6 (30%) were admitted to the pediatric intensive care unit with 2 (33.3%) having GI symptoms. Like that in Bhat report, only 3 of the 18 vaccine eligible children in our study had received age-appropriate vaccination.

We detected influenza in both nonrespiratory sites studied, stool and blood. Detecting influenza RNA in stool has previously been reported with stool detection rates of up to 24.6%6 and 47%.7 Similar to our results, viral RNA positivity had little correlation with GI symptoms or outcome.5 7 Unlike prior reports, fecal viral concentration in our study did not correlate with symptom duration. This could have been related to our small sample size. Time from collection to storage would have been less likely to impact results as stool specimens were process more quickly for RNA-negative (26.0 hours [range 0.2–69]) versus RNA-positive (41.6 [2–72]) samples. We were not able to isolate live influenza virus from stool. This may have been related to the low inoculum or dilution effect inherent in stool samples. This is supported by the high Ct values detected in 7 of 8 qPCR-positive stool samples.

In conclusion, we detected viral RNA in respiratory and nonrespiratory sites among immunocompetent children. Viremia with seasonal influenza has been rarely reported. In contrast, viremia with nH1N1 has been reported in the blood of patients with severe infection and among immunocompromised patients using serum or plasma. Animal models have suggested red blood cell, such as we used in our study, to be a more successful target for polymerase chain reaction.10 Our enrollment period (January 2009 to April 2011) involved 3 influenza seasons; however, only children with nH1N1 had viral RNA detected in nonrespiratory sites. Thus, our clinical and laboratory findings may be more reflective of the nH1N1 pandemic virus, highlighting perhaps a difference in cell tropism between seasonal and nH1N1 influenza.

In conclusion, we detected viral RNA in respiratory and nonrespiratory sites among immunocompetent children. Influenza RNA in stool was not associated with the presence of GI symptoms or more severe disease. Cultivable influenza viruses were not detected in stool; however, the presence of viral RNA raises infection control concerns. The finding of viremia in an immunocompetent child adds to the potential for systemic spread to nonrespiratory sites during influenza infection in children and adverse outcome.

REFERENCES


HIGH INCIDENCE OF SUBCUTANEOUS EMPHYSEMA IN CHILDREN IN A SOMALI REFUGEE CAMP DURING MEASLES OUTBREAK

Peter Moons, MD and Monica Thallinger, MD, DTMH

Abstract: During an outbreak of measles in a refugee camp in Ethiopia, 9 patients (age range 4 months to 18 years) were diagnosed with subcutaneous emphysema. Incidence of this rare complication of measles in this refugee camp was higher than previously reported. We hypothesize that the high incidence is most likely related to poor physical state of the refugee population with high rates of malnutrition.

Key Words: measles/complications, subcutaneous emphysema, protein-energy malnutrition, child, child nutrition disorders/complications

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From the Médecins Sans Frontières, Amsterdam, The Netherlands. This case series met the requirements of the MSF ethical review board for retrospective review of routinely collected data.

Both authors reviewed patient data and contributed to design and writing of the report. P.M. performed a background literature search and reviewed the data. M.T. abstracted clinical patient data. The authors have no other funding or conflicts of interest to disclose.

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Following years of escalating military conflict in Somalia, the United Nations declared a famine in several Somali regions in 2011. By that time, the population had already suffered for long
We report 9 cases of subcutaneous emphysema treated in the Hiloweyn Refugee Camp. Subcutaneous emphysema is a well described but rare complication of measles. It is associated with malnutrition and can be fatal. The exact pathogenesis of this complication of measles is not known. It is postulated to result from rupture of alveoli because of increased intra-alveolar pressure. Air in the bronchovascular sheet then travels through fascial planes to mediastinum and subcutaneous tissues. The hypothesis is that increased fragility of connective tissues due to both malnutrition and following the measles infection leads to the formation of bulla and pulmonary interstitial emphysema. The incidence of emphysema in our population was higher than previously reported.

