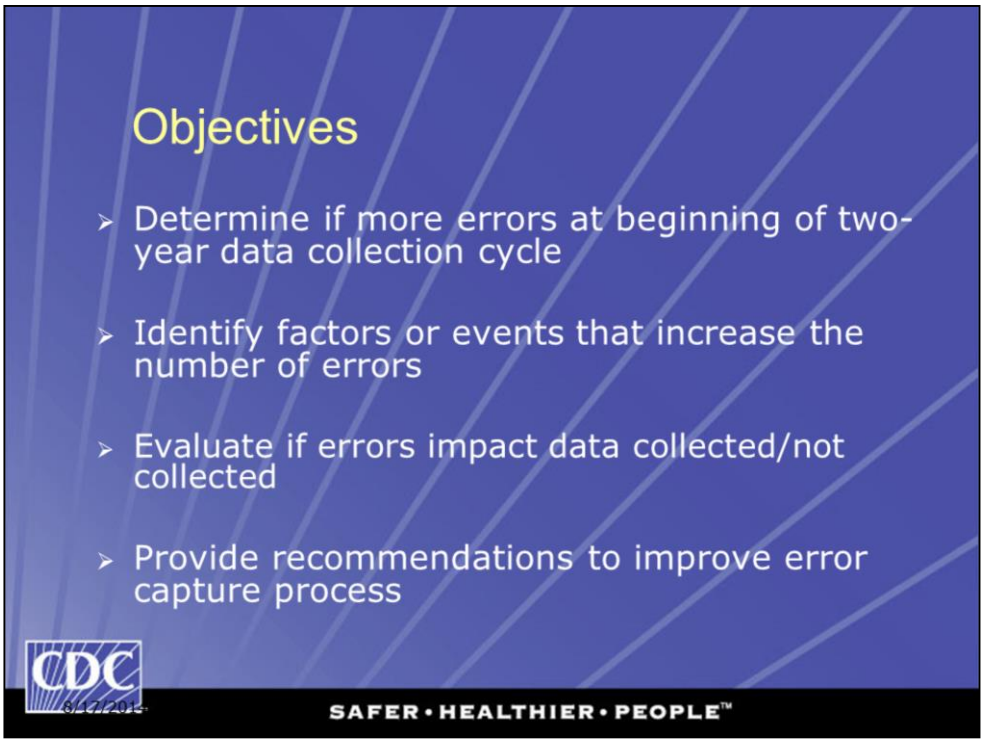
Objectives
Determine if more errors at beginning of two-year data collection cycle
Identify factors or events that increase the number of errors
Evaluate if errors impact data collected/not collected
Provide recommendations to improve error capture process
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National Health and Nutrition Examination Survey (NHANES)

- Cross-sectional study of the US non-institutionalized population
- 30 locations and 10,000 respondents / two-year cycle

- Data collection software applications
  - CAPI and ACASI questionnaires
  - Biomedical measures

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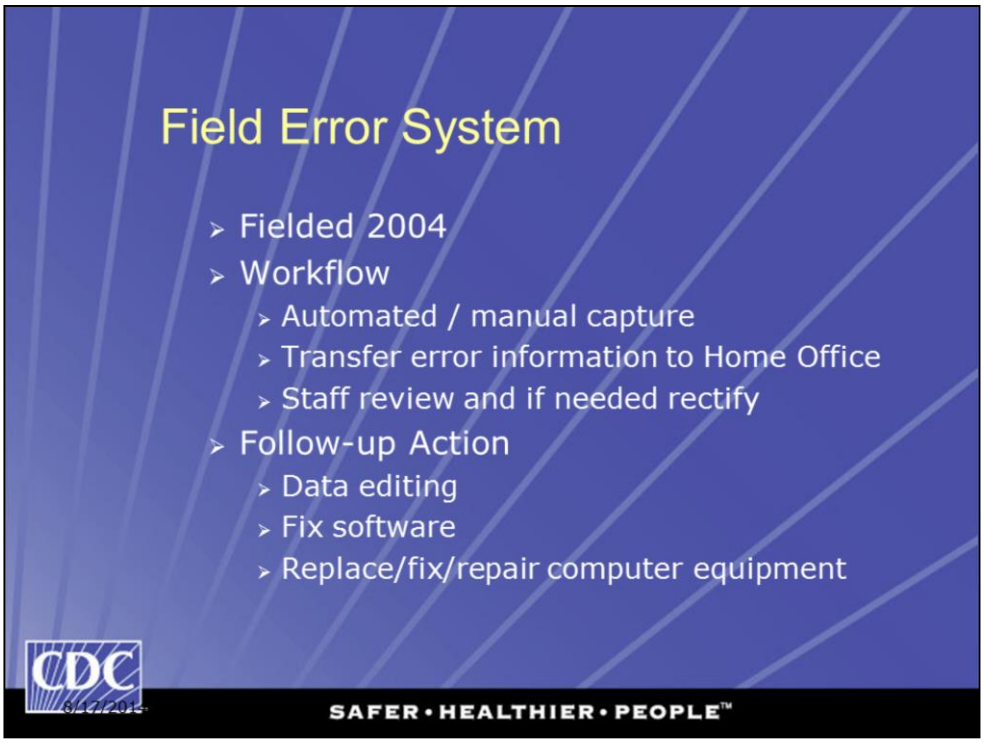
Field Error System
Fielded 2004
Workflow
Automated / manual capture
Transfer error information to Home Office
Staff review and if needed rectify
Follow-up Action
Data editing
Fix software
Replace/fix/repair computer equipment
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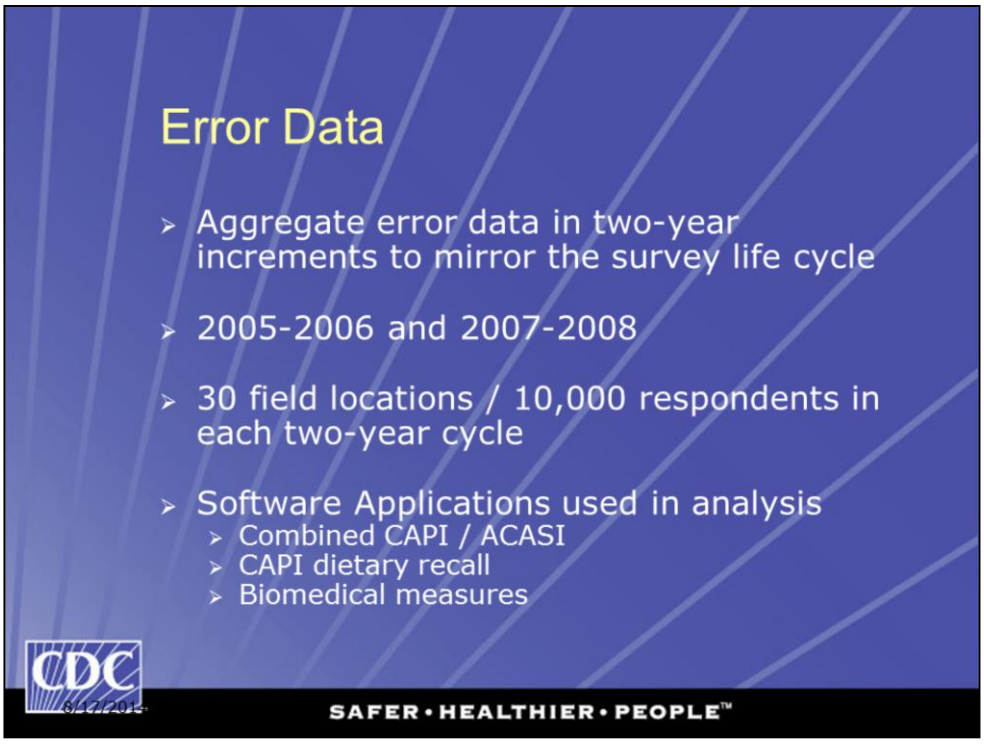
NHANES IT Field Error Types

