Bronchiolitis and Hypoxia: Discharge on Oxygen from the ED is a viable alternative to hospital admission

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Faculty Disclosure Information

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I do not intend to discuss an unapproved/investigative use of a commercial product/device in my presentation.
Changes You May Wish to Make in Practice

- Conduct a feasibility analysis of a home oxygen program in your community
- Contact successful programs for keys to success and barriers
- Create a system to track outcomes
Background

• Bronchiolitis
  – Most common reason for hospital admission in children <1 year of age
  – 120,000-150,000 hospital admissions/year in the US
  – Hospitalization rates have been increasing dramatically over the last 2 decades
    • Shay D et al, *JAMA*, 1996
• 500-700 million dollars/year
The Epidemic of Bronchiolitis

**Figure 1.** Bronchiolitis Hospitalizations Among US Children Younger Than 1 Year or 1 to 4 Years, by Month and Year of Discharge, 1980-1996
Background

Figure 1. Observed (labeled points) and predicted (continuous lines) nos. of monthly admissions for bronchiolitis, asthma, and any respiratory illness/1000 children in each age cohort, by age group, are shown. For example, the denominator for age 0–6 months is the total no. of children born within 6 months, and the denominator for age 6–12 months is the no. of children born 6–12 months before the admission month.

Figure 2. Hospital admissions for bronchiolitis/1000 children aged 0–48 months.
Effect of Oxygen Supplementation on Length of Stay for Infants Hospitalized With Acute Viral Bronchiolitis

Stefan Unger, MBChB, BSc, Steve Cunningham, MBChB, MRCPCH, PhD

Department of Respiratory and Sleep Medicine, Royal Hospital for Sick Children, Edinburgh, United Kingdom

Unger, Pediatrics, 2008
Background

• So, what do we know?
  – Bronchiolitis admissions are dramatically increasing
  – We use the pulse ox data in our decision to admit
  – Patients stay in the hospital just for oxygen

The uncritical use of oximetry data is an example of how our medical students and residents have come to worship at the shrine of numbers. Their religion holds that if information is expressed in digits, if a whistle blows, a bell rings, or a light blinks, the truth is revealed. Clinical judgment is seen as subjective and therefore less valid. This deceptive reasoning saps the confidence that is so important in order to be an effective physician.

Speaking of parents, what about cardiorespiratory monitors that now are attached to virtually every child who breathes? We physicians know that these ubiquitous monitors are attached so nurses don’t have to spend time taking vital signs. But many parents who fixate on the monitors think they provide life support and are dismayed when they are abruptly disconnected when the child is discharged (“But how will we know if she’s okay?”).
What do we know about home oxygen?

• Answer: Not much
When in doubt, send out a survey

The following questions were asked: “Do you discharge patients with bronchiolitis home on oxygen?” “How long should the patient be off oxygen before discharge?” “What level should the patient’s oxygen saturations be on room air before discharge?” “Do you discharge patients home if they are still wheezing?” “Should a patient be at baseline home p.o. intake or is adequate hydration sufficient?” “How long should a patient be off deep suctioning before discharge?” “Do you use home health care nursing for your bronchiolitis patients, and if so, what therapies are ordered?” The results were as follows.
Results-survey

Fifteen of 17 respondents said they “never” or “rarely” discharge patients home on oxygen. If the patient must be off oxygen before discharge, 6 hospitals required 24 hours or overnight off oxygen, 4 required 6 to 12 hours off oxygen, and 4 required 4 to 6 hours off oxygen. Eleven hospitals required saturations of 92% to 93%, with 2 accepted saturations of 88% to 90%, and 2 required saturations of at least 94% before discharge. Some hospitals do sometimes send patients home on oxygen. One hospital reported that they would discharge the patient with saturations >85% on a room air challenge provided that the saturations can increase to 90% with no more than .5 lpm oxygen. Another hospital stated that if the child’s oxygen saturation on room air challenge is 82% to 84%, they would send the child home on oxygen as long as there are means of transportation and communication and there are no smokers in the household.

