positive effect of the use of steps would be implemented by adjusting the bed height to the rescuer's knee height.

However, the setting of the present study was opposite to that assumed by the hypothesis. Although the authors wanted to verify that the use of steps would increase CPR quality, the height differences between the manikin and children as rescuers were increased when they used steps (T1, T2, and T3). Therefore, steps affected CPR quality adversely in the present study.

The major difference in the experimental environment between previous studies and the present study was whether the manikin was on the bed or on the floor. If the author had used the same setting with the manikin on the bed, the effect of using steps would be positive.

Even though they did not verify the positive effects of steps, I agree that the results have significance. By elevating the rescuers' location above the standard position (T0), they created a favorable environment to load the rescuer's weight onto the compression area. This environment might increase the chest compression depth because the rescuer can load their weight more easily than in standard position. However, the results showed that the chest compression depth (CCD) decreased when the height of steps increased. This result might be caused by a leaning effect. Increasing rates of incomplete recoil might reflect the leaning effect. However, the occurrence of leaning could not be confirmed because the rate of incomplete recoil further decreased at the highest step (15 cm). The authors could show data (leaning depths) for each group, to confirm whether leaning depth increases according to step height.

Although the CCD was maximized when the bed height was the same as the rescuer's knee height, it decreased significantly when the bed height was 20 cm higher than the knee height of the rescuer in a previous study [4]. The setting in the present study is the same whether the bed height is used with a rescuer's knee height, knee height – 5 cm, knee height – 10 cm, and knee height – 15 cm. Therefore, significant differences in CCD according to different step heights might not be obtained with a small number of study participants, considering the results of the previous study [4]. Instead, the results of the present study explain why the CCD did not decrease significantly when the bed height was 20 cm lower than the rescuer's knee height.

In conclusion, the present study offers a deeper understanding of the environment needed for high-quality CPR. Although the anthropometric characteristics of children as rescuers were different among the study participants, it was confirmed that the height difference between the patients and the children might affect CPR quality, similar to that with adult rescuers. Further study is warranted, including use of another setting to confirm the effect of height difference on CPR quality.

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Bellows sign: A novel sonographic sign for the detection of segmental atelectasis

Point-of-care ultrasound examination of the chest has evolved into a radiation-free bed-side diagnostic tool for a variety of pulmonary disorders, including pneumothorax, pleural effusion, consolidation, edema and ARDS [1-3]. The detection of atelectasis by ultrasound, however, remains a diagnostic challenge.

Atelectasis presents as primary or secondary. During secondary atelectasis, the lung is externally compressed by air or fluid in the pleural space. The diagnosis of secondary atelectasis by ultrasound is demanding, but feasible [4,5]. Primary atelectasis, caused by airway obstruction, results in complete lung, lobar or segmental collapse. Ultrasonography allows early detection of total lung collapse with the "lung pulse" sign, consisting of transmission of the heart beat to the pleural line through collapsed lung tissue [6]. The recognition of primary lobar or segmental atelectasis using ultrasound hasn't been previously described.

We recently identified in a mechanically ventilated 42-year-old patient a novel ultrasonographic pattern that is indicative of primary segmental atelectasis. The patient was admitted to the RICU because of bilateral pneumonia and respiratory failure, requiring mechanical ventilation. Past medical history included hepatitis C, mild chronic kidney disease and drug addiction but no lung disease. Chest-X-ray on admission showed multiple areas of consolidation and a mediastinal shift to the right, allegedly secondary to atelectasis (Fig. 1A). We performed ultrasonography of the lower anterior chest wall (area marked with an arrow on Fig. 1A) using a Philips CX50 ultrasound device (Phillips Medical Systems, Andover, MA, USA) and a phased array probe with 1–5 MHz frequency range. We demonstrated an abnormal inward movement pattern that shortened the distance between adjacent ribs and between two nearby B lines, (Fig. 2A and B). With resolution of atelectasis, mediastinal displacement and the aberrant ultrasonographic movement pattern resolved completely (Fig. 1B). We propose to term this novel point-of care ultrasonographic sign that is indicative of segmental lung atelectasis as the "Bellows Sign".