Error Type	Example
Computer Equipment	○Touch screen ACASI monitor not working. ○The DataMax printer gives a "24V - OUT OF TOLERANCE" error.
Software	○Run Time Error message displayed when application initially executed. ○Received a “disk or network error” message and was not able to continue with the scans.


Error Data
Aggregate error data in two-year increments to mirror the survey life cycle
2005-2006 and 2007-2008
30 field locations / 10,000 respondents in each two-year cycle
Software Applications used in analysis
Combined CAPI / ACASI
CAPI dietary recall
Biomedical measures
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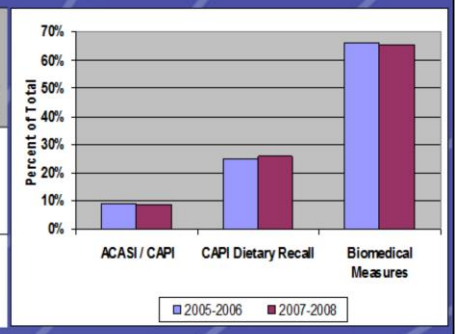
Example of Error Data

Field Location	Error Type	Error Status	Exam/Interview Type	Error description	UFO_action
3	Software	Action Taken	MEC Interview	Win sock error messages occurred during interview.	Interview complete
3	Computer Equip	Action Taken	MEC Interview	Touchscreens in both MI rooms lose calibration everytime PC reboots	Per Adrian's sugge
3	Computer Equip	Action Taken	MEC Interview	Continuous problems with touch screen.	Finished ACASI in M
3	Software	Action Taken	MEC Interview	Time in current residence still does not display date.	Issue still not resol
3	Software	Action Taken	Body Measures	SP refused PAM, the No was clicked when asked if this SP was given a PAM	Check to make sur
3	Computer Equip	Action Taken	Dietary Interview	Power failure to trailer caused winsock error. PC stayed on but errors cause	SP was guest so di
3	Software	Reviewed	Opthamology		
3	Software	Reviewed	Opthamology	Unable to forward computer after 4 images captured. Pupil size forgotten initi	notified data manag
3	Software	Action Taken	Body Measures		
3	Computer Equip	Action Taken	MEC Interview	Touch Screen did not work.	Used mouse. CL-T
3	Software	Reviewed	Physical Exam		
3	Software	Action Taken	MEC Interview	While conducting interview in Spanish, I didnot change pop-up window but er	The interview is co
3	Software	Action Taken	Cardiovascular Fitness	originally sp said 1000 last bite time i asked am or pm she said am then while	dm notified and me
3	Software	Action Taken	Body Measures		
3	Software	Reviewed	Audiometry		
3	Software	Action Taken	MEC Interview	Interviewer tried to open Critical Data and got an error that CIDI could not run	Since I had witness
3	Software	Reviewed	Audiometry	Could not capture QC data from audiometer	entered numbers m
3	Software	Reviewed	Audiometry		
3	Software	Reviewed	Audiometry		
3	Software	Action Taken	Audiometry	could not capture audiometer data.	recorded data on p
3	Software	Reviewed	MEC Interview		
3	Software	Reviewed	Opthamology	DVD burned correctly but 4 labels were printed.	
3	Software	Reviewed	Physical Exam		
3	Software	Reviewed	Physical Exam		
3	Software	Reviewed	Physical Exam		
3	Computer Equip	Reviewed	Opthamology	I had film error message on the retinal camera and error reading open conne	Turned camera off,
3	Software	Reviewed	Cardiovascular Fitness	Was told to do CV fitness in stand alone mode. Unable to do exam, although	notified data manag

