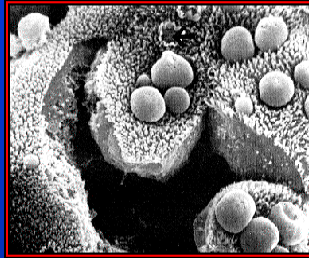
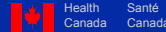


North Battleford, Saskatchewan Cryptosporidiosis Outbreak Spring, 2001



Report prepared by Health Canada for Saskatchewan Health
and The Battlefords District Health Unit

Presented by: Dr. Andrea Ellis
Section Head, Outbreak Response and Issues
Management Division of Enteric, Foodborne and
Waterborne Diseases



Health Canada's mandate in outbreak investigations

- ◆ Health Canada becomes involved in investigating a local or provincial outbreak only when invited by the provincial public health authorities
- ◆ Report to the medical officer(s) in charge

Introduction



Division of Enteric, Foodborne and Waterborne Diseases

◆ Outbreak Response Section

- Conduct outbreak investigations in the area of infectious enteric, foodborne and waterborne diseases
- Provide expertise to provincial and local officials, upon request
- Co-ordinate national investigations
- Conduct surveillance for enteric disease outbreaks

Introduction



Outbreak Investigation Team

◆ Areas of expertise

- field epidemiologists/ outbreak investigation
- waterborne disease surveillance
- epidemiology of cryptosporidiosis
- medical geographer
- statisticians

Introduction



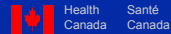
Health Canada Investigators

Dr. Rob Stirling†
Dr. Jeff Aramini‡
Dr. Andrea Ellis‡
Gillian Lim‡
Rob Meyers‡
Manon Fleury‡
Dr. Denise Werker†

†Field Epidemiology Training Program, Centre for Surveillance Coordination, Population and Public Health Branch, Health Canada

‡ Division of Enteric, Foodborne and Waterborne Diseases, Bureau of Infectious Diseases, Centre for Infectious Disease Prevention and Control, Population and Public Health Branch, Health Canada

Introduction



Acknowledgements

- Battlefords District Health Unit
- Saskatchewan Health
- Health Districts and First Nations in Saskatchewan
- Municipal officials and public works employees of the City of North Battleford and the Town of Battleford
- Saskatchewan Environment and Resource Management
- The British Columbia Centre for Disease Control
- Pharmacies

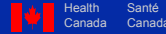
Introduction



April 25, 2001

- ◆ Saskatchewan contacted the Field Epidemiology Training Program and the Division of Enteric, Foodborne and Waterborne Disease to request assistance in North Battleford
- ◆ Precautionary Drinking Water Advisory (PDWA) issued

Introduction



April 26, 2001

- ◆ Field Epidemiologist arrived in North Battleford
- ◆ Epidemiologist from Division of Enteric, Foodborne and Waterborne Diseases arrived on April 29.

Introduction



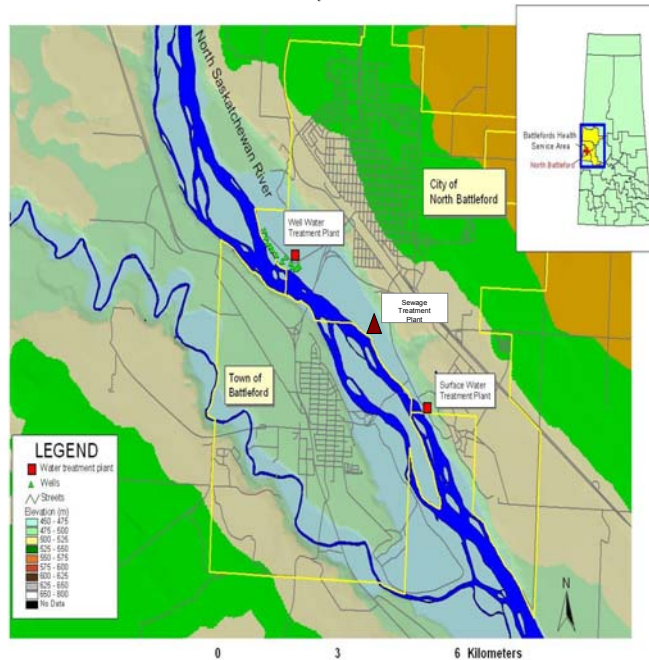
Investigation Objectives

The purpose of the investigation was to determine the scope, magnitude, and likely source of the outbreak.

