First *Mycobacterium abscessus* Outbreak Associated with Recreational Water in the U.S.

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BACKGROUND

- *Mycobacterium abscessus,* a rapidly growing acid-fast bacterium (AFB) naturally found in water, soil, and dust, is an opportunistic pathogen that causes rare skin and subcutaneous tissue infections.
- Previous studies have found *Mycobacterium spp*. in swimming pools.
- Outbreaks of skin infections related to recreational water were identified in Canada (2003), Italy (2009–2011); no previous U.S. outbreaks associated with recreational water have been reported.
- Four children were referred to a pediatric infectious disease clinic because of lesions on hands and feet testing AFB positive.
- Reporting by clinician prompted a public health investigation.

METHODS

Case investigation

- Clinical evaluation, included diagnostic laboratory testing
  - Skin biopsy, swab of exudate
  - AFB staining and mycobacterial culture
  - Bacterial RNA polymerase β subunit (rpoB) gene sequencing or 16S rDNA sequence analysis; *erm*(41) and *hsp*65 gene assays
- Standardized questionnaire

Environmental investigation

- Visually inspect pool, play structures, equipment
- Review maintenance records, interview staff
- Swab environmental surfaces for mycobacterial testing
- Sample pool water for ultrafiltration and mycobacterial testing

Molecular laboratory investigation

- Gene sequence analysis for identification and relatedness studies
- Pulsed-field gel electrophoresis to identify clonal relationships

Images of lesions

CASE INVESTIGATION RESULTS

- Prior to referral, some patients had diagnosis of viral hand, foot and mouth disease; endocarditis was suspected, but ruled out, in patient with congenital heart disease.
- Multiple erythematous or purple firm nodules, some with central purulence, on palms and soles were not warm. Lack of systemic symptoms was striking.
- Immunodeficiency was ruled out in Patient #1; epidemiologic findings precluded need for immunodeficiency testing in subsequent cases.
- Treatment approaches varied (see table below). No complications or recurrence after resolution were reported to the authors.
- Common source was suspected based on exposure history of all 4 patients.
- Stimulated passive surveillance identified 7 additional cases.
- Standardized questionnaire was used to interview parents.
- Sole common exposure was a fitness facility's wading pool 12/2012 – 04/2013.

ENVIRONMENTAL INVESTIGATION RESULTS

- 10,100 gallon wading pool, ~47 minute turnover through rapid sand filter
- Granular rubberized decking showed wear
- Worn rubber mat on pool bottom at slide exit
- Chlorine level 3.0 ppm on 4/26/2013 inspection (acceptable range 1–5 ppm)

Wading pool

Worn decking

Decorative decking insert

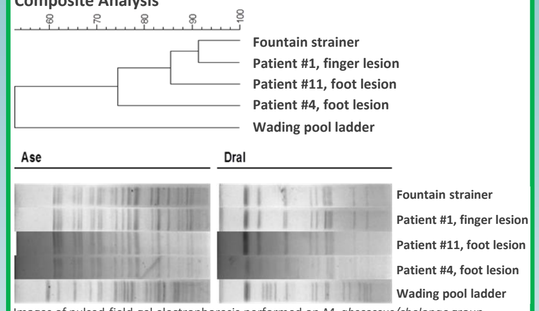
Fountain strainer

ENVIRONMENTAL LABORATORY RESULTS

Source	Sample type	Organism identified	PFGE
Wading pool deck	Swab	*M. fortuitum* gp.	No
Fountain strainer	Sponge-stick	*M. abscessus/chelonae*	Yes
Wading pool ladder	Sponge-stick	*M. abscessus/chelonae* *M. fortuitum* gp.	Yes
Wading pool strainer	Sponge-stick	No AFB recovered	No
Wading pool water	Water (40 L)	*M. mucogenicum* *M. phocaicum*	No
Wading pool stairs	Swab	No AFB recovered	No
Adult pool decking	Sponge-stick	No AFB recovered	No
Wading pool decking insert	Sponge-stick	No AFB recovered	No

MOLECULAR LABORATORY RESULTS

Composite Analysis



Images of pulsed-field gel electrophoresis performed on *M. abscessus/chelonae* group organisms isolated from patients and environmental sources. Analysis of clonal relationships suggested possible relationships between the fountain strainer and the patient isolates, whereas the wading pool ladder isolate was not as closely related.