Scale of Software Application Usage 2005-2006, 2007-2008

2 Year Cycle	# Respondents	Software Applications			Total Software Application Executions
		ACASI / CAPI	CAPI Dietary Recall	Biomedical Measures (9)	
2005-2006	10,152	7,313	19,725	54,292	81,330
2007-2008	9,847	6,827	19,284	58,247	84,358



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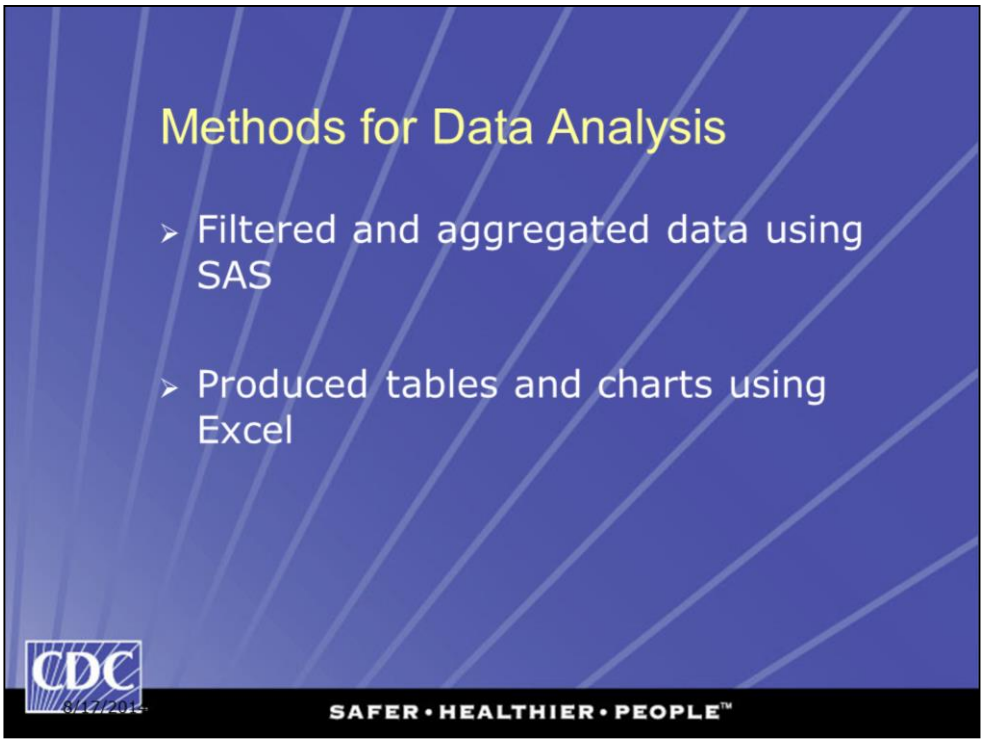
Applications and # of times executed --

Biomedical Measures – 6 / Respondent

Main Differ:

05-06: CV Exam ended

07-08: Respiratory Health started


Methods for Data Analysis
Filtered and aggregated data using SAS
Produced tables and charts using Excel
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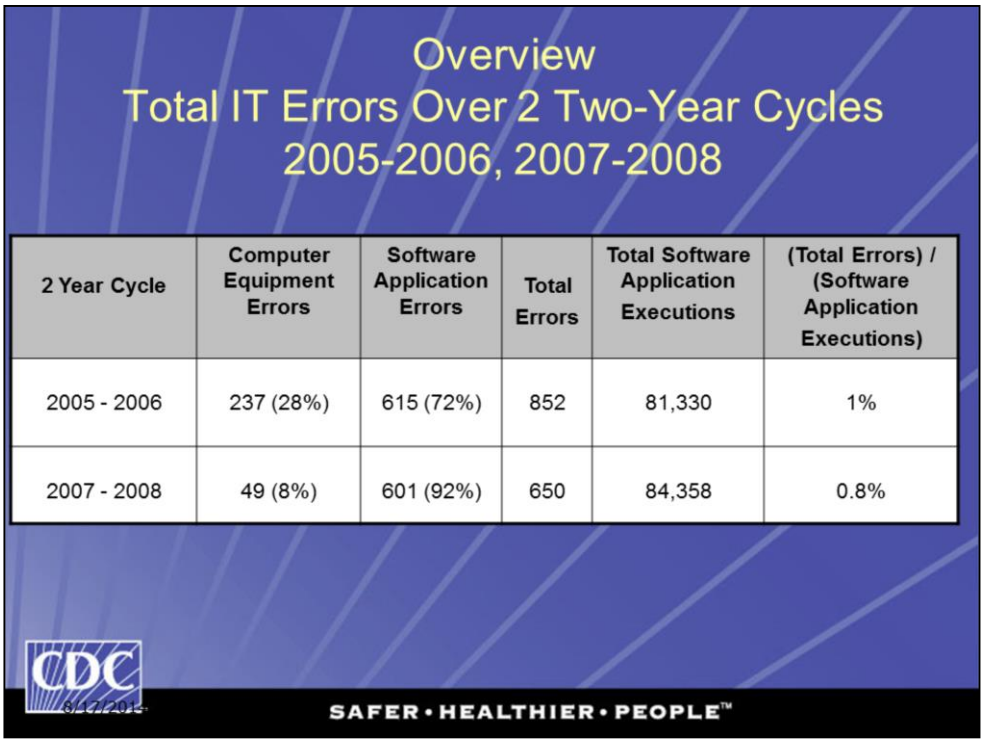
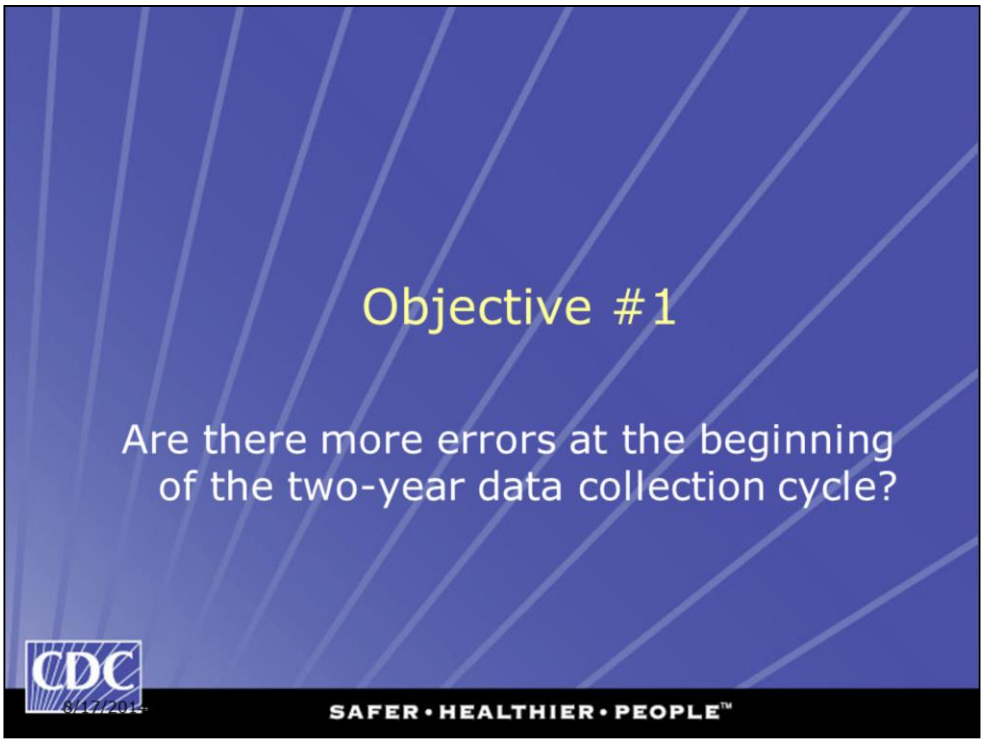


2 Year Cycle	Computer Equipment Errors	Software Application Errors	Total Errors	Total Software Application Executions	(Total Errors) / (Software Application Executions)
2005 - 2006	237 (28%)	615 (72%)	852	81,330	1%
2007 - 2008	49 (8%)	601 (92%)	650	84,358	0.8%