Primary segmental atelectasis as result of bronchial obstruction impedes segmental lung expansion during inspirium, because air entry into the involved lung segment is impeded and because of negative pressure distal to the bronchial obstruction. As result, the movement of the chest wall during breathing is not accompanied by normal parallel expansion of the lung. In the absence of adhesions between the visceral and the parietal pleura, "lung sliding" is still present, but the usual to and fro movement is replaced by a centripetal motion, as the hyper-echogenic pleural line appears to converge onto its own center. During the inspiratory phase and in the presence of segmental atelectasis, when the ultrasound transducer is placed to show two coalescing ribs, the ribs and their acoustic shadow demonstrate a converging motion pattern, with the distance separating them diminishing. During the expiratory phase, the entire field appears to re-expand. Interestingly, the "comet tail" and the "B lines" artifact follow the same characteristic centripetal movement during inspiration. The "Bellows Sign" correlates with the "intercostal retraction sign" of atelectasis that is seen over the chest wall by plane observation. Because the ultrasonographic picture is enlarged on the screen, the movement of the involved

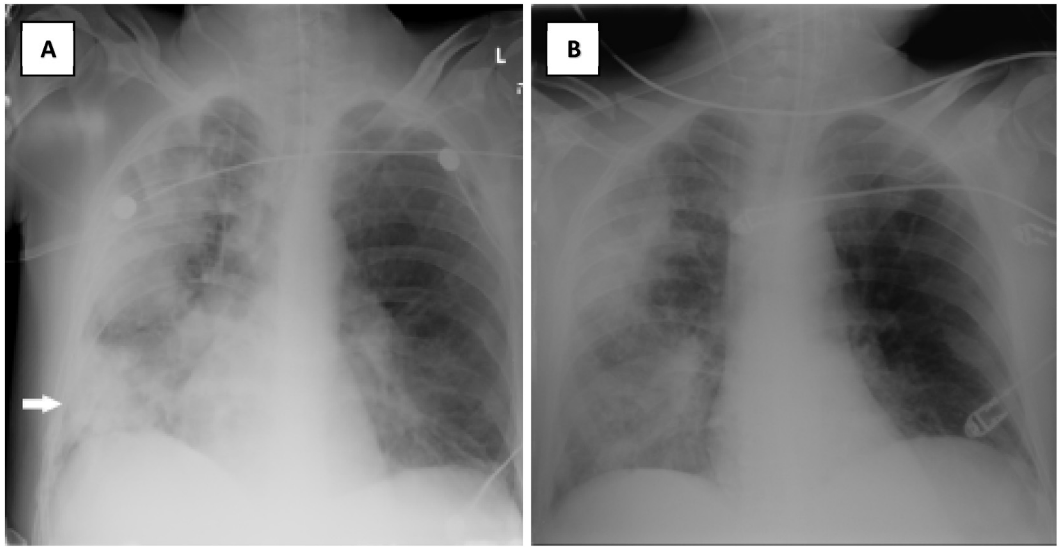

Fig. 1. Chest-x-ray showing (A) large pulmonary large infiltrates in the right lung field, with the mediastinum deviated to the ipsilateral side, hallmarking atelectasis (arrow indicates insonated area), and (B) after resolution of atelectasis and return of mediastinum to its normal position.