All institutions indicated that they send patients home despite continued wheezing, and 12 felt that they could be discharged as long as the children are drinking adequately to prevent dehydration. Three hospitals do not use deep suctioning for their bronchiolitic patients. Seven require the patient to be off deep suctioning for at least 12 hours, while 6 other institutions allowed shorter periods off deep suctioning before discharge.
What do we do?

• Turn crisis into opportunity
• No Inpatient beds; Boarding common
• Clinical assessment has been replaced with pulse oximetry

Whose fault?
• Inpatient folks who can’t discharge people!
• This hospital doesn’t care about the ED! We can never be “full”
• The pulse ox is the problem.....
• Victims everywhere.....
A Randomized Trial of Home Oxygen Therapy From the Emergency Department for Acute Bronchiolitis

Lalit Bajaj, MD, MPH, Carol G. Turner, MD, Joan Bothner, MD

*Department of Pediatrics, Section of Emergency Medicine, University of Colorado Health Sciences Center/Children's Hospital, Denver, Colorado; bAspen Park Pediatrics, Conifer, Colorado

The authors have indicated they have no financial relationships relevant to this article to disclose.
### TABLE 2 | Inclusion/Exclusion Criteria

**Inclusion criteria**
- 2–24 mo, minimum of 44 wk after conceptional age
- Clinical diagnosis of bronchiolitis defined as an acute respiratory illness associated with nasal congestion, cough, diffuse wheezing or crackles, and tachypnea or retractions
- Chest radiograph consistent with viral bronchiolitis
- First episode of wheezing
- Room-air saturation of ≤87% on arrival to the ED
- Family has transportation to return to PCP or ED 24 and 48 h after discharge from the ED
- Lives at altitude ≤6000 ft (1829 m)
- Lives ≤30 min from an emergency medical facility
- Caregivers must maintain a smoke-free environment defined as no smoking in house or car
- Caregivers must have a contact telephone number

**Exclusion criteria**
- Preexisting cardiac, pulmonary (including bronchopulmonary dysplasia), neuromuscular, or nutritional (including failure to thrive) disorders and preexisting congenital or acquired airway anomalies
- <44 wk after conceptional age
- History of apnea
- Acute bacterial pneumonia as defined as a focal infiltrate on chest radiograph
- Prior episode of wheezing
- Room-air saturations >87%
- No available transportation for follow-up visits
- Lives at altitude >6000 ft (1829 m)
- Lives >30 min from health care facility
- Steroid administration
- Caregivers unable to stay with patient in observation unit

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**Diagram:**

- Nasal deep suction
- 2 albuterol treatments via nebulizer over 60 min
- Chest radiograph
- Informed consent obtained and random assignment to home or hospital

**Home**
- ED observation for 8 h

**Hospital**
- Treatment at attending physician’s discretion
  - 1-wk telephone follow-up with caregiver
  - Chart review
  - Discharge on ≤1 L O₂ via nasal canula
    - 24/48-h follow-up visits
    - 72-h telephone follow-up with caregiver and PCP
    - 1-wk phone follow-up with caregiver
TABLE 3 Demographics/Clinical Characteristics of Randomized Patients (n = 92)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Overall (n = 92)</th>
<th>Home (n = 53)</th>
<th>Inpatient (n = 39)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mo</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>7.8</td>
<td>7.6</td>
<td>8.2</td>
<td>.606^a</td>
</tr>
<tr>
<td>Range</td>
<td>2–23</td>
<td>2–21.4</td>
<td>2.1–23</td>
<td></td>
</tr>
<tr>
<td>Gender, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>52 (57)</td>
<td>29 (55)</td>
<td>23 (59)</td>
<td>.424^b</td>
</tr>
<tr>
<td>Female</td>
<td>40 (43)</td>
<td>24 (45)</td>
<td>16 (41)</td>
<td></td>
</tr>
<tr>
<td>Maternal age, y</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>27.06</td>
<td>26.68</td>
<td>27.59</td>
<td>.541^a</td>
</tr>
<tr>
<td>Range</td>
<td>16–43</td>
<td>18–43</td>
<td>16–43</td>
<td></td>
</tr>
<tr>
<td>Initial RDSS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>4.23</td>
<td>4.13</td>
<td>4.43</td>
<td>.366^a</td>
</tr>
<tr>
<td>Initial room-air saturation, mean, %</td>
<td>85.0</td>
<td>84.3</td>
<td>85.8</td>
<td>.208^a</td>
</tr>
<tr>
<td>8-h RDSS, mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>2.28</td>
<td>2.31</td>
<td>2.25</td>
<td>.876^a</td>
</tr>
<tr>
<td>Range</td>
<td>0.485</td>
<td>0.436</td>
<td>0.560</td>
<td>.037^a</td>
</tr>
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</table>