Overview before show detail


Objective #1
Are there more errors at the beginning of the two-year data collection cycle?
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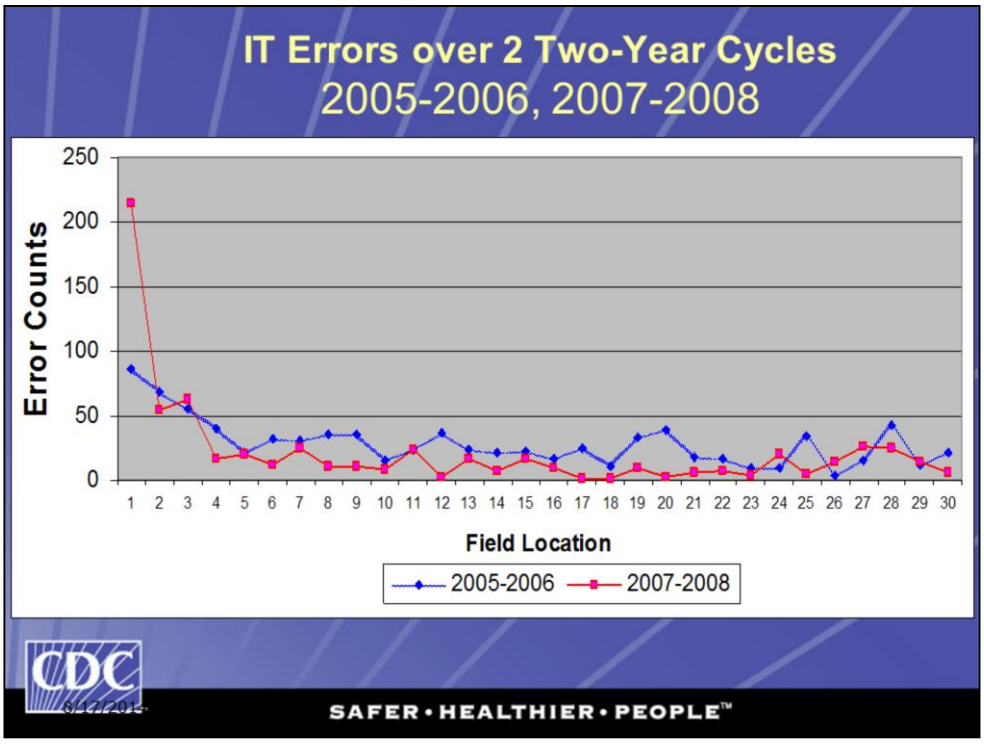
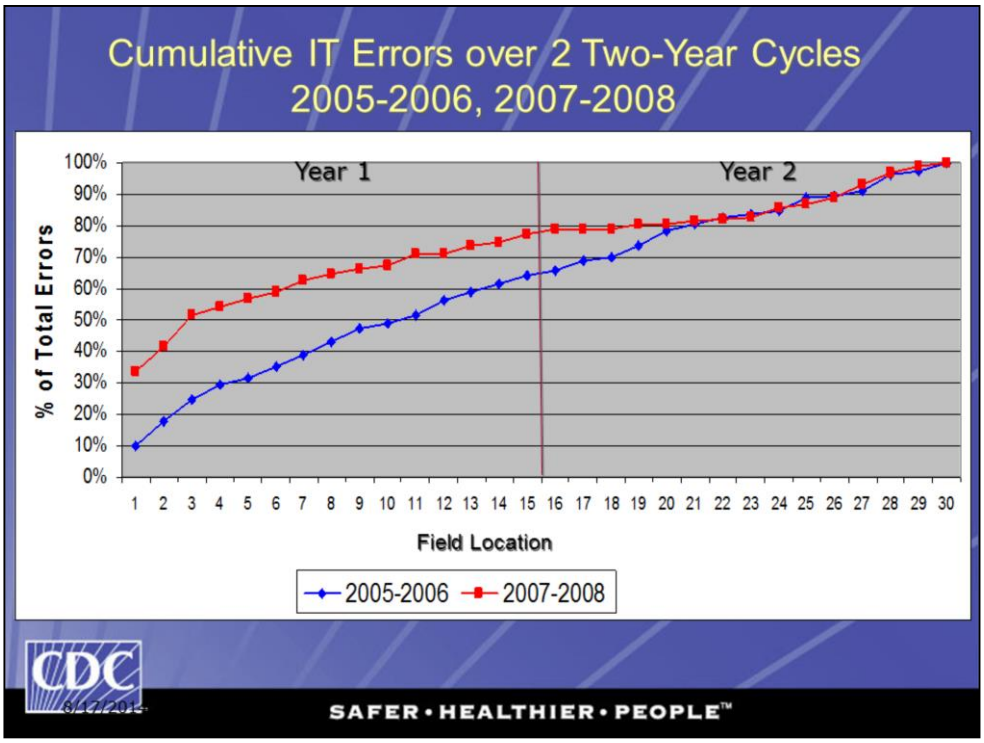


Yes, there are a high # of errors in first 3 Field Locations – then levels out



Many errors the first 3 Stands – then levels out

Cycle 1 – more of a Steady increase

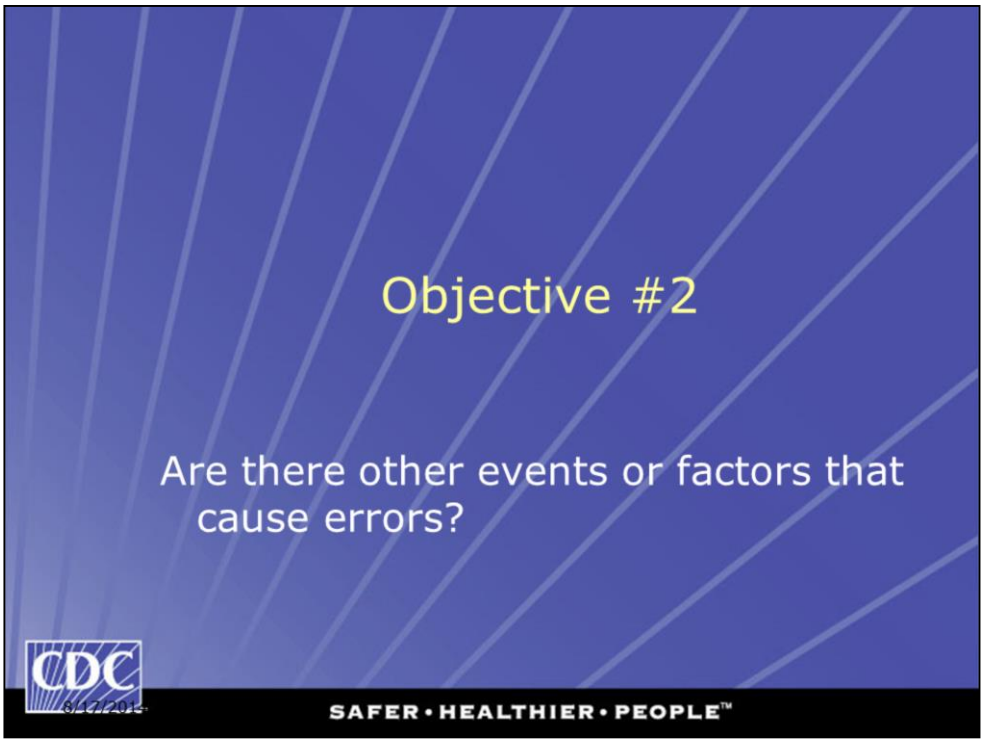
Cycle 2: new exam started & new technology had a system enhancement