### Patient Presentation

Between August and November 2011 a total of 237 cases of measles were registered. Nine cases of subcutaneous emphysema were diagnosed in patients who had all recently been diagnosed with measles. Clinical characteristics are summarized in Table 1. All cases were malnourished. Median age was 6 years (range 4 months to 18 years). Seven patients were male. Median duration from onset of rash to development of subcutaneous emphysema was 7 days (range 2–13 days). Four patients still had typical measles rash at presentation. Eight of the patients presented with fever. In all patients the initial respiratory symptom was cough. Three children had a hoarse voice. Subcutaneous emphysema typically started in the neck and spread thereafter to the thorax. In 3 patients there was extension to the abdomen and groin. Extension to the extremities and face occurred in 2 patients. Two patients showed signs of respiratory distress with clinical findings consistent with pneumothorax, pain over the affected lung, decreased air entry and increased percussion sounds. All patients were admitted to the inpatient facility and treated according to standard feeding protocol (including supplemental feeding, supplemental hydration). We cannot report radiologic findings in our patients because there are no radiologic facilities in Hiloweyn camp. In the setting where radiographs were available, radiologic evidence of subcutaneous emphysema may be missed.

### DISCUSSION

Measles remains an important, potentially fatal childhood disease in all parts of the world where vaccination coverage is low. It is an acute viral infection, which classically presents with a maculopapular rash and high fever. It is commonly associated with cough and may also be associated with conjunctivitis, otitis media, pneumonia and encephalitis. It is well recognized that the disease is usually more severe in malnourished children. Subcutaneous and mediastinal emphysema are a rare but important complication. Case series report varying incidences from 0.59% to 1.5%. It has most commonly been reported in children less than 5 years of age but also affects older children and adults. Larger case studies report a male predominance and emphasize an association with malnutrition, where 50–100% of patients affected were malnourished. Subcutaneous and mediastinal emphysema can develop at any stage of the infection. It does not necessarily occur when measles exanthema is present (in 1 report only 30% of cases presented during the eruptive stage). The possibility of late presentation is therefore important for clinical practice as, due to the absence of rash, a relationship between the infection and subcutaneous emphysema may be missed.

All our patients had signs of pulmonary involvement (crepitations). We cannot report radiologic findings in our patients because there are no radiologic facilities in Hiloweyn camp. In setting where radiographs were available, radiologic evidence of infection in subcutaneous and mediastinal emphysema varied from periods and large numbers of refugees had crossed the border into neighboring Ethiopia.

Médecins Sans Frontières (MSF) has provided independent medical aid in refugee camps in the area since 2008. Efforts have been made to administer routine vaccinations on arrival to the camps. Children less than 15 years of age are prioritized. With the sudden influx of refugees in 2011 operational constraints prevented adequate vaccine coverage in the first months of the response. People across all age groups had not been previously vaccinated. Due to the sheer number of refugees combined with the lack of "herd immunity," there was an outbreak of measles from August to October 2011.

We report 9 cases of subcutaneous emphysema treated in the Hiloweyn Refugee Camp. Subcutaneous emphysema is a well described but rare complication of measles. It is associated with malnutrition and can be fatal. The exact pathogenesis of this complication of measles is not known. It is postulated to result from rupture of alveoli because of increased intra-alveolar pressure. Air in the bronchovascular sheet then travels through fascial planes to mediastinum and subcutaneous tissues. The hypothesis is that increased fragility of connective tissues due to both malnutrition and following the measles infection leads to the formation of bulla and pulmonary interstitial emphysema. The incidence of emphysema in our population was higher than previously reported.

### Table 1. Clinical Characteristics and Outcome of Cases

<table>
<thead>
<tr>
<th>Case</th>
<th>Sex</th>
<th>Age</th>
<th>Level of Malnutrition*</th>
<th>Site Subcutaneous Emphysema</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>14 yr</td>
<td>Moderate wasting</td>
<td>Neck, extending to chest wall</td>
<td>Survived</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>2 yr</td>
<td>Severe wasting</td>
<td>Neck, extending to chest wall</td>
<td>Survived</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>6 yr</td>
<td>Severe wasting</td>
<td>Neck, extending to left anterior chest wall and spreading down to scrotum</td>
<td>Died</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>15 yr</td>
<td>Moderate wasting</td>
<td>Neck</td>
<td>Died</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>18 yr</td>
<td>Moderate wasting</td>
<td>Neck, face (inability to open left eye because of extensive eyelid swelling), trunk up to hip level, arms up to fingers</td>
<td>Survived</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>4 mo</td>
<td>Severe wasting</td>
<td>Neck, extending to chest wall and oropharyngeal swelling</td>
<td>Survived</td>
</tr>
<tr>
<td>7</td>
<td>F</td>
<td>8 mo</td>
<td>Severe wasting</td>
<td>Neck</td>
<td>Died</td>
</tr>
<tr>
<td>8</td>
<td>M</td>
<td>15 yr</td>
<td>Severe wasting</td>
<td>Chest, abdomen, right arm, left shoulder</td>
<td>Survived</td>
</tr>
<tr>
<td>9</td>
<td>M</td>
<td>8 mo</td>
<td>Severe wasting</td>
<td>Neck</td>
<td>Died</td>
</tr>
</tbody>
</table>