^a Student’s t test.
^b χ² test.
<table>
<thead>
<tr>
<th>Variable</th>
<th>24/48-h Visit Questionnaire at PCP Office (33 of 37), n (%)</th>
<th>72-h Telephone Questionnaire (33 of 37), n (%)</th>
<th>7-d Telephone Questionnaire (35 of 37), n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caregiver satisfied at home</td>
<td>32/33 (97)</td>
<td>31/33 (94)</td>
<td>34/35 (97)</td>
</tr>
<tr>
<td>Caregiver preference</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td></td>
<td>26 (79)</td>
<td></td>
</tr>
<tr>
<td>Hospital</td>
<td></td>
<td>5 (15)</td>
<td></td>
</tr>
<tr>
<td>No preference</td>
<td></td>
<td>2 (6)</td>
<td></td>
</tr>
<tr>
<td>PCP preference</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td></td>
<td>21 (64)</td>
<td></td>
</tr>
<tr>
<td>Hospital</td>
<td></td>
<td>9 (27)</td>
<td></td>
</tr>
<tr>
<td>No preference</td>
<td></td>
<td>3 (9)</td>
<td></td>
</tr>
<tr>
<td>PCP satisfaction</td>
<td>31/33 (94)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate instruction</td>
<td></td>
<td>33/33 (100)</td>
<td></td>
</tr>
<tr>
<td>Parent observation length</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Too short</td>
<td>1 (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>13 (40)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Too long</td>
<td>15 (45)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No opinion</td>
<td>4 (12)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Still on $O_2$ at 1 wk</td>
<td></td>
<td>4/35 (11.4)</td>
<td></td>
</tr>
</tbody>
</table>
### Table 6: Hospitalized Patients (n = 33)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hospitalized Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 33)</td>
</tr>
<tr>
<td>Length of stay, d</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>1.83</td>
</tr>
<tr>
<td>Range</td>
<td>0.58–6.33</td>
</tr>
<tr>
<td>&gt;3 d of hospitalization, n/N (%)</td>
<td>5/33 (15.2)</td>
</tr>
<tr>
<td>Discharged on home O₂, n/N (%)</td>
<td>26/33 (79)</td>
</tr>
<tr>
<td>Telephone questionnaire at 7 d, n/N (%)</td>
<td>33/33 (100)</td>
</tr>
<tr>
<td>Caregiver preference</td>
<td></td>
</tr>
<tr>
<td>Home, n (%)</td>
<td>12 (36)</td>
</tr>
<tr>
<td>Hospital, n (%)</td>
<td>16 (49)</td>
</tr>
<tr>
<td>No opinion, n (%)</td>
<td>5 (15)</td>
</tr>
</tbody>
</table>

### Table 7: Days Missed From Work: Home versus Hospital

<table>
<thead>
<tr>
<th>Days Missed</th>
<th>Home (n = 37)</th>
<th>Hospital (n = 33)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1.72</td>
<td>2.69</td>
<td>.145*</td>
</tr>
</tbody>
</table>

* Student's t test.
Bajaj et al

• Now what do know?
  – Feasible - yes
  – High parental satisfaction
  – Safe – uhhh..not sure
  • Insufficient power to analyze risk factors for unscheduled returns and subsequent admissions to the hospital

What next?