First 10th = 25% / 50%

First 3rd = 50% / 70%

Half = 65% / 80%

Last 3rd – same % increases


Objective #2
Are there other events or factors that cause errors?
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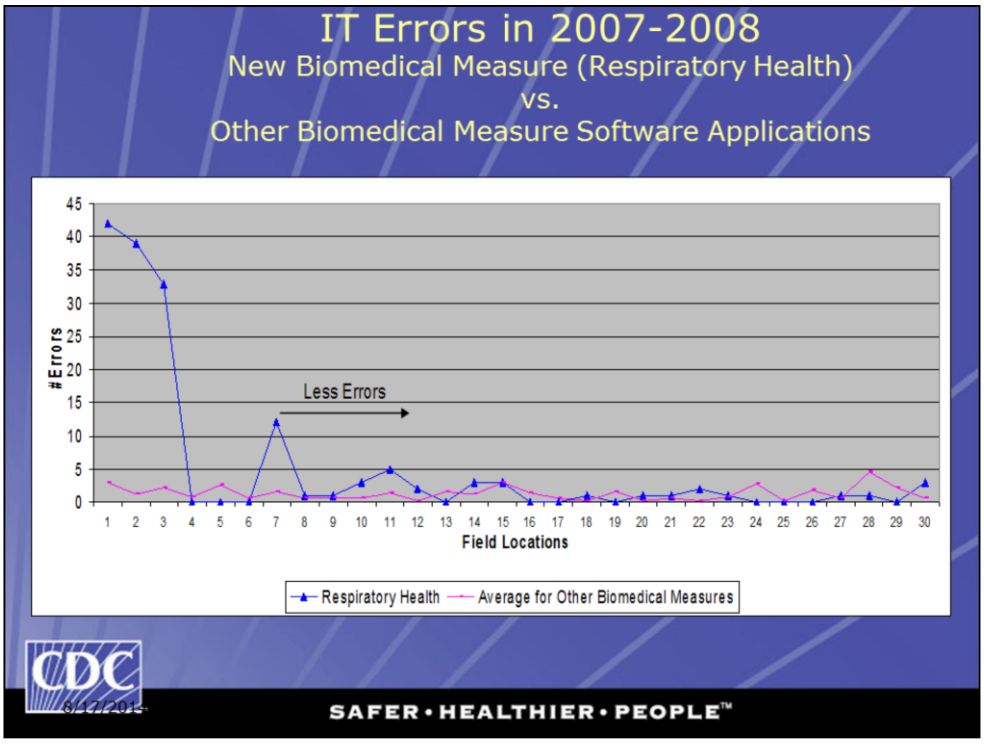
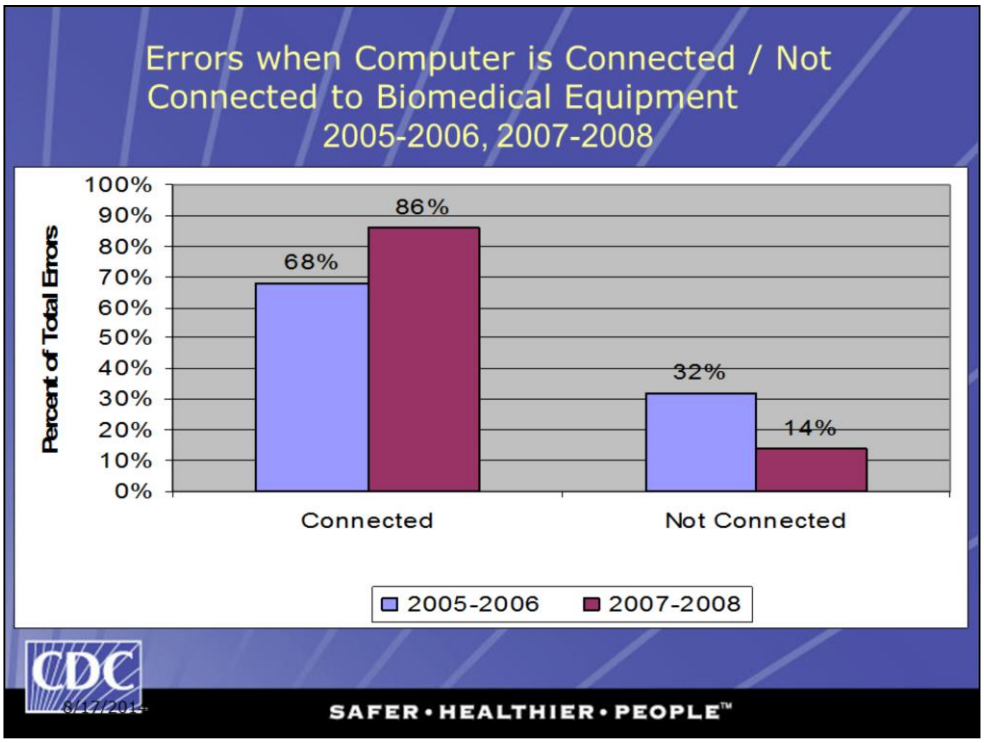


74% of the errors occur in the first 3 field locations; 15% for old Biomed Measures