*World Health Organization definitions and World Health Organization growth standards were used to express the level of malnutrition. Severe wasting: weight for height Z score <-3 or mid upper arm circumference <115 mm. Moderate wasting: weight for height Z score <-2 or mid upper arm circumference <125 mm.
54% to 100% of cases.1,5,9 Association of subcutaneous and mediastinal emphysema and pneumothorax varies from 4% to 75%.1,9

The differential diagnosis of subcutaneous emphysema includes pertussis, severe asthma, direct trauma, barotrauma, tuberculosis, as a complication of certain surgical procedures and infection with gas forming bacteria. We clinically excluded all of the potential etiologic factors above in each of our patients. Tuberculosis was not confirmed in any of our patients, but cannot be completely ruled out.

Subcutaneous emphysema is a rare complication of measles. Some large studies do not report any cases. Case series report incidence of up to 6.4% in a subpopulation of children with complicated measles.1 Incidence in our settings is high, most likely because of high rates of severe malnutrition in the camps.

Treatment of subcutaneous emphysema is mainly supportive. Because of high rates of pulmonary bacterial super infection, broad-spectrum antibiotics are generally recommended. Surgical interventions (drainage of pneumothorax and tracheostomy) have been performed successfully.5

Measles can lead to high case fatality rates especially when outbreaks occur in displaced populations.10 The case fatality rates reported for subcutaneous emphysema are variable and are likely to be a reflection of resources available and have been reported to be as high as 50% (Table 2).

**REFERENCES**


**COMMUNITY-ASSOCIATED STAPHYLOCOCCUS AUREUS INFECTIONS IN OTHERWISE HEALTHY INFANTS LESS THAN 60 DAYS OLD**

Cecilia Torres Day, MD, †† Sheldon L. Kaplan, MD, †† Edward O. Mason, PhD, †† and Kristina G. Hulten, PhD ††

Abstract: Community-associated (CA) Staphylococcus aureus (CA-MRSA) infections were reviewed in 179 infants (60–60 days) from June 2006 to June 2011. CA-MSSA accounted for 16 of 44 (36%) in year 1 up to 12 of 25 (48%) in year 5 (P = 0.08). Abscess/cellulitis infections were more likely (P = 0.006) to be caused by CA-methicillin-resistant S. aureus (67%) versus other manifestations of infections (46%). Among 160 isolates, 13% were clindamycin resistant and 63% were USA300.

**Key Words:** community-associated Staphylococcus aureus, neonates, infants, pulsulosis

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**STAPHYLOCOCCUS AUREUS** causes infections ranging from localized pustulosis to invasive cases in neonates and infants.1 The emergence of community-associated (CA) methicillin-resistant S. aureus (MRSA) has complicated the diagnosis and management of S. aureus infections in this age group.2,3

We reviewed CA-S. aureus infections in healthy infants ≤60 days old at Texas Children’s Hospital (TCH) from June 2006 to June 2011 to determine (1) if the proportion of CA-methicillin-susceptible S. aureus (MSSA) infections increased relative to infections caused by CA-MRSA as had been noted in older children at TCH after 2007,4 (2) if any changes in diagnostic evaluations and management had occurred since our previous study on CA-S. aureus infections in neonates1 and (3) the microbiologic and molecular characteristics of the associated CA-S. aureus isolate.

**PATIENTS AND METHODS**

**Study Design and Patient Population**

We identified from a prospective S. aureus surveillance study previously healthy infants ≤60 days old evaluated in the TCH Emergency Center (EC) and from whom S. aureus was isolated.