Introduction



The Battlefords, Saskatchewan



Investigation Activities

- ◆ Case-Series Study
- ◆ Anti-Diarrheal Drug Sales Review
- ◆ Cross-Sectional Study
- ◆ Environmental Review

Introduction



Case-Series Study

Purpose:

To gather information from persons reporting gastrointestinal illness believed to be related to the outbreak to better understand:

- who was being affected (age, gender)
- the symptomatology of those affected
- the time frame of the outbreak
- the geographic distribution of those affected

Case-Series Study



Case-Series Study Methodology

- ◆ Within Battlefords Health Service Area
 - Retrospective ER Chart Review
 - Standard Line-listing Form
- ◆ Outside Battlefords Health Service Area
 - Standard Line-listing Form

Case-Series Study



Case-Series Study Methodology

- ◆ Case Definitions
 - **Epi-linked Case**: a resident or visitor to the Battlefords area with onset of diarrhea after March 20, 2001
 - **Confirmed Case**: met criteria for epi-linked case, but also had stool specimen positive for *Cryptosporidium parvum* oocysts

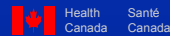
Case-Series Study



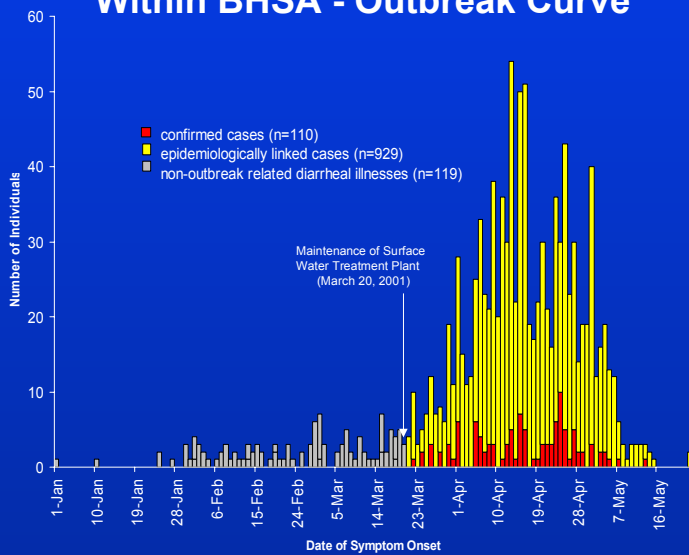
Cases from Within the BHSA

- Information obtained from 1376 people
- 1039 met case criteria
- 110 laboratory confirmed cryptosporidiosis