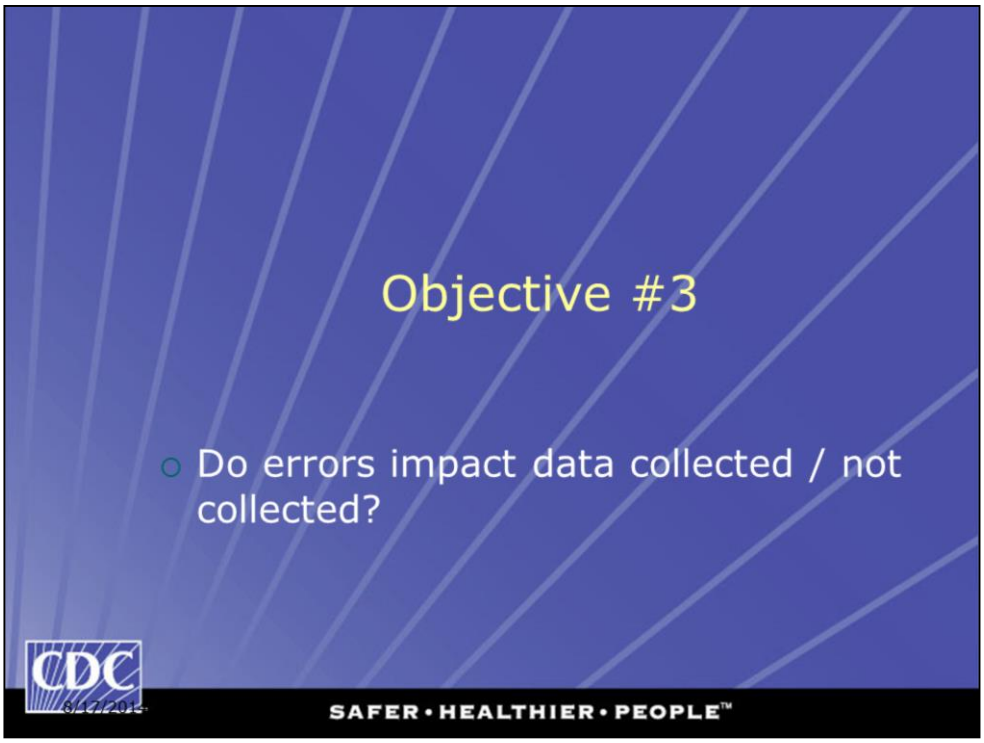
6 months to stabilize the new complex Biomedical Measure (3rd party software; new hardware, etc.)

81% of the New Biomedical Measure errors occurred in 7 field locations; 31% for old



Connecting biomedical equipment to computers causes substantially more errors.

Reason for higher in 07-08: Respiratory Health started in 07-08


Objective #3
Do errors impact data collected / not collected?
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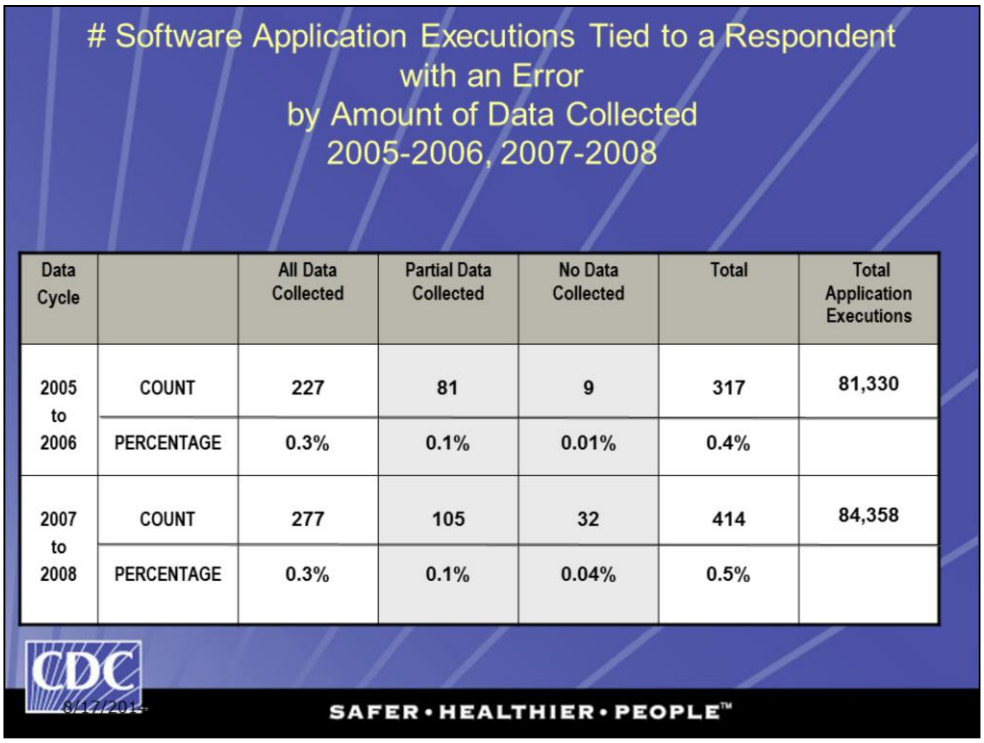
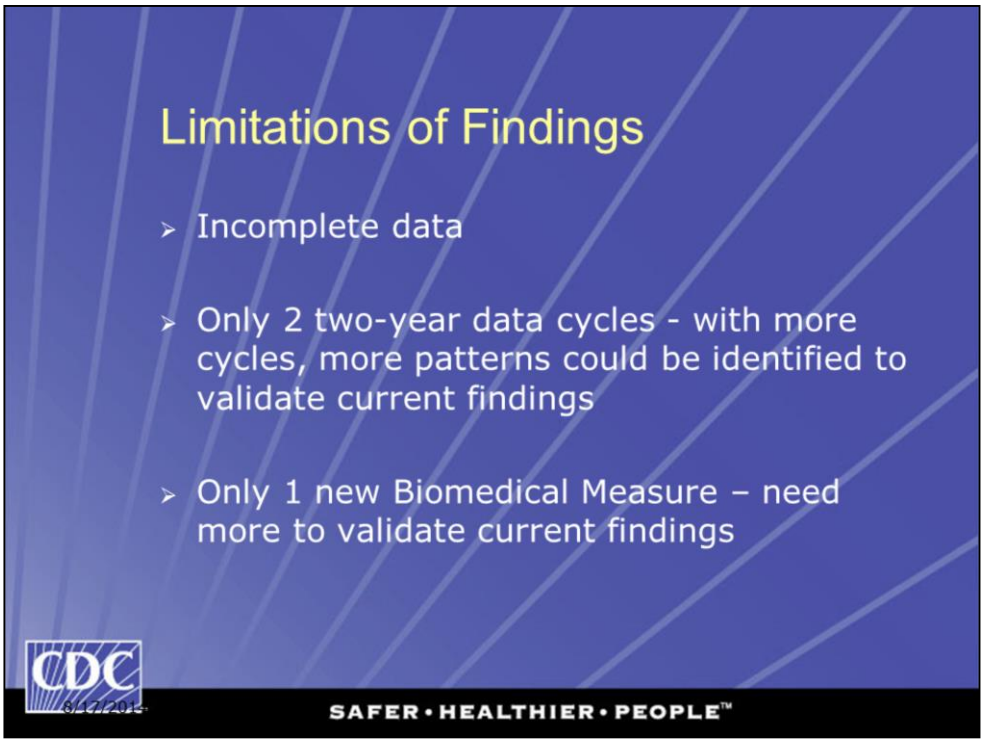