• But now we have a problem.......  
• Everyone (Including the PCPs) loves home oxygen, so we can’t randomize anyone  
• So what do we do?
What now? – Need some standardization

• Convene a task force!
  – ED
  – Pulmonary
  – Respiratory Therapy
  – Nursing

• Then..........a miracle occurred....we all agreed

• Home Oxygen Protocol is Born!
Now has become standard of care

- Age 3 -18 months with a minimum of 48 weeks (corrected for pre-maturity)
- First episode of wheezing
- RA saturation <88% on arrival or at any time in the emergency department
- Reliable transportation, social situation and phone number
- Lives at an altitude of ≤ 6000 ft
- Lives within 30 minutes from emergency medicine facility
- No apnea
8 hour observation

- Discharge criteria:
  - Saturations of ≥90% on ≤ 0.5 L/min nasal cannula oxygen while awake, asleep and feeding
  - Able to maintain hydration
  - No signs of deteriorating respiratory status
  - Attending/caregiver comfortable with discharge home
  - 24 hour follow-up arranged with either PCP or ED

- Respiratory therapy contacted and home oxygen arranged
Meanwhile
Discharged on Supplemental Oxygen From an Emergency Department in Patients With Bronchiolitis

AUTHORS: Sarah Halstead, MD, Genie Roosevelt, MD, MPH, Sara Deakyne, MPH, and Lalit Bajaj, MD, MPH

Section of Pediatric Emergency Medicine, Department of Pediatrics, University of Colorado Denver, Children’s Hospital Colorado, Aurora, Colorado
Decreases Admission by 30%

**Figure 1**
Disposition of patients diagnosed with bronchiolitis.
Cost

• 3600$ (cost) for an uncomplicated bronchiolitis hospital admission
• 2005-2009: > 2 million in cost savings
What is the community impact?
• Prospective Observational Study
• 2011-2014
• Bronchiolitis and hypoxia diagnosed in ED
• Plan for discharge home on $O_2$ per guidelines:
  – Uncomplicated bronchiolitis (1st time wheezing)
  – Age 3-18 months; minimum of 48 wks corrected prematurity
  – Oxygen saturations <88%
• 8 hour observation period in the ED on oxygen
  – Pulse oximetry ≥ 90% on ≤ 0.5 LPM oxygen
  – Maintaining hydration without frequent deep suctioning
  – No signs of deterioration
  – Caregiver and Physician comfortable with discharge home
• 24 hour follow-up arranged with PCP or in ED if PCP unavailable
Methods

• Post discharge
  – Caregivers contacted by phone on approximate post-discharge days 3, 7, 14 (and 28 if still on O₂ during the previous call)
  – Subjects not reached by phone were mailed a survey via post mail or email and/or PCPs were contacted regarding missing data
  – Electronic health records were reviewed for subjects who were eligible for the home oxygen program but subsequently admitted to the hospital.

• IRB approved
275 Eligible for Home O₂

- 50 Admitted (18.2%)
- 224 Home on O₂ (81.8%)
- 1 Home on Room Air (0.4%)

- 195 Completed Course at Home (94.6%)
- 11 Returned & Admitted (5.4%)
- 18 Lost to Follow-up (8%)
<table>
<thead>
<tr>
<th></th>
<th>Home oxygen patients (n=224)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ED testing</strong></td>
<td></td>
</tr>
<tr>
<td>- CBC/BCx</td>
<td>0</td>
</tr>
<tr>
<td>- CXR</td>
<td>27 (12%)</td>
</tr>
<tr>
<td>- Viral Testing</td>
<td>13 (6%)</td>
</tr>
<tr>
<td>- UA/UCx</td>
<td>7 (3%)</td>
</tr>
<tr>
<td><strong>ED treatment</strong></td>
<td></td>
</tr>
<tr>
<td>- Albuterol</td>
<td>10 (4%)</td>
</tr>
<tr>
<td>- Racemic epinephrine</td>
<td>4 (2%)</td>
</tr>
<tr>
<td>- Hypertonic Saline</td>
<td>4 (2%)</td>
</tr>
<tr>
<td>- Steroids</td>
<td>1 (&lt;1%)</td>
</tr>
<tr>
<td>- Antibiotics (OM)</td>
<td>49 (22%)</td>
</tr>
</tbody>
</table>
Community Outcomes