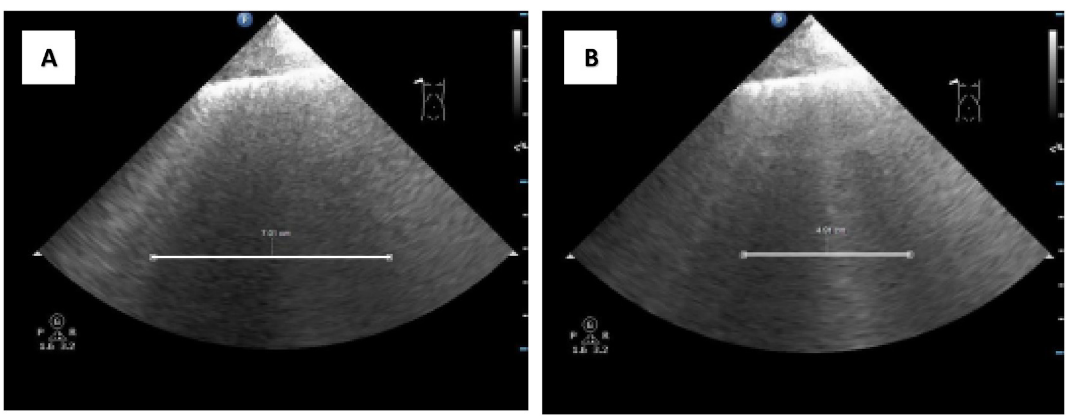

Fig. 2. Ultrasonographic "bellows sign" of the segmental atelectatic lung area, with the distance between the "B lines" (A) 7 cm upon expirium and (B) 5 cm upon inspirium, with enhancement of a "B line" in the center field.

structures is magnified and can be readily recognized by a trained operator. The motion pattern resembles closing and opening of bellows (the B lines and the ribs' attenuation can be viewed as the handles of hand-operated bellows at work), hence the term "Bellows Sign". This sign can be detected during spontaneous breathing, as well as during patient-triggered mechanical ventilation, and can serve for bed-side point-of-care diagnosis.

Ultrasonography using the "Bellows Sign" may be advantageous to chest x-ray, in which minor segmental atelectasis could be easily missed. As retraction of the lung (rather than anticipated expansion) occurs during the inspiratory phase, the paradoxical nature of the movement can be fully appreciated only by simultaneously sensing the respiratory phase with the operator's hand keeping the probe in place. Such changes are difficult to demonstrate with still photos, but are detectable on real time, as lung ultrasonographic pattern recognition relies on movement. Computed tomography can also detect subtle changes seen with segmental atelectasis but is rarely indicated in seemingly stable patients, considering the radiation exposure, the high cost and the marginal benefit.

Segmental atelectasis may be of minor clinical significance, but it may herald major bronchial obstruction and impending lobar atelectasis. Recognizing even minor segmental atelectasis can direct to corrective strategies, such as physiotherapy, posture changes, recruitment maneuvers and elevation of end-expiratory pressures in ventilated patients, thus preventing further respiratory deterioration, if timely implemented. Real-time ultrasonography at the patient's bedside without the risks of radiation or contrast material is thus a promising novel tool for the detection of primary segmental atelectasis.

There are limitations to the ultrasonographic technique to diagnose segmental atelectasis. Point-of-Care ultrasonography requires training and expertise that are not available in all medical facilities. And yet, Point-of-Care is a discipline that is rapidly evolving worldwide. Second, there is need for specific training aimed at recognizing the ultrasonographic features of ribs, "lung sliding" and "B lines". Such skill that can be acquired, however, with short training. Third, incomplete assessment of the chest may miss segmental atelectasis on an otherwise normal lung. Therefore, a thorough methodological scrutiny of the entire chest wall is required. Fourth, an appropriate transducer needs to be adapted to the patient's body habitus, to allow a field depth of at least twice the distance from skin to pleura. Fifth, in a dyspneic patient, muscular contraction can render assessment of rib movement difficult. Nonetheless, the movement pattern of the B lines, when present, is easily recognizable. Finally, subcutaneous emphysema, if present in concurrently with pneumothorax or pneumomediastinum, may obscure the ultrasonographic chest examination.

The novel "Bellows Sign" provides for the first time a bed-side tool for the diagnosis of primary segmental lung atelectasis. The sign incorporates demonstration of aberrant ultrasonographic lung sliding and typical movement patterns of the B lines and ribs that result from collapsed lung tissue that remain immobile while the surrounding lung and chest wall are expanding. However, since this is only the first description of the sign, it cannot yet be recommended to replace other diagnostic modalities. The sensitivity and specificity of this sign for primary segmental atelectasis of the lung still require validation in comparative clinical studies. Nonetheless, the potential advantages of this novel point-of-care diagnostic technique for a fairly common clinical condition in the intensive care setting are uncontestable.

Authors' contribution to the manuscript

Conception and design: DJ, AY, AB; Analysis and interpretation: DJ, AY, YY, AB; Drafting the manuscript for important intellectual content: DJ, AY, YY, AB.

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Epidemiology of and risk factors for iliopsoas abscess in a large community-based study

The psoas muscle is closely adjacent to organs such as kidneys, sigmoid colon, jejunum, appendix, pancreas, abdominal aorta, and ureter [1]. Iliopsoas abscess (IPA) is an uncommon infective clinical condition, often with nonspecific signs and symptoms. IPA is classified based on its origin, with primary IPA thought to be triggered by an unrecognized staphylococcal bacteremia, and secondary IPA caused by an underlying condition or disease, or spread of infection subsequent to surgery [2]. Symptoms of IPA vary due to the location of the psoas muscle, but the classical clinical presentation includes fever, back pain and difficulty ambulating [2]. Delays in diagnosis may lead to increased morbidity and mortality. Modern imaging techniques such as ultrasonography, computed tomography (CT) and magnetic resonance imaging (MRI) are often used to confirm IPA diagnosis. There is no uniform treatment strategy for IPA, however therapy usually consists of broad-spectrum antibiotics, often combined with percutaneous or surgical drainage [3]. Our study objectives were to assess the epidemiology, risk factors, clinical features, and prognosis of patients presenting to emergency department (ED) with IPA.

This was retrospective cohort analysis to determine the prevalence, imaging features and clinical conditions associated with IPA in patients presenting to the EDs of seven affiliated hospitals in West Michigan. All eligible cases were seen between January 2006 and December 2017 (12 years). IPA was classified as primary or secondary, depending on the presence or absence of underlying disease. The diagnosis was made based on diagnostic imaging (CT or MRI) performed in the hospital. ED records were used to collect data on prevalence and risk factors for IPA, demographics, associated signs and symptoms, imaging results, and treatment provided (particularly surgical procedures). Hospital records were used to determine treatment provided (particularly surgical procedures), hospital course, complications and morbidity. Descriptive statistics (mean, SD) and frequency tables were used to describe the key quantitative and qualitative variables.

During the study period, 128 patients met inclusion criteria. The mean age was 62.1 ± 17.9 years; age range 11 to 93 years. The typical patient was elderly (48%), Caucasian (85%), and male (61%) with multiple co-morbid conditions. Risk factors included diabetes (25%), renal failure (12%), immunosuppression (9%), previous IPA (8%), inflammatory bowel disease (7%), alcoholism (7%), IV drug use (4%), malnutrition (4%) and HIV (2%). Presenting symptoms were often nonspecific, with an average duration of 17.1 ± 11.2 days. Pain was present in 92% of patients with localization to the back, flank, abdomen, pelvis or hip. Other clinical features included malaise (21%), fever (11%), leg swelling (9%), and altered mental status (9%). The classic triad of back pain, fever and limitation of hip movement was seen in only 14% of patients; a mass lesion was documented in only 3%.

Overall, 19 IPA cases (15%) were primary; 85% secondary. Among the 109 secondary IPA cases, the most common etiologies were skeletal (46%), followed by gastrointestinal (28%) and cardiovascular (14%) (Table 1). Primary abscesses were often monomicrobial, with *Staphylococcus* spp. as the predominant pathogen (93%). Secondary IPA were often polymicrobial (27%), with *Staphylococcus* still accounting for 69% of cases, followed by *E. coli* (16%), *Bacteriodes* (12%), *Prevotella* (10%), *Fusobacterium* (8%), *Enterococcus* (7%), *Streptoccus* (7%), *Klebsiella* (5%), and *Salmonella* (2%). CT confirmed the diagnosis in most patients (71%), followed by MRI (26%), white blood cell nuclear scan (2%), and ultrasound (1%). MRI was useful in patients with a poor treatment response or high suspicion for infection of adjacent structures. The diagnosis of IPA was made in the ED in only 32 patients (25%). Common admitting diagnoses were septic arthritis, pneumonia, sepsis, osteomyelitis, acute febrile illness, diverticulitis, pyelonephritis, altered mental status, and musculoskeletal back pain. Patients were initially treated