Data Cycle		All Data Collected	Partial Data Collected	No Data Collected	Total	Total Application Executions
2005 to 2006	COUNT	227	81	9	317	81,330
	PERCENTAGE	0.3%	0.1%	0.01%	0.4%	
2007 to 2008	COUNT	277	105	32	414	84,358
	PERCENTAGE	0.3%	0.1%	0.04%	0.5%	

Very low - tenth of 1% of total data executions had data not collected

Approx 50% of errors are linked to a respondent


Limitations of Findings
Incomplete data
Only 2 two-year data cycles - with more cycles, more patterns could be identified to validate current findings
Only 1 new Biomedical Measure – need more to validate current findings
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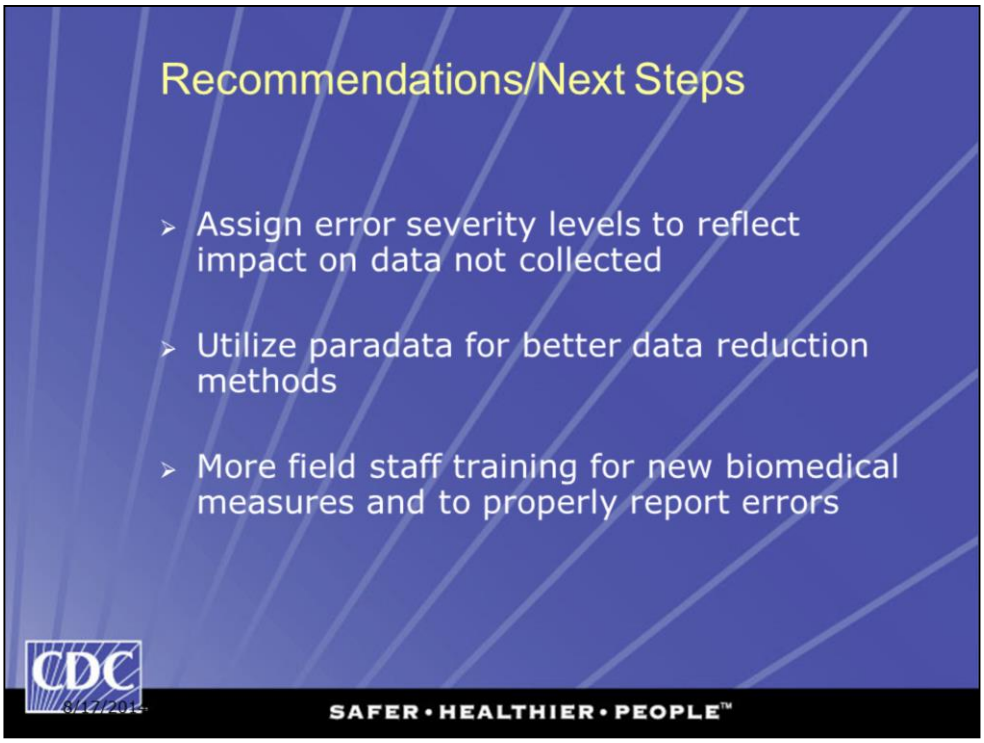
Conclusions

- Objective # 1: Two year cycles
  - More errors occur during the first 3 field locations in two-year cycle, then level out
  - Computer equipment errors decreased by 79% from 2005-2006 to 2007-2008
- Objective 2: Factors or events increasing errors
  - More errors for new biomedical measures compared to existing biomedical measure
  - More errors for application software with connected biomedical equipment compared to those without biomedical equipment
- Objective 3: Errors impacting data collected / not collected
  - < 0.2% of errors are associated with data loss. Do not know if causal.


Recommendations/Next Steps
Assign error severity levels to reflect impact on data not collected
Utilize paradata for better data reduction methods
More field staff training for new biomedical measures and to properly report errors
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