Case-Series Study



Case-Series Study Results Within BHSA - Outbreak Curve

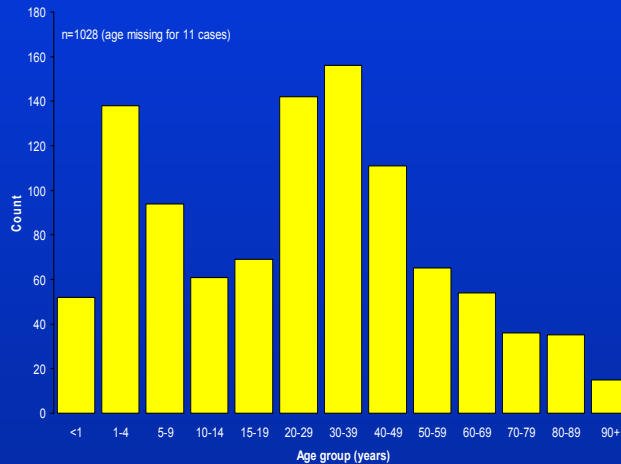


Case-Series Study



Case-Series Study Results

Age Distribution for Cases from Within the BHSA



Case-Series Study



Case-Series Study Results

Illness Profile for Cases from Within the BHSA

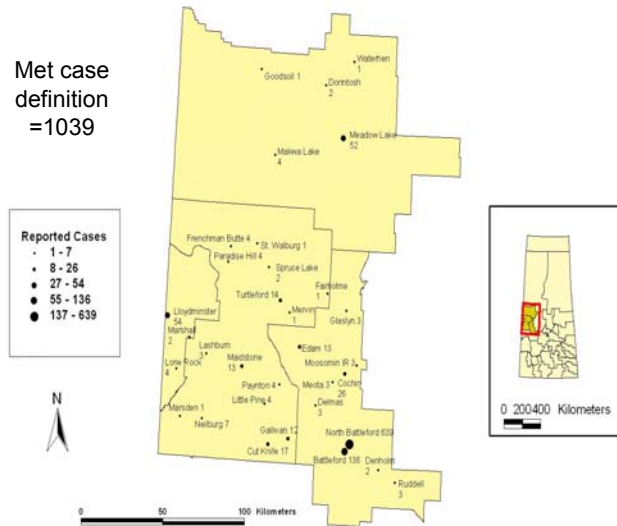
	No.	%
Diarrhea	1039	100
Abd pain/cramp	343	33
Vomiting	299	29
Nausea	509	49
Malaise	54	5
Anorexia	486	47
Fatigue	68	7
Fever	389	37
Weight Loss	195	19

Case-Series Study



Cases from Within BHSA

Met case definition
=1039



Case-Series Study



Cases from Outside the BHSA

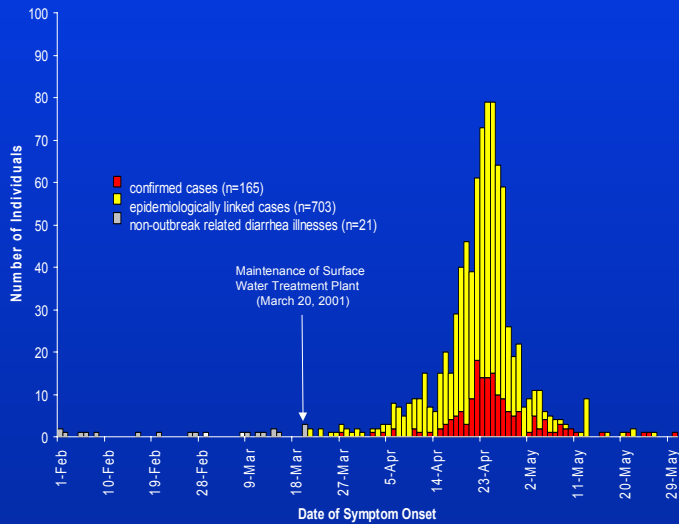
- Information obtained from 955 people
- 868 met case criteria
- 165 laboratory confirmed cryptosporidiosis

Case-Series Study



Case-Series Study Results

Outside BHSA - Outbreak Curve



Case-Series Study



Case-Series Study Results

Visit Dates for Cases from Outside the BHSA to the Battlefords

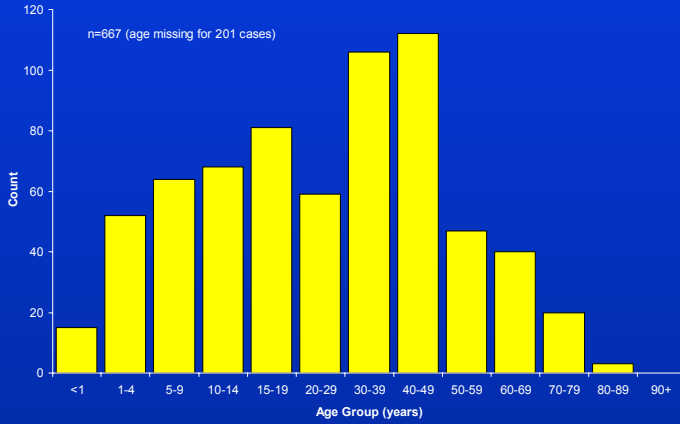
- Visit location available for 690 cases:
 - 86% visited the City of North Battleford, 8% the Town of Battleford, and 6% both
- Reason for visit available for 240 cases:
 - dance (53%), casino event (5%), and church camp (14%).
- Dates of visiting recorded for 578 cases:
 - majority visited between April 12 to April 26
 - among those that only visited for one day or less, visit dates ranged from March 23 to May 6.

Case-Series Study



Case-Series Study Results

Age Distribution for Cases from Outside the BHSa



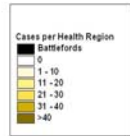
Case-Series Study



Cases from Outside BHSa

Met case definition
(and could be mapped)
=701

Other Provinces
Alberta = 141
Manitoba = 19
British Columbia = 7



Case-Series Study



Case-Series Study Results

Laboratory Investigations for Other Pathogens

- No increases in notification of bacteria or parasites, other than *Cryptosporidium parvum*, in stool specimens.
- No viruses were detected in 12 randomly selected stool specimens.
- Other laboratories in Saskatchewan, Manitoba, Alberta and British Columbia testing individuals with diarrhea who visited North Battleford only detected *Cryptosporidium*

Case-Series Study



Overall interpretation of the case series study

- ◆ Many people affected across all age groups and both genders
- ◆ Most people who became ill were residents of the Battlefords but many visitors were affected, including many who visited for only 1 day
- ◆ The majority of people became ill in mid to late April although the outbreak began in late March

Case-Series Study



Anti-Diarrheal Drug Sales Review

Purpose:

To obtain further information regarding the time frame of the outbreak by using anti-diarrheal drug sales as an indicator of community gastroenteritis.

Drug Sales



Anti-Diarrheal Drug Sales Review Methodology

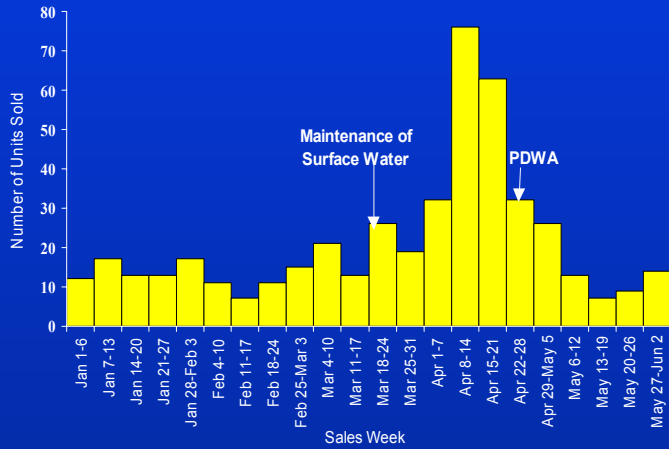
- ◆ Convenience sample
- ◆ Unit sales of common anti-diarrheal medications
- ◆ Time frame:
 - January-May, 2000
 - January-May, 2001

Drug Sales



Anti-Diarrheal Drug Sales Review- Results

Pharmacy A, Jan-May 2001

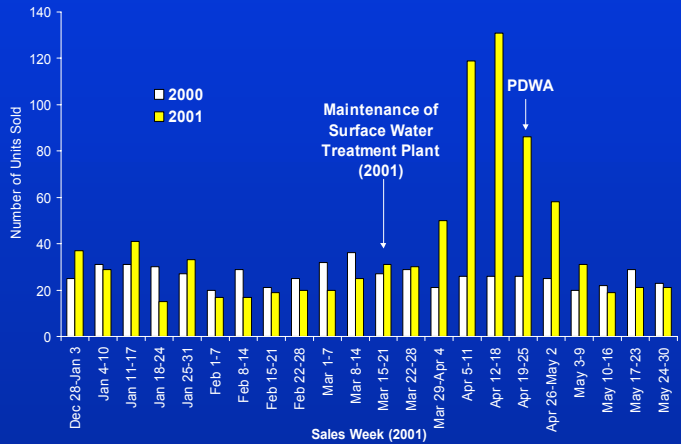


Drug Sales



Anti-Diarrheal Drug Sales Review - Results

Pharmacy B, Jan-May 2000, 2001

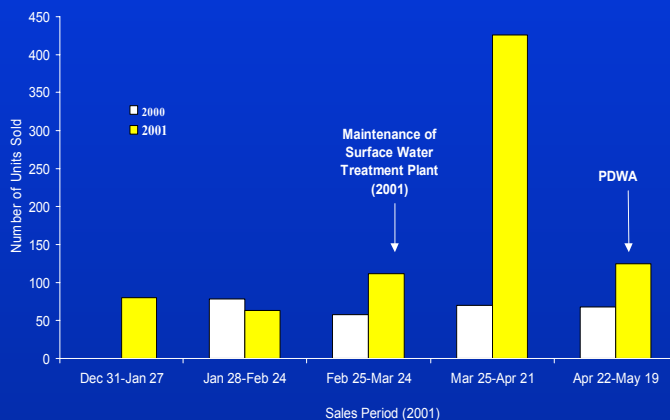


Drug Sales



Anti-Diarrheal Drug Sales Review - Results

Pharmacy C, Jan-May 2000, 2001



Drug Sales



Overall Interpretation of Anti-Diarrheal Drug Sales Review

- ◆ Review provides evidence to suggest an increase in gastroenteritis was occurring in North Battleford beginning at least by the first week of April
- ◆ This review illustrates the usefulness of anti-diarrheal sales data as a measure of community gastroenteritis

Drug Sales



Cross-Sectional Study

Purpose:

This community survey was conducted to obtain information regarding risk factors for gastroenteritis and to allow us to make community based estimates of illness.

Cross-sectional Study



Cross-Sectional Study Methodology

◆ Data Collection

- Random sample of households
- Telephone survey with structured questionnaire
- Adult proxy
- Household and individual level data

◆ Data Analyses

- multivariate regression and spatial analyses

Cross-sectional Study



Cross-Sectional Study Methodology

- ◆ **Case Definitions (Household Level)**
 - **Ill Household:** one or more individuals met primary case definition
 - **Non-ill Household:** no person(s) had symptoms of gastrointestinal illness
 - **Other Household:** person(s) with gastrointestinal symptoms but did NOT meet primary case definition

Cross-sectional Study



Cross-Sectional Study Methodology

- ◆ **Case Definitions (Individual Level)**
 - **Primary Case** is a person with:
 - ✦ onset of diarrhea between March 21 - time of survey
 - ✦ from household with NO diarrhea between February 14 - March 20
 - **Secondary Case** is a person with:
 - ✦ met criteria for primary case
 - ✦ symptom onset ≥ 7 days after initial household case

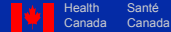
Cross-sectional Study



Cross-Sectional Study Methodology

- ◆ Case Definitions (Individual Level) (cont'd)
 - **Confirmed Case** is a person with:
 - ✦ met criteria for primary or secondary case
 - ✦ stool specimen positive for *Cryptosporidium parvum* oocysts
 - **Control** is a person from any household who had no symptoms of gastrointestinal illness

Cross-sectional Study



Cross-Sectional Study Methodology

Risk factor analysis

- ◆ Univariate analysis- compare exposures among ill to non-ill in simple 2X2 tables
- ◆ Multivariate modelling to obtain a final model which controls for relationships between different risk factors



Cross-Sectional Study Methodology

Community Estimates of Illness

- ◆ Estimate background rate of GI illness (study based and literature based)
- ◆ Calculate age-specific crude attack rates for each community
- ◆ Multiply crude attack rates by age-specific census populations for each community
- ◆ Total age-specific estimates to derive population estimates for each community

Community Estimates



Cross-Sectional Study Results Household Level

- ◆ 259 households surveyed
 - 65.5% North Battleford
 - 25.1% Battleford
 - 9.3% other communities
- ◆ 122 ill households (47%)
- ◆ 93 non-ill households (36%)
- ◆ 44 other (17%)

Cross-sectional Study



Cross-Sectional Study Results

Individual Level

Information obtained regarding 652 individuals

- ◆ 196 classified as primary cases
- ◆ 51 classified as secondary cases. Thus 38% (247/652) of those surveyed had gastroenteritis.
- ◆ 311 people reported no symptoms and did not have any ill household members- used as controls

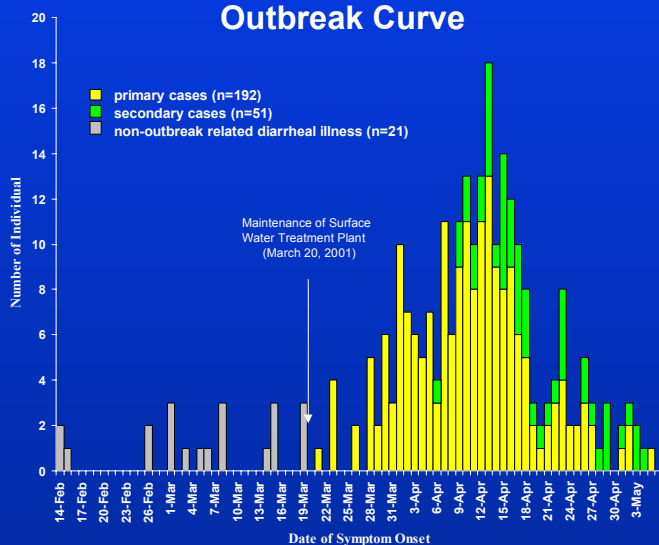
Cross-sectional Study



Health Canada Santé Canada

Cross-Sectional Study Results

Outbreak Curve



Cross-sectional Study



Health Canada Santé Canada

Cross-Sectional Study Results

Multivariate Analyses

Exposure	Odds Ratio (95% C.I.)	Statistical Significance (p-value)
N.B. Water in Home (OR work/school)	1.52 (0.90-2.54)	0.0019
N.B. Water in Home (AND work/school)	2.73 (1.55-4.81)	
Contact with livestock	0.45 (0.23-0.88)	0.0166
Age group (10-14 yrs)	2.78 (1.30-5.95)	0.3100
Age group (20-29 yrs)	4.06 (1.67-9.88)	
Age group (30-39 yrs)	2.28 (1.15-4.51)	

Cross-sectional Study

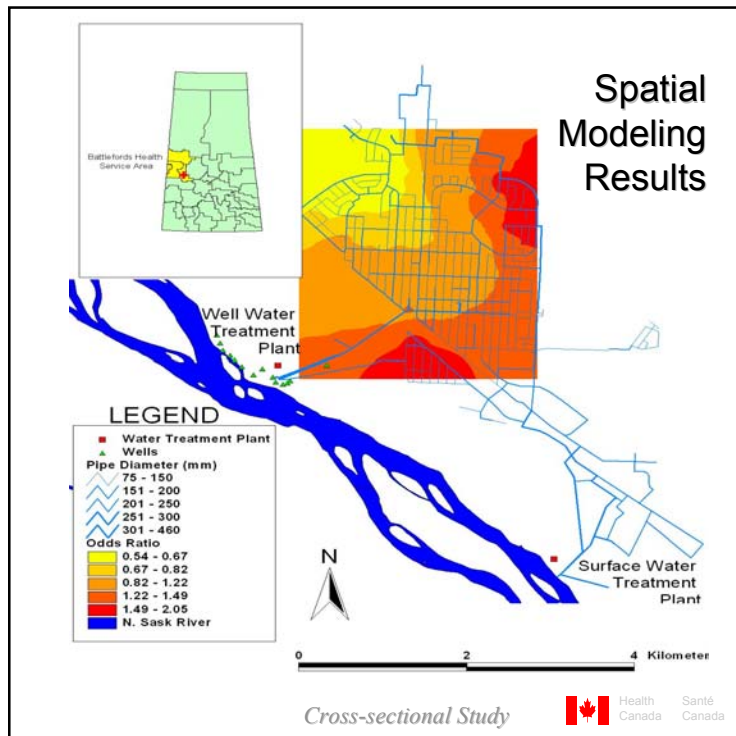


Cross-Sectional Study Results

Exploring the Significance of the March 20th Event

- Further modelling was conducted to evaluate whether or not North Battleford water was a risk factor for gastroenteritis between February 14 and March 20.
- Results *suggest* that the consumption of North Battleford water was not associated with gastroenteritis between February 14 and March 20.
- These results support the hypothesis that the malfunction in the SCU was a primary factor in allowing *Cryptosporidium* to enter the drinking water.





Cross-Sectional Study Results

Community Estimates of Illness Results

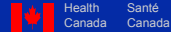
- ◆ In the City of North Battleford & Town of Battleford an estimated 5800 to 7100 people developed gastroenteritis as a result of the outbreak
- ◆ Unable to determine an estimate for those outside the Battlefords

Environmental Review

Purpose:

Determine what factors may have contributed to the contamination of the water supply

Environmental Review



Environmental Review Methodology

- ◆ Review of water treatment plant operations
- ◆ Collection of water treatment data:
 - Finished water turbidity (SERM)
 - Percent settling of Solids Contact Unit
 - Water volume contributions to community from each plant
 - Distribution system water quality

Environmental Review

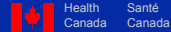


Environmental Review Results

Areas of with no significant findings

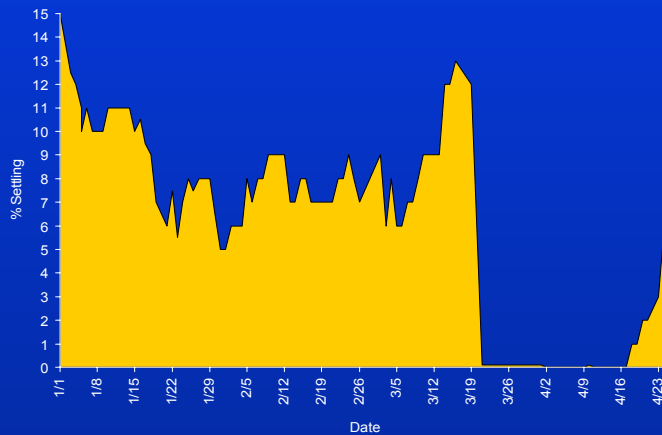
- ◆ No irregularities reported at the ground water treatment plants
- ◆ Records of bacterial water quality and chlorine residuals in the North Battleford distribution system from Jan-April 2001 showed no abnormalities

Environmental Review



Environmental Review Results

North Battleford Surface Water Treatment Plant: Solids contact unit percent settling

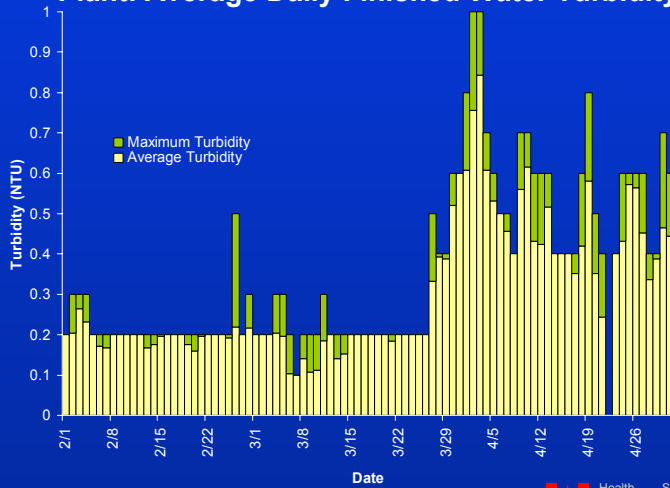


Environmental Review



Environmental Review Results

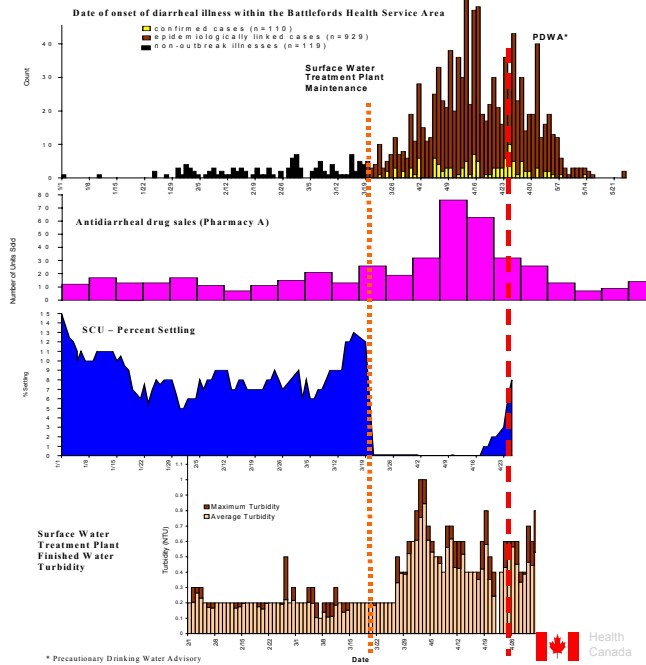
North Battleford Surface Water Treatment Plant: Average Daily Finished Water Turbidity



Environmental Review



Comparison of Water Quality and Disease Burden Data



* Precautionary Drinking Water Advisory



Overall Conclusions

- ◆ Battlefords area experienced an outbreak of waterborne cryptosporidiosis in spring 2001.
- ◆ An estimated 5800-7100 people from the Battlefords along with hundreds more from other communities and provinces affected.
- ◆ Outbreak most likely precipitated by a shut down of the SCU which left the system vulnerable to contamination from the river.

Conclusions



Conclusions continued

- ◆ Contamination most likely came from fecal contamination upstream.
- ◆ Illustrates the need for a multi-barrier approach to protecting municipal water supplies.

Conclusions