CONTROL MEASURES

- Power washed surfaces; disinfected with EPA-registered tuberculocide
- Hyperchlorinated pool; backwashed filters
- Drained, manually scrubbed, disinfected pool
- Scrubbed pool decking with 0.34% sodium hydroxide and degreaser; disinfected with 5.25% sodium hypochlorite
- Replaced worn decking and rubber mat at bottom of slide
- Repeat visits and consultation by local public health officials

CONCLUSIONS

- An outbreak of *M. abscessus* skin infections among children was associated with exposure to a wading pool and controlled by environmental remediation. Clinicians who identify patients with *M. abscessus* skin infections should ask about water exposures and contact their public health agency.
- Limitations: Mild cases might have been undetected. Elapsed time between exposure, illness onset, and clinical care limited recall and timeliness of environmental sampling. Further molecular studies could elucidate relationships among isolates.

CASE INVESTIGATION: HISTORY, CLINICAL EVALUATION, TREATMENT, OUTCOME

Patient ID	Age (years)	Sex	Onset Date	Exposure Months	Lesion Location and Pain	Specimen Type	AFB Stain	Culture Result	Surgical Treatment	Medical Treatment and Clinical Course
1	3	F	1/28/2013	12/12 , 1/13	Hands, feet Painful on feet, not hands	Exudate Tissue biopsy	Positive Negative	*M. abscessus,* not *chelonae* *M. abscessus,* not *chelonae*	Incision/drainage	Linezolid, moxifloxacin, clarithromycin x 4 weeks, then clarithromycin monotherapy x 8 weeks; complete resolution
2	6	M	2/1/2013	1/13	Hands	N/A	Not done	Not done	Incision/drainage	Unknown antibiotic; resolved after surgical treatment
3	2	F	2/7/2013	1/13	Hands, feet; mildly painful	N/A	Not done	Not done	Incision/drainage	Topical steroid. Clarithromycin x 12 weeks; complete resolution
4	3	F	2/10/2013	1/13, 2/13	Feet Painful	Exudate	Positive	*M. abscessus/chelonae*	Incision/drainage	Amoxicillin-clavulanate , trimethoprim-sulfamethoxazole Resolution prior to culture result, no further therapy prescribed
5	3	F	2/11/2013	1/13	Hands, feet Not painful	Tissue biopsy	Positive	Not done; PCR negative for mycobacteria	None	Clarithromycin x 4 weeks; complete resolution
6	3	F	3/23/2013	3/13	Hands, feet	Unknown	Unknown	Unknown		Clarithromycin and unknown topical antibiotic
7	3	F	3/29/2013	12/12, 1/13, 3/13	Feet Not painful	Exudate	Positive	No growth	Incision/drainage	Clarithromycin x 10 weeks; complete resolution
8	2	F	4/14/2013	2/13–4/13	Foot	N/A	Not done	Not done		Clarithromycin
9	2	F	4/15/2013	4/13	Hands, back of neck	N/A	Not done	Not done	None	Hydrogen peroxide; spontaneous rupture
10	5	F	4/25/2013	2/13–4/13	Feet	Unknown	Negative	No growth	None	Clarithromycin; spontaneous rupture
11	6	M	5/1/2013	2/13–5/13	Foot	Exudate	Positive	*M. abscessus/chelonae*		Clindamycin
12*	4	F	2/27/2013	Throughout 2013	Hands, feet; painful	Exudate	Positive	*M. abscessus/chelonae*	Incision/drainage	Clarithromycin x 12 weeks; complete resolution

* Case reported 9/2014 after possible recurrence of 2/2013 illness

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The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the Centers for Disease Control and Prevention.