• 224 patients over 2 seasons (2011-2014)
• Similar return rate: 5.4%
• Median time on oxygen: 7 days
• 87% families would choose it over hospital with another child
• 36% of the children in day care could bring their child to daycare
• Median missed work days: 1 day
Distribution of lowest O₂ Sats
Conclusions

• This data supports previous retrospective admissions data on HOT for bronchiolitis.
• 8 hour observation period identifies a cohort that is ultimately admitted.
• The HOT guidelines and practice of ED discharge on HOT for bronchiolitis are reliable, safe, and an effective way to decrease hospitalizations.
• Caregivers are comfortable with HOT and prefer it to hospitalization.
Dissemination
• To assess current knowledge, practice, and feasibility of home $O_2$ programs for bronchiolitis throughout North America.
Methods

Design:
- Cross-sectional survey
- Administered via the AAP SOEM listserv over a 3-month period via RedCap web-link.

Participants:
- Practicing attending or fellow ED physician members of the AAP SOEM.

Survey Development:
- Survey underwent formal validity testing via modified Delphi method using clinical experts. Test-retest reliability was excellent ($\alpha = 0.98$).
Methods

Measurements:

• Assessed current practice, physician knowledge, and opinions on hypoxia via multiple-choice questions.
• Likert scales were used to assess Institutional readiness (10 point), and barriers (5 point) to initiation of home O₂
• A barrier rating of ≥4 was considered a “major barrier.”
• Readiness of ≤3 was considered “Unready”
• Data was analyzed using descriptive and comparative statistics
Results

• 320 of 1229 (26.0%) SOEM members responded
• 293 surveys were eligible for analysis
Demographics

• Respondents were primarily:
  – Pediatric ED attending physicians
  – Academic institutions (84.1%)
  – Working in EDs with volumes of >50,000 visits/year (65.2%)
  – Spread across all regions.

• 70.1% practice at an altitude of <2000ft
Defining Hypoxemia

- The median $O_2$ saturation at which providers would initiate supplemental $O_2$ was 89%.
Current Practice

• Disposition

For hypoxemic patients with bronchiolitis, Providers currently recommend:

- Admission: 93%
- Home O2: 5%
- Other: 2%
Current Practice

- CXR: 10%
- Viral Testing: 20%
- Trial of Albuterol: 50%
- None: 50%
Knowledge of Home O$_2$

- 84.5% knew that home O$_2$ was being used in current practice
- only 10% knew the basics of home O$_2$ protocols
Presence of Essential Components of Home O₂ Programs
Feasibility and Readiness for Home O₂

• 51% felt that Home O₂ is FEASIBLE at their institution
• The median READINESS score was 3 (IQR 1,4)
• 85% of providers felt that home O₂ was safe for patients with bronchiolitis
• What is an Acceptable “Bounceback” Rate?
  • 40% thought 10%
  • 10.5% thought up to 15% was acceptable
Major Barriers to Home O₂ Programs
Limitations

• Survey limited to AAP SOEM members. Therefore little data from non-academic or general EDs.
• 26% response rate
• Survey relies on provider report of personal practice and awareness of institutional and community resources.
Conclusions

- ED providers are familiar with home O₂ therapy for bronchiolitis, though current use is infrequent.
- Current work-up/treatment practice not in concordance with 2014 AAP Bronchiolitis Guidelines
- ED providers felt home O₂ is feasible at some institutions though self-reported readiness for implementation was poor.
- Changes in ED infrastructure may be necessary to facilitate implementation of home O₂, in addition to institutional, provider, and caregiver education.
References

For more information on this subject, see the following publications:

