TRANSCRIPT TRANSMITTAL MEMORANDUM

DATE: February 6, 1998
TO: Donna Taylor-Kolis, Esq.
FROM: Maxine D. Marshall

CASE NAME: Michelle Mack
v.
University Hospital Health System, Inc.

NAME OF WITNESS: Robert s a Holzman, M.D.

DATE TAKEN: January 29, 1998

Dear Ms. Kolis:

Enclosed please find your copy of the transcript of the deposition given by Dr. Holzman in the above-entitled matter on Thursday, January 29, 1998.

Would you please have Dr. Holzman read and sign his deposition before any notary, if required. If there are any suggested corrections, please have him make them on the errata sheet provided. It should be noted that no changes may be made to the transcript.

The errata/signature sheet should then be forwarded to Mr. Groedel for inclusion in the original transcript, retaining a copy for your records.

Thank you for your cooperation in this matter,

Very truly yours,
Maxine D. Marshall
Maxine D. Marshall

Enc.
Cc: Marc W. Groedel, Esq.

ATTACH TO DEPOSITION OF: Robert S. Holzman, M.D.

CASE: Michelle Mack,
v.
University Hospital Health System, Inc.

ERRATA SHEET

INSTRUCTIONS: After reading the transcript of your deposition please note any change or correction to your testimony and the reason therefor on this sheet. DO NOT make any marks or notations on the transcript volume itself. Please sign and date this errata sheet (before a Notary Public, if required).

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I have read the foregoing transcript of my testimony taken on Thursday, January 29, 1998, and except for any corrections or changes noted above, I hereby subscribe to the transcript as an accurate record of the statements made by me.

_____
(Signature of Deponent)

SWORN TO AND SUBSCRIBED BEFORE ME
THIS _____ DAY OF _____,
____, AT _____.

_____

MY COMMISSION EXPIRES: _____

VOLUME: I
PAGES: 1 - 82
EXHIBITS: (3)

THE STATE OF OHIO
COUNTY OF CUYAHOGA
IN THE COURT OF COMMON PLEAS

MICHELLE MACK, Administratrix
of the Estate of JENNIFER MACK,
Plaintiff,
) Civil Action
v.) No. 322444

UNIVERSITY HOSPITAL HEALTH
SYSTEM, INC., et al.,
Defendants.

DEPOSITION of ROBERT S. HOLZMAN, M.D., taken on behalf of the Defendant, pursuant to the applicable provisions of the Ohio Rules of Civil Procedure, before Maxine D. Marshall, Certified Shorthand Reporter and Notary Public in and for the Commonwealth of Massachusetts, at the Children's Hospital, 300 Longwood Avenue, Boston, Massachusetts, on Thursday, January 29, 1998, commencing at 10:20 a.m.

PRESENT:

DONNA TAYLOR-KOLIS, ESQ.
330 Standard Building
Cleveland, Ohio 44113
for the Plaintiff

REMINGER & REMINGER
Marc W. Groedel, Esq.
The 113 Saint Clair Building
Cleveland, Ohio 44114
for: the Defendant

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EXHIBIT 5

P R O C E E D I N G S

(Exhibit Nos. 1, 2 and 3 marked for identification,)

ROBERT S. HOLZMAN, M.D.

A witness called for examination by counsel for the Defendant, being first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. GROEDEL:

Q. Dr. Holzman, we've met. My name is Marc Groedel and I'm here to take your deposition because you have been identified as an expert witness in this case. Have you ever been deposed before?

A. I have not been deposed before,

Q. Okay. I'm going to ask you questions pertaining to yourself, your background, and your review of this case. It's important for you to give me answers in an audible fashion; try to say yes, no. Don't nod your head, shrug your shoulders or say uh-huh or uh-uh because that way we may not be clear as to exactly what your response is when we read the transcript, **Okay?**

A, I understand.

Q. Also, if you need to take a break for any reason, let me know and I'm sure we can accommodate you. If you need to answer a beeper or whatever, it's not a problem,

Donna has provided me with a copy of your CV, and prior to the deposition you indicated that for all practical purposes it's up to date, And this is your CV dated July 23, 1997?

A, That's correct,

Q. While we're talking about your CV, can you tell me whether or not there are any writings in there by you that you would deem pertinent to the issues of this case?

A. Just for the sake of completeness, may I reviewed it so I can be more precise? There are some that I can recall offhand would be pertinent, but let me just check to be sure.

There are several, some of which you have indicated here as highlights. I would say in particular the Crisis Management Anesthesiology book that was edited by Gaba; the review article that appeared in the Pediatric Clinics of North America; a review article. There are others that are tangentially related, but I would say they are

probably not directly related.

Q. But the ones that you've previously identified you would consider directly related?

A. I would say that there are aspects within those articles that touch on similar issues.

Q. Anything else in there?

A. Nothing else that would be directly related.

Q. Okay, thanks. Describe for me your current practice?

A. I'm a full-time pediatric anesthesiologist at Children's Hospital, on full-time faculty at Harvard Medical School.

My clinical practice consists entirely of the practice of pediatric anesthesiology in the operating room at Children's Hospital.

Q. What percentage of your time do you spend providing anesthesia services versus anything else you might do?

A. 60 percent of my time, three days a week, is devoted to clinical services in the operating room, and 40 percent of my time is devoted to non-clinical services where I am a member of

various committees. I have time for research, for writing, for activities of the medical school and for various other administrative duties that I have at this point in my career.

Q. And you're certified in what specialties?

A. Anesthesiology.

Q. Board-certified?

A. Board-certified in anesthesiology.

Q. To become a pediatric anesthesiologist, one does not need to be certified in pediatrics beforehand or afterwards?

A. That's not required.

Q. Okay. Is there some sort of added certificate of requirements that you have obtained in your subspecialty field?

A. At this point there's no recognized subspecialty certification. What there is by general agreement is experience in a pediatric anesthesia fellowship at a recognized fellowship training center. My pediatric anesthesia fellowship was done at Children's Hospital National Medical Center in Washington, D.C., and that's indicated on my CV.

Q. Right. And your hospital privileges are

also indicated on your CV as well?

A. That's not ordinarily a part of the organization of the CV at Harvard. So my hospital privileges are active staff; is that what you mean?

Q. Where are they at, your hospital privileges?

A. You have to clarify.

Q. At what hospitals do you have privileges?

A. This hospital, Children's Hospital. Some of our consulting hospitals where pediatric patients are given care, such as Brigham and Women's Hospital and Beth Israel Hospital, and in addition I have privileges at several community hospitals in the outlying area.

Q. Since the completion of your training, have you ever worked in an emergency room?

A. I have never worked in an emergency room.

Q. Did you work in an emergency room while you were in training?

A. As part of my internship I had rotation responsibilities at the emergency room where I did my internship.

Q. So you probably spent about a month or so in the ER?

A. My recollection is about a month in the emergency room, and of course anesthesiologists provide services in emergency rooms on a consultation basis,

Q. Have you ever been employed as a house officer in a similar position that Dr. Irefin was in at the time in question?

A, As a moonlighter,

Q. Yes.

A. Yes.

Q. When was that?

A, That has been in the past, and in fact it continues now. That's why I continue to hold some privileges at community hospitals in the surrounding area, because I do provide such services even through the present time.

Q. What sort of services do you provide?

A. Anesthesiology services.

Q. Is that to provide services as an anesthesiologist for an operation?

A, Yes.

Q. In your experience as a pediatric

anesthesiologist, have you ever been required to perform an emergency intubation of a child?

A. Yes.

Q. Approximately how many times would you say you've had to do that in your career?

A. It would be safe to say thousands.

Q. Generally speaking, what are the types of things in your experience that have required you to perform emergency intubations?

A. One would have to distinguish between several situations where that might be required. There are emergency intubations, for example, in the operating room where one would have to take care of patients that couldn't be intubated by somebody else. And they may be children who are not in distress but may simply have a difficult airway requiring more expertise, more familiarity with the airway and greater experience.

Other situations, for example, as a member of the code team would require my presence and expertise at sites outside of the operating room, and children who are in medical distress, respiratory distress in a code situation would require securing of the airway with an endotracheal

tube.

So I would say that it would probably be situation-dependent.

Q. Have you ever been called to emergently intubate a child in an emergency room setting such as what we had here?

A. Yes.

Q. Approximately how many times has that happened in your career?

A. It would be difficult to put a number on that. It could be a thousand. It could be a little bit less. It could very easily have been more.

Q. And I assume that of those thousand or so cases, there were some situations where you had to intubate a child because, among other things, he or she was suffering from severe stridor?

A. Yes.

Q. Or other signs of respiratory distress?

A. Yes.

Q. In your career have you ever had a situation where you were unable to successfully intubate a child and as a result the child required a surgical airway?

A. No, I have not had that.

Q. Does the inability to intubate a child and the need for a surgical airway necessarily mean that the intubation was carried out in a substandard fashion?

A. Could you repeat that?

Q. Sure. If you have a situation where a physician has been unable to complete an oral intubation successfully and as a result has required a surgical airway to be established, does that in and of itself mean that there was substandard care in the intubation attempts?

A. No.

Q. So even though it hasn't happened to you, you can envision a scenario where someone would be unable to complete an oral intubation successfully and they would have to go on to do a surgical airway?

A. Absolutely, yes. And there are a variety of specific circumstances where that might be the case.

Q. What would they be?

A. For example, there are patients who have extremely difficult airways because of anatomic

abnormalities. The mouth may not be able to be opened easily. They may have abnormalities of the jaw. A conventional laryngoscopy might not be able to be easily accomplished, and there may be circumstances where the appropriate equipment may not be readily available as it might be in other situations where having planned for an elective difficult airway one would be prepared with specific equipment or specific consultants who could use that equipment in an expert fashion.

On the other hand, there are alternatives that are commonly available even if one can't intubate to go ahead and provide adequate oxygenation and ventilation while a surgical airway is being planned and equipment for surgical access is being gathered.

Q. What are those?

A. There are other airway devices as alternatives, including conventional bag mask valve ventilation. There are laryngeal masks that are available as airways and there are a variety of alternative pieces of equipment that can be used even if one can't use a conventional laryngoscope.

Q. You mentioned anatomic abnormalities as

one potential reason why one wouldn't be able to intubate a child. What other reasons are there generally speaking that might prevent somebody from successfully completing an intubation?

A. It's conceivable that experience might be a factor as well, And I think that in those circumstances it might be -- if one was in a situation that was less familiar by virtue of experience os training, then it might be harder to know when one has achieved a successful end point.

My guess is that those circumstances are probably relatively rare, Since by training through, residency training in anesthesia one gets exposed at least for several months to pediatric anesthesia, for example.

Q. Do you perform cricothyrotomies or emergency tracheostomies?

A. I don't perform them. I'm familiar with the anatomy. I'm familiar with what I would have to do should it be required. Fortunately I've never had to perform that.

Q. You mentioned before the deposition that you reviewed the records from Bedford Medical Center, the records from the University Hospitals

covering the terminal admission, the chest x-ray and the depositions of Nurse Sharp, Dr. Irefin and Dr. Douglas. I think that's everything that you reviewed?

A. Yes.

Q. I take it you didn't review any literature, medical literature, specifically for this case?

A. No, I didn't.

Q. I take it that reviewing medical malpractice cases is something that you do relatively infrequently?

A. I do relatively infrequently. Probably not more than two a year.

Q. Before this case, had you ever reviewed any other cases for Ms. Kolis?

A. NO.

Q. How did she come to find you to review this case?

A. It was through one of the neuroradiologists here at Children's.

Q. Who referred her to you.

A. Yes.

Q. Have you ever testified in a case as a

medical malpractice expert either by way of deposition or in trial?

A, No,

Q. So this is the first time you've given a deposition as an expert,

A. Yes,

Q. I'm going to hand you what we've had marked as Holzman Exhibit 1, and for the record can you identify that for us, please?

A. Yes,

Q. What is it?

A, It's a letter that I wrote to Ms. Kolis dated January 5th, summarizing my initial impressions from my review of the initial materials that were made available to me from this case,

Q. What materials were those?

A, I'll read back from the first paragraph.

Q. Okay. It says in the letter, okay,

A, Yes, The materials included the emergency room records from University Hospital Bedford Medical Center, a chest x-ray film taken at UH-Bedford, the University Hospitals of Cleveland admission records, and the UH-Bedford emergency room records provided by the parents,

Q. And Holzman Exhibit No. 2 is what?

A. That's a list that I make for myself when I review the materials. It's a working list that helps me organize my thoughts based on the sequencing of materials that I read that are made available to me. In this particular instance these were the three depositions of Dr. Irefin, Mr. Sharp and Dr. Douglas.

Q. And Holzman Exhibit 3 is what?

A. This was a series of questions that I had about the materials that I reviewed.

Q. There's red handwritten notes on that exhibit; whose writing is that?

A. That's my handwriting.

Q. All right. Can I have those back? Thank you.

How would you characterize Jennifer Mack's condition when she was first brought to the emergency room?

A. From my review of the records, her signs and symptoms seemed compatible with upper airway obstruction. She presented with signs and symptoms of respiratory distress and biphasic stridor.

Q. Would you characterize her condition as

that of severe respiratory distress at the time of admission?

A, I would say she was in severe respiratory distress. Her vital signs were compatible with that and her physical exam was compatible with that.

Q. And is it your belief that this distress was being caused by an upper airway obstruction?

A. Her signs and symptoms were compatible with that, yes.

Q. And in her case what was causing the upper airway obstruction?

A. You would formulate a differential diagnosis based on her presentation. She certainly had by her history a history of prior croup, and this seemed perfectly compatible with croup. Other considerations would have been epiglottitis, foreign body obstruction, some other form of extrinsic airway compression. But it was certainly compatible with croup.

Q. Based upon the subsequent records from UH that you've looked at, would you be able to rule out the other diagnoses and come to a probable diagnosis of severe croup in this case?

A. Yes. And in fact I think that you could come to that as the most likely diagnosis based on her history and based on the sequencing of events in her treatment within the first half hour of arrival.

Q. Is severe croup a potentially life-threatening problem?

A, Yes.

Q. Why is that?

A. There are several reasons, The first reason, of course, is that if there's complete airway obstruction, then that's a life-threatening problem altogether,

The second reason is that there is in the underlying pathophysiology of croup the question of why it occurred in the first place. It could, for example, accompany a viral illness, and that viral illness could cause both upper airway obstruction as well as pulmonary dysfunction or lung dysfunction making it more difficult for a patient to oxygenate and ventilate. So there could be both lung disease as well as tracheal disease or subglottic disease.

The third problem that can occur with

croup is as a consequence of the mechanics of breathing, in order to breathe against a very tight airway, for example, if one has to -- one can imagine, for example, being choked and having a great deal of difficulty inspiring. That work of breathing in order to generate a negative pressure within the chest sufficient for someone to ventilate their own lungs can cause pneumothorax or lung collapse as well as pneumomediastinum or collapse around the great vessels and cardiac structures.

So that in fact severe croup is a very different disease entity from the mild barky croup that many parents are familiar with with their own children.

Q. And in your opinion this was a case of severe croup,

A, In my opinion this was a case of severe croup.

Q. And I don't think I asked you this: Can you define for the record what severe croup is?

A. There are a number of ways to define that. Let me begin by the pathophysiology of what croup is.

If one could take a look at the trachea of the patient who has croup, the trachea is a cartilaginous structure that has a basement membrane and a lining of mucosa around it. So if one imagines a tube with several layers of lining within it, that lining can either be applied more tightly or more loosely. The mucosa, when it's applied very tightly, doesn't dislodge. And just for purposes of elucidating for the record, one can imagine two surfaces sliding over each other. That can either be tighter or looser.

The looser a basement membrane is the more susceptible it is to swelling, edema, as a result of either traumatic injury or bacterial or viral injury.

There are populations of patients, most particularly children, who have loose basement membranes, and they may in fact be born with that or may be a consequence of early intervention in life, for example, intubation in ex-premature babies.

Regardless of how one has a loose basement membrane, if you have a cold or an upper respiratory tract infection, if you're such a

patient you can easily develop croup, And there are children who have chronic croup who generally tend to outgrow it as they age by the time they may be six, seven, eight years of age because that basement membrane will become more tightly applied,

So croup pathologically is an abnormality of the mucosa, mucosal lining of the trachea,

Symptomatically what happens is that as a patient develops the barky cough, if the edema and swelling of that mucosa swells to the point where it significantly impairs air flow, then that air flow will become more turbulent, and the turbulence of the air flow will create biphasic stridor, inspiratory stridor and expiratory stridor, That, in turn, will create more difficulty for the work of breathing. So that small children will consume more energy, will have to breathe faster, will develop respiratory distress, And as they develop respiratory distress, the efficiency of their breathing decreases dramatically.

As they become more anxious, the

process will worsen and it develops into a spiral of worsening respiratory distress.

Many times if children can relax and slow their breathing, interestingly enough their breathing will become more efficient because they are not generating as much turbulence across a narrowed segment of their airway. However, most children can't control that, so they become more anxious, it becomes more difficult for them to breathe and they require some therapeutic intervention.

Q. The records indicate that when Jennifer Mack was brought to the emergency room, she was very agitated; you're aware of that?

A. Yes.

Q. Would it be fair to state that that agitation was probably due to her being hypoxic at that time?

A. That would be one mechanism of helping to explain it. In the largest context it is probably explicable by hypoxia as well as agitation as well as the work of breathing as well as fear. So I think that there's a constellation of problems that combines to form the clinical picture, but it's

certainly compatible with a child in respiratory distress,

Q. Are you able to tell us what amount of hypoxia Jennifer had sustained by the time she reached the emergency room?

A, From my review of the records it states that her saturations measured by pulse oximetry were in the 80s. It also states that it was difficult to obtain those saturations in several places. And I can easily envision that it probably was. She was probably very agitated. It was probably very difficult to keep a pulse oximeter probe on her. But from the record it's indicated that her saturations were in the 80s.

Q. Which would be indicative of what?

A, That would be indicative of hypoxia.

Q. Mild? Moderate? Severe?

A, That would be moderate hypoxia.

Q. There's some reference in the record to Jennifer being cyanotic upon admission. Would that be indicative of some degree of hypoxia as well?

A. That would be indicative of hypoxia as well. And I think, if I recall correctly, the description was a description of perioral

cyanosis. I don't recall seeing a description of nail bed cyanosis or skin cyanosis. So from that description and from the physical findings and the saturation findings I would put together a portrait of a child who was in moderate to severe respiratory distress at that point.

Q. With moderate to severe hypoxia?

A. I would say with moderate to severe hypoxia. It's a continuum. It's a spectrum. So again, looking at the large picture, looking at the vital signs, looking at the respiratory rate, it would put together for me a picture of moderate to severe respiratory distress.

Q. The child's temperature was noted to be at 95.6; does that have any significance to you in this setting?

A. I think it's very difficult to use that as a corroborating portion of the diagnosis. I'm not sure where that temperature was taken,

Q. There is a "T" next to it; what would that mean? I didn't know.

A. It's a T. Perhaps tympanic membrane. An ear thermometer, I think it would be very difficult to know how to put that together with

this picture. And I'm in my mind not sure that it's material to the sequencing of events.

Q. I didn't think it was. I was just wondering what you thought too.

A. I don't find it so.

Q. Her blood pressure was 90 over 60 on admission. Does that have any significance to you?

A. Not particularly. I think that that's a blood pressure that's a little high for that age. Certainly compatible with the distress that she was experiencing; and in fact, I'm surprised that it was actually that low.

Q. Initially she was treated with racemic epinephrine; do you agree with that course of treatment?

A. Yes, that would be the initial treatment that I think most people would undertake with the diagnosis of croup.

Q. And does it appear as though that treatment did not work?

A. It appears that way. And in fact, in some portion of the record, I don't remember exactly where, it was stated that that was ineffective as an intervention.

It seems to me that there are a variety of reasons why it could have been ineffective, including perhaps the patient's mental state and inability to cooperate at that point in time.

Treatment with racemic epinephrine in an agitated five-year-old would be difficult in an uncooperative patient. So it's not surprising to me that it may not have been effective. But it may have been ineffective because of the inability to deliver it rather than an incorrect therapeutic choice. I believe that it was a correct therapeutic choice at that point.

Q. Would the severity of the underlying disease process also be one reason why perhaps it didn't work?

A. It could be a reason why it didn't work. Although if it was effectively delivered and you made a decision after the delivery that the patient appeared to be getting better, then you might repeat the treatment.

So 1 think that that's something that is done in a sequencing of events, It's not at all unusual to require several racemic epinephrine

treatments for severe croup.

Q. Now, I take it you're aware from your review of everything in this case that Dr. Irefin first attempted to intubate the child with a No. 5 endotracheal tube?

A. Yes.

Q. Is that an appropriate size to use for an initial attempt?

A, Yes, it is. That would be an appropriate size by this patient's age,

Q. And you're aware of the fact that he was unsuccessful in completing the intubation with that tube?

A, Yes,

Q. What's your understanding as to why he was unsuccessful?

A, From my review, and I believe it was either from his statement in deposition or from the note, I can't remember the source, he said that he was able to pass the tube between the cords but it couldn't be advanced below the level of the cords, the vocal cords,

Q. I've seen references in the records to true vocal cords and false vocal cords; can you

explain the difference for me?

A. The structure of the larynx is such that there are two vocal folds. In the superglottic space, the initial vocal folds are the so-called false vocal cords. There is an area between the true vocal words which are just underneath the false vocal cords called the laryngeal ventricle, and then true vocal cords which provide the inlet to the larynx. The larynx is really the space between the true vocal cords and the subglottic space lies just underneath that. So if one is looking at a tubular structure, there is an invagination initially and then a small space and then a second invagination. And those are the true vocal cords. And then blow that is the subglottic space.

Q. What's your understanding as to why he was unable to complete the intubation with the No. 5 tube?

A. From the review and from my understanding of the pathology and the pathophysiology and the anatomy of croup, it's most likely that he was unable to pass the tube beyond the true vocal cords because of the swelling in the subglottic space,

which was compatible with her signs and symptoms.

Q. So I take it then that you are not critical of him for his inability to intubate with a No. 5 tube,

A. In fact I'm not surprised at that at. all.

Q. You don't blame him for trying, though, do you, with a No. 5?

A. It was a perfectly good selection of an age-appropriate tube.

Q. And the records indicate that he then used either a 3 or a 3.5 tube to complete the intubation, I take it you don't have any problem with the use of that size tube?

A. One has to select the tube that will fit. He could have just as easily been successful with a 4.5 or a 4. It would be impossible to know a priori. The fact that the 3 or a 3.5 seemed to fit I think is perfectly fine.

Q. Is a 3.0 or a 3.5 tube shorter than a 5 tube?

A. Yes.

Q. What's the difference in length?

A. I would have to measure them to tell you precisely.

Q. Are they standard sizes?

A, They are standard sizes.

Q. So I could go to any endotracheal tube kit and whatever I see would be the same size tube that you're looking at as well most likely?

A. The dimensions of all endotracheal tubes, regardless of manufacturer, are set by the American National Standards Institute.

Q. Is there a greater risk of an accidental extubation when one is using a smaller tube than usual?

A. That's a difficult question to answer. That depends on a number of factors. The first factor is how the tube is secured, The second factor is that there is some difference in the resilience of the tube, in that a smaller tube is thinner and shorter and it's more subject to bending. So in that sense it's somewhat less resilient.

There's absolutely no question that even a small endotracheal tube can be secured and can provide a perfectly adequate airway, For example, we intubate small babies all the time with small endotracheal tubes. So I would say the

bigger the tube the more easily it's secured, but that doesn't imply that even a small tube can't be secured well and provide a perfectly adequate airway.

Q. Based upon what you've seen in this case, does it appear as though the first intubation by Dr. Irefin was accomplished at about 12:40?

A. I think that it was perhaps accomplished a little bit later than that. From my review of the time sequence, and it's marked on the concurrent emergency room record that appeared to be kept by the nurse, that at **0040** the time was indicated as Dr. Irefin's arrival, and the administration of versed, v-e-r-s-e-d. At **0043** succinylcholine, s-u-c-c-i-n-y-1-c-h-o-1-i-n-e, was administered. And within a minute the patient was intubated. So I would say that the patient was probably intubated at 0044.

Q. And would I be correct in assuming that up until 12:44 a.m. you don't have any standard of care criticisms of Dr. Irefin as of yet?

A. From my review I don't find anything to be particularly critical about. **There are** some things missing from the record. It's unclear, for

example, whether the patient was preoxygenated on the record prior to the administration of the versed and the succinylcholine.

Q. That would be something, a standard thing that a physician should know to do, continue to oxygenate the patient,

It would be a standard measure, and that is bag masking the child with oxygen, while giving medications prior to completing the intubation?

A. Yes, that would be standard. And although there's no indication of that, there's no indication that it wasn't done, So while it would be difficult for me to assume any level of practice, I would assume that a pediatric patient in respiratory distress was probably receiving oxygen at the time that these medications were given.

Q. In this setting is that something that would probably be done by the respiratory therapist?

A, It could have been done by the respiratory therapist. In this setting it's most likely to have been done by Dr. Irefin, because he

would in all likelihood want to control the bag mask valve ventilation prior to laryngoscopy intubation.

Q. How does one confirm that an endotracheal tube has been properly placed?

A, There are a variety of ways of doing that, Primarily it is physical examination, physical diagnosis and devices that are generally recognized as indicators of successful intubation.

The first method, of course, is when you're doing the direct laryngoscopy you can see the endotracheal tube passing between the vocal cords, The second method is to listen to the chest and confirm that there are breath sounds bilaterally. The third method is to look at the chest and see the chest rising and see that there are symmetrical excursions.

The reason that symmetry is important is that one can have the tube placed too deeply, and so looking for symmetry in chest wall excursions is another method.

Another method is to look for a flash of water vapor in the tube during exhalation. That in and of itself is not totally reliable, but the

presence of it commensurate with other signs of physical diagnosis helps to confirm that the tube is in place,

In addition to those physical diagnosis criteria, there are criteria that are established by medical devices, The best device for confirming placement of an endotracheal tube is the detection of carbon dioxide in the end-tidal breath, That can be done in a number of ways, There are colorimetric, c-o-1-o-r-i-m-e-t-r-i-c, end-tidal C02 detection devices, and they provide either a qualitative or a semiquantitative way of assessing the presentation of carbon dioxide in the exhaled breath.

There are also a variety of devices that are available, the technology of which is infrared analysis or mass spectrometry analysis or Raman scattering analysis.

Q. Why don't we just limit your answers to what would be relevant to an emergency room setting like this,

A. In the emergency room, the most likely device to be used would be a qualitative or semiquantitative end-tidal CO2 analysis device,

Q. And that device simply tells us that CO_2 is being exhaled, which confirms that we've got the tube in the trachea as opposed to the esophagus?

A. Yes. It's possible when an esophageal intubation is done that in the initial few breaths that are delivered end-tidal CO_2 can be detected, especially in a patient who has been receiving positive pressure ventilation.

For example, there is some carbon dioxide in the stomach. Usually that is extinguished, that volume of carbon dioxide is extinguished within the first several breaths. So that even if carbon dioxide is detected, it will only last two, three, four breaths, and then the indicator will indicate that no carbon dioxide is being detected. That distinguishes it from placement in the trachea where continuous repeat carbon dioxide is detected.

In addition to that, the natural history and progression of the patient and resolution of the problem helps to determine the adequacy of the placement of the endotracheal tube because oxygenation will improve if you're dealing with a hypoxic patient on the basis of inadequate

pulmonary ventilation.

There are other reasons for hypoxia that may not have to do with problems in the lungs. And in that case, the hypoxia may not resolve. But for most patients who have pulmonary problems as the cause of their hypoxia, their hypoxia will get better.

Q. It's your opinion that the first intubation was completed successfully?

A, Yes.

Q. Can an endotracheal tube become dislodged in an agitated patient even if it has been properly secured?

A, Yes,

Q. Has this ever happened to you?

A, Yes,

Q. How does one detect tube dislodgment?

A, There are a variety of ways, and they're all mirror images of the ways that I described to detect the adequacy of tube placement. So, for example, in an end-tidal CO2 device that is detecting the breath-to-breath presence of carbon dioxide, one would note its absence, One would note the absence of breath sounds, the absence of

the chest wall rising. And in the general large picture of whether the patient is getting better or getting worse, clearly the patient will begin to get worse.

Frequently one can audibly hear, for example, the delivery of positive pressure through the mouth or in the pharynx. If the tube has become dislodged, one can hear the sounds of air being delivered through the mouth.

Occasionally, in small children, one might even detect bubbling through the nose, for example, because of retrograde air delivery.

Q. And this tells us the tube is now in the esophagus as opposed to the trachea?

A. It wouldn't necessarily have to be in the esophagus to do that. For example, it could be sitting in the pharynx. One of the more common things, especially with the shorter tubes that are less resilient, is that if the patient coughs it out, they may cough it into their oropharynx even if it's secured with tape or any other securing device.

Q. Do you have an opinion in this case as to when Jennifer's endotracheal tube first became

dislodged?

A, Yes, I do,

Q. What is that?

A. Although I don't have an exact time.

Q. Give me a time frame or a period, if you can,

A. As I went through the times between -- and we can look back in the record if you like for a reference -- between 0040 and 0052, at the time of the cardiac arrest and the beginning of resuscitation, the most logical sequence it seemed to me was, as I started to outline before, she was probably intubated around 0044 or 0045. Under the influence of succinylcholine, which is a very rapidly acting neuromuscular blocking agent, it probably wouldn't take any longer than two or three minutes for her to start recovering from the effects of that neuromuscular blockade. That would bring us to somewhere around 0047 or 0048,

Having seen this situation many times, been involved with the situation many times, it would be most logical to me that the sequence of events would be as follows: The patient started to recover from the neuromuscular blockade, started to

move around. She could have easily reached up to try to pull the tube out herself. She could have started moving her head around, resuming the same struggle that she had had just previously because that was certainly her behavior before,

And at that point it was unclear to me how the tube was secured, Not that that would necessarily guarantee it remaining in place, as I outlined before. The tube could have been secured with tape or could simply have been held by the hands of Dr. Irefin or the respiratory therapist at that point. But sometime probably commensurate with the recovery from the neuromuscular blockade, around 0047 or 0048 is the most likely time that when the patient resumed moving or struggling, that the tube was probably dislodged. It seemed to me that that was recognized by the caretaking team as well, because it was at that point that she was reintubated.

Q. So you believe then that there was a timely recognition of the ET-tube's dislodgment?

A. Yes.

Q. And what do you believe transpired after the tube was recognized as being dislodged?

A. It seemed to me that it was replaced, and it was probably replaced according to the sequence of events that I reviewed, it was probably replaced prior to the administration of any subsequent neuromuscular blocking drug.

There is a reference that Pavulon was administered after the second tube was placed. And that seems consistent.

There are also references that the placement of the second tube was somewhat difficult, and I think a few people referred to that. Nevertheless, the tube seemed to have been placed prior to the Pavulon administration, and I would put that sometime between 0048 and perhaps 0050.

Q. Do you have an opinion in this case as to when the chest x-ray was taken?

A, I do.

Q. What is your opinion?

A. My opinion is that the chest x-ray was probably taken after the second tube was placed and not after the first tube was placed.

Q. And what's your basis for that opinion?

A. The findings on chest x-ray are

incompatible with the physiology and the history and the natural evolution of what was occurring clinically with the patient. The patient -- would you like me to elaborate on that?

Q. Yes.

A. The patient was intubated by all accounts apparently successfully. There was the presence of end-tidal CO2. There were breath sounds that were confirmed. Her clinical picture got better. Her saturations came up by the nurse's note to 99 percent.

So by all accounts and by natural history and by an understanding of the pathophysiology of respiratory distress, the tube was in the trachea, she was doing exactly what you would expect her to do. And the neuromuscular blockade agent resolved quickly and the tube came out and the tube was replaced.

The chest x-ray findings are not compatible with an endotracheal tube that's placed within the trachea.

Q. You looked at the chest x-rays?

A. Yes.

Q. And I know you've been kind enough to

make a copy of the film for me. Why don't you show for me on the chest x-ray what the pertinent findings are?

MS. KOLIS: Do you have a wax pencil? Okay if you don't. I was just thinking for Marc's purposes if we had you mark with wax you can ask him, I'm just trying to be courteous. You can't write on it with ink, so...

THE WITNESS: Would you like me to try to find one?

MR. GROEDEL: If you can, if it won't take long.

(Discussion held off the record.)

(Short recess taken).

Q. Why don't just go ahead and take a look at the x-ray and describe for me your findings,

A. Sure. If you don't mind me holding it up to the light and if it's adequately transilluminated.

Q. Sure.

A. There are certain findings on here that are important to know about, and let me just begin by saying x-rays can reflect a lot of different densities, The whiter something is then the more

dense it is. X-rays can reflect a number of different densities. And the whiter something is then the more dense it is; and the darker it is then the more lucent it is. Lucency is generally air quality, and darker tissues reflect water density -- strike that, Whiter tissues reflect water density and the whitest tissues reflect bone because they obstruct the passage of the x-ray, So it's very easy to tell the difference between bone, for example, here in the arm or the ribs and air density. And this is clearly an air density because it's very lucent.

There are a number of findings here that are pertinent. No. 1, this is the stomach and this is the intestine that's connected to the stomach, the duodenum. This is compatible with air density because it's very lucent.

Q. You're talking about the stomach and the intestine?

A, Yes.

Q. They have got a lot of air in them, is that what you're saying?

A. They've got a lot of air. If you go up on the film to where the lungs should be, and of

course you would expect that the lungs would have a lot of air in them. Being properly aerated they should have the same appearance as the stomach does. They should look very lucent. And in fact they don't. They look like they have water density or soft tissue density.

Since lungs are normally air-filled structures, if you remove the air from lungs, those the sacks that represent the alveoli collapse, and they provide more of a water density as far as the penetrating x-rays.

So this in fact could be compatible with lung collapse from collapsed alveoli. It could be a bilateral diffuse pneumonia. It could be bilateral pulmonary edema. All of those are possible in a differential diagnosis.

There's another structure here that is filled with air, a long tubular structure that's filled with air. And this tubular structure is connected to the stomach; you can follow it down right through here and right through here and into this portion of the lesser curvature of the stomach. This **structure is** the esophagus. Proximal to this structure is the endotracheal

tube, which is clearly seen because it has radiopaque materials within it.

So there's an endotracheal tube that's placed within the esophagus that's dilating the esophagus just like a balloon would be dilated if it was filled with air.

Within the parenchyma of the lung tissue there are also air bronchograms, and air bronchograms reflect the trapping of air within the conducting airways of the lung that lead to the alveoli. Air bronchograms are these small structures that outline the main stem bronchus and peripheral bronchi.

And it's easy to imagine, for example, that in collapsed lung tissue surrounding the small amount of air that continues to fill these conducting airways, it outlines by contrast the air within those conducting airways.

So this is a picture that is most compatible with an endotracheal tube that's placed within the esophagus, distending the esophagus, massively distending the stomach and a proximal portion of the duodenum also indicating pulmonary collapse.

Q. Is that it?

A. That's it.

Q. When one looks at that chest x-ray, are you able to determine how long the tube had been in the esophagus before this picture was snapped?

A. You can't tell that from the x-ray. The only thing that you can really tell -- let me come back to that, You can't tell how long it's been because of the size and age of the patient, This is 15 kilogram five-year-old. It doesn't take very long to insufflate the stomach of a 15 kilogram five-year-old before you get massive gastric distension compatible with what you see on the film.

Q. Is this picture, this chest x-ray film, compatible with an esophageal intubation that was going on for one minute?

A. Yes. Could have been a minute, could have been a few minutes. But it certainly could be compatible with a minute.

Q. The findings that we see in the child's lungs, do you have an opinion as to what was causing those findings?

A. Yes.

Q. What's your opinion?

A, My opinion based on that film and based on the patient's course at that point in time is that it's most likely, with pulmonary collapse, failure to adequately ventilate, and it reflects alveoli collapse. It is by history not compatible with pulmonary edema, nor is it compatible with bilateral pneumonia,

Q. And why do you say that?

A, Because the patient could be adequately oxygenated several minutes beforehand. If it was a diffuse pulmonary process, then the patient's efficiency of oxygenation wouldn't have resolved so quickly.

Q. You mean after the first intubation?

A. After the first intubation, And since there was no description of pulmonary edema fluid in the endotracheal tube, it doesn't seem compatible with pulmonary edema either, nor would you expect the efficiency of oxygenation if the patient had pulmonary edema to have resolved so quickly.

Q. Do you believe any of the findings on this chest x-ray were caused by the croup that

brought her to the hospital?

A. No.

Q. And so you believe that all of the findings were caused by the esophageal intubation.

A, Yes.

MS. KOLIS: You know I trust Marc enough that I'm going to go to the ladies room. If he asks you anything outrageous, don't answer it,

(Discussion held off the record.)

(Recess taken).

Q. Would you agree that a physician really doesn't need a chest x-ray to confirm whether or not he's got the tube in the trachea?

A. Yes, I would agree.

Q. If I asked you this already or if you told me this, I apologize. But does this film definitively in your opinion show the tube to be in the esophagus as opposed to the trachea?

A, Yes. For all of the reasons that I outlined, including what I think is critical is the patient's normal course of events.

No one reads a chest. x-ray in isolation. Often people are quizzed that way, but in fact the x-ray is only a part of the findings,

And if you put it together with the physical diagnosis, with the natural history and with the evolution of the events, it's all perfectly compatible.

Q. The record indicates that Jennifer was given a dose of Pavulon at 12:50 a.m. Is that your understanding as to when the second intubation was completed?

A. According to the sequence that I've outlined it wouldn't surprise me. And of course I have to guess my best guess as to the sequence of events which I base on my experience and having seen these before. But I would say that probably the second intubation was around 12:48 or 12:49. It certainly would seem that the Pavulon was given afterwards rather than before because it seemed as if she didn't receive a neuromuscular blocking agent for the second intubation. Therefore 12:50 seemed like a perfectly believable time.

Q. Was it appropriate to give Pavulon?

A. I think it's perfectly appropriate. It's something that we very easily might have done here as well. I've certainly been in the same situation where I've done exactly that.

Q. And the purpose of the Pavulon would be for what in this setting?

A. To ensure motionlessness so that her airway could remain secure,

Q. And it's your belief then that following the second intubation, the patient became bradycardic at about 12:52 and went into full arrest at that time?

A. Yes. And again the record would indicate that based on the strip chart of the EKG.

Q. Show me on the strip where it shows that the arrest started at 12:52.

A. Well, that's a difficult problem and I'll tell you why. This is not a continuous strip.

Q. Just take portions of it.

A. Here, the way that the recorder seems to work is that prior to the date is the time stamp, So I would assume that this stamp that I'm indicating here on the strip is 0034. And it indicates a sinus tachycardia, which is perfectly compatible with what her history was. And then at 0052 there is a profound sinus bradycardia. That is compatible with severe hypoxia and an end stage agonal heart rate, particularly in pediatric

patients. Sinus bradycardia is usually the agonal heart rate that precedes cardiovascular collapse and cardiac arrest in children who are hypoxic,

But these are discontinuous, so that right before here there might have been a progressive bradycardia and her heart rate may have slowed to an ominous rate and then became agonal, We can't see that. But again based on my experience it wouldn't be incompatible with this history,

That window of time was really only two minutes between 12:50 and 12:52. So it's not a very long window of time.

Q. Is that surprising to you? Or can somebody --

A, No, it's not surprising at all. It's again perfectly compatible with children,

Q. And so can a patient in this setting, who's been esophageally intubated for two minutes, sustain the arrest that this patient had at about 12:52?

A. Yes,

Q. I take it you're not critical of the fact that the patient was esophageally intubated, are

you?

A. No, That in fact happens to everybody,

Q. Your criticism is that it wasn't in your opinion recognized in a timely fashion?

A. Yes, that's correct,

Q. What would be your opinion as to Dr. Irefin's responsibility to this patient once the code started at 12:52?

A. Well, I think that his responsibility isn't discontinuous. So that his obligation is at the first sign of things not going well, when they had previously gone well, is to doubt the adequacy of the intervention. And I really think that's the essence of the problem. If he hadn't known that beforehand, if he hadn't known that things went well with the initial intubation in the trachea, then he would have less data to go on, For example, he might have thought that the underlying lung disease or the putative underlying lung disease might truly be the cause, But in fact he had information to the contrary, He knew that a patient in respiratory distress got better through his initial intervention. He made a second intervention and the patient got worse. The index

of suspicion attached to that should be very high for saying what could I do to re-evaluate, to doubt, to be skeptical about the adequacy of this tube placement,

Q. And so at what time do you believe the standard of care required Dr. Irefin to question the adequacy of the tube placement?

A, In the two minutes between -- and if we're going according to this hypothetical time line -- in the two minutes between 12:50 and 12:52, what was the evidence to suggest that the tube was in a good position and what was the contravening evidence to suggest that the patient was deteriorating, and how could those two be resolved?

For example, everybody in anesthesia has been in the position to have to doubt and treat their own interventions with skepticism. And it seems to me that even in a short window of time there was ample opportunity to confirm by these same previously utilized physical diagnosis criteria or by chemical criteria or electronic criteria was the tube in the right place.

On the other hand, you're left with a

progressive, almost an inexorable course toward a profound bradycardia, impaired oxygen saturation, Why is the patient getting worse? And what means were available to reassess the adequacy of tube placement?

The end-tidal **C02** detection device that was used initially could have been used a subsequent time. All of the physical diagnosis criteria could have been used. A re-laryngoscopy, which in the record was indicated as having been done, although it's a little unclear to me as to when. I don't know, for example, if the re-laryngoscopy was done during that two-minute interval prior to the cardiac arrest or if it was being done during the cardiac arrest, That's unclear.

But on the one hand, you have a tube that's replaced and some means of assessing whether it's in the correct place, On the other hand, you have a deteriorating patient. And you don't have a lot of time to decide why the patient is deteriorating, but you have the ten minutes preceding that where the problem got better by a simple intervention,

So it seems to me that during that window of time you have to resolve that problem before the patient progresses from a sinus bradycardia to ventricular fibrillation,

Q. Two minutes doesn't seem like an awfully long period of time to be able to make the assessment and accomplish the change, does it?

A. It's a very short time. And the challenge in working with sick children is that you don't have a long time to do that, Their underlying physiology and their metabolic activity and their oxygen consumption and their C02 production doesn't allow you the luxury of several minutes to decide, You really only have a minute or two to decide,

Q. would it be fair to state that, based upon your extensive training and experience in this area, you're more expert in and more attuned to problems associated with intubating a child as opposed to a general anesthesiologist would be?

A, I would say that I'm more comfortable taking care of children than most adult anesthesiologists are, That's what I do,

Q. Are you able to state to within a

reasonable degree of probability that if Dr. Irefin had questioned the adequacy of his tube placement within that two-minute time frame, the arrest would have been avoided?

A. Yes. I would say that within that two-minute time frame, if he had made the diagnosis of an esophageal intubation and had rapidly replaced the tube accurately within the trachea, that the progression of sinus bradycardia to a cardiac arrest would have been avoided.

These are other alternative means available as well, For example, let's say that for some reason it was difficult to replace the tube, or there is difficulty in visualizing the larynx, The essence of the intervention is not necessarily whether the tube was replaced, but whether the patient was oxygenated and ventilated. So for example, one wouldn't have to replace the tube necessarily, One could simply take out the tube that was in the esophagus and simply bag-mask ventilate the patient,

What the patient needed was oxygenation and ventilation. Whether you delivered that by endotracheal tube or by laryngeal mask or

by tracheostomy wouldn't matter at that point.

Q. Do you know if a laryngeal mask airway would have been available in the emergency room at that time?

A. I don't know. They were available commercially in the United States. Whether anybody had used them, had the expertise for it, whether it was available and whether it would have been effective is very hard to determine.

Q. Do you know if it would have been effective if they had simply decided to bag mask the child after pulling out the endotracheal tube two minutes before the arrest?

A. It's impossible to predict retrospectively. In similar situations that I've been in, there is no compulsion to re-intubate the patient if you know that you can adequately bag mask valve the patient.

For example, a patient with a difficult airway who's had an extremely difficult intubation; let's say after an extremely difficult intubation for one reason or another the endotracheal tube somehow becomes dislodged. You don't have to rush as long as you know you can bag

mask valve ventilate the patient. And if you need a surgeon to establish a surgical airway, all you simply have to do is ventilate the patient, provide oxygen.

So that the first priority, the highest priority in a situation like this is to adequately ventilate and adequately oxygenate by any means available, as long as it's quick and easy. And if it's easier to mask the patient and have a surgeon do a tracheostomy, then that would be an appropriate course of treatment.

Q. In light of the patient's severe croup stridor, would that make it difficult to properly oxygenate a child with just a bag and mask?

A. It would make it difficult, yes. The airway is narrowed; there's no question that it would make it more difficult.

Q. So intubation would be the preferred way of oxygenating the child.

A, At that point yes, because the hazard, of course, is that when you apply positive pressure to the airway, not only are you ventilating the trachea, but if you have to use high pressures, you may be ventilating the stomach as well.

Q. Do you believe that Jennifer was taking in any air that was getting into her esophagus and stomach prior to hitting the emergency room?

A. She may have been. Aerophagia is a common accompaniment of respiratory distress.

Q. Are you able to state that if Dr. Irefin had decided to pull out the tube within this two-minute interval and bag-masked the child, that that would have avoided the arrest?

A. It wouldn't necessarily have avoided it. If he was sure that he could deliver adequate ventilation and oxygenation by bag mask valve. For example, if the airway edema was so severe that he couldn't adequately ventilate, then he would simply have to replace either the endotracheal tube or a tracheostomy would have to be performed or a rigid bronchoscopy would have to be performed in order to pass a bronchoscope past the area of obstruction.

In all likelihood they wouldn't have a rigid bronchoscope available in the emergency room and that's something that one would ordinarily have available in the operating room.

On the other hand, it's entirely possible that he could have been able to adequately

ventilate and adequately oxygenate, or get enough oxygen in so that the saturations could have come up to levels that would be more compatible with preventing a cardiac arrest. It's impossible to say that at this point retrospectively.

Q. So just so the record is clear, you're unable to state that bag masking during this interval of 12:50 to 12:52 would have prevented the arrest; is that correct?

A. I'm unable to state with certainty that it would have prevented it. On the other hand, it would be in all likelihood the first thing that I would have donee And in the operating room,, for example, or in other similar situations it's common practice, not only my common practice but common practice among my colleagues, to doubt the placement of the endotracheal tube, to remove it immediately if the patient is doing things that show deterioration and to worry about the adequacy of an endotracheal tube placement afterwards.

So the first thing you do is doubt the adequacy of the tube placement, remove the tube immediately and bag mask valve ventilate.

Q. And in this case, if you had bag mask

ventilated the child, you can't tell whether or not that would have avoided the arrest,

A. I can't predict with certainty whether it would have avoided it. It would have been the first thing I would have done, Again, one has small windows of time to make those decisions, but adequate windows of time. You can tell within five to ten seconds whether or not the situation is getting better, whether you're moving the chest, whether you're moving air. And if the situation is not getting better, you haven't lost much time in five to ten seconds, so you can do a re-laryngoscopy and attempt doing an intubation,

Q. Do you have an opinion as to for how long Jennifer was esophageally intubated?

A. I have an opinion but I don't know a definite amount of time, I do think that she was esophageally intubated from %he time of the second intubation until the time of the tracheostomy. And that opinion is based on the progression of events, the lack of resolution of her oxygen saturation, and the immediate resolution of events once a surgical airway was established.

Now, looking at that time frame,

12:52 is noted as the time of the arrest, and I believe 1:04 was noted as the time of the resolution of vital signs,

Q. During the period that the child was in your opinion esophageally intubated prior to the arrest, she was still breathing?

A. Could you say it again?

Q. Sure. I think you said that she was esophageally intubated at around 12:50 or so,

A. Yes.

Q. And then she arrested at 12:52.

A, Yes.

Q. During that two-minute time frame, she was also breathing, though, true?

A. I don't think so. And the reason that I say that is that she was given Pavulon.

Q. So once the Pavulon was given, she wouldn't be able to spontaneously breathe on her own.

A, Yes, as a neuromuscular blocking agent, it in fact would have committed her to requiring positive pressure ventilation.

Q. So **would it be fair to** state **that** your first standard of care criticism against Dr. Irefin

is his failure to timely recognize the esophageal intubation during the time frame of 12:50 to 12:52?

A, Yes,

Q. And do you have any criticisms, standard of care criticisms, of Dr. Irefin once the code began?

A. The ongoing criticism for the same reason. I think that at any point during that time he, or a member of the team, and I believe that a member of the team actually did point out his doubts, Mr. Sharp, according to his deposition, pointed out his doubts about the adequacy of the tube placement. I don't exactly recall what criteria he used other than this assertion that it appeared to be loose. There may have been other criteria, I'm sorry, I just don't recall. But there was a continuum between 12:52 and 1:04 where at any point someone could have questioned "is this tube in the right place or not?'' I didn't see any evidence questioning that, and it would be something that I think should be appropriately questioned a great. deal,

It seems to me that there were

measures available to assess that. And again, looking at children, the epidemiology of children and why they have cardiac arrests, the problem is generally an airway problem, so one always looks very skeptically at the adequacy of the airway whenever a child isn't resolving as quickly as you would expect.

So I would say that it wasn't only those two minutes; those two minutes were the opportunity for reversibility. The other minutes were the opportunity for resolution, although I think that that was, the reversibility issue, was getting worse and worse during that time.

Q. Your comments that you just made a few moments ago about your awareness of the fact that in situations like this, for children, the airway is usually the reason €or the arrest or problems with the airway. Is that something that you would expect to be within the fund of knowledge of a general anesthesiologist?

A. Yes.

Q. You know, I've never seen this happen, I guess thank goodness, but it's my understanding that if somebody has been esophageally intubated,

it's something that a trained medical person should be able to see fairly easily, isn't it?

A. The answer to that is complex. It's yes and no. First of all, there's the context of the emergency room, and it's a battle field context. It doesn't have the serenity of the operating room and it doesn't have the quiet of the operating room. It's noisy; it's difficult to assess. That's why there are multiple modalities that have some redundancy built into them to help you confirm or deny the adequacy of the placement.

One could say, for example, that you could do a laryngoscopy. Look at the larynx and see whether a piece of plastic is in the trachea or in the esophagus; and intuitively that seems like it would be easy to do. The only problem is that everybody in their training has been fooled. So there's always some skepticism that has to be shed onto that.

One could say that you should always be able to hear breath sounds in the chest, except the smaller the child the more easily you can hear breath sounds anyplace even if a tube is in the esophagus. I've heard breath sounds in the head of

babies, and clearly a tube isn't in a baby's head. So an esophageal intubation, especially in small children, you can certainly hear what you believe to be breath sounds, Again, the reason for the redundancy,, And taken together, even all of those physical signs and biochemical signs have to be combined with a picture of what's going on,

If a patient is doing well and you have all those physical signs, then the tube is probably in the right place. If a patient is doing badly and you think you have most of those physical signs, you have to doubt it and you have to look for further corroborating evidence.

Q. Can you have a physician reasonably think he or she is hearing breath sounds in the lungs when in fact you have an esophageal intubation?

A. Unquestionably,

Q. Can you have a physician reasonably think that he or she is seeing the chest rise symmetrically when you in fact you have an esophageal intubation?

A. You can have them believe that they see it; but that's more difficult, because the chest doesn't rise when you're ventilating the

esophagus, You may think that you see it, and it may depend on the angle that you view the chest from.

For example, one of the ways that I encourage our fellows and residents to look at the chest is not from above, but to actually crouch down to the level of the patient's ear and look and see whether the chest excursions are symmetrical and actually rising. And from that point of view, from that perspective, they can actually see the stomach rising but not the chest.

So there are ways of sharpening the physical diagnostic methods that are less conventional than what one uses with adults,

Q. Can one have an esophageal intubation and not see the stomach rise?

A. Yes, especially if the stomach is already distended, So it's entirely possible. All of those are entirely possible. That's why my emphasis is on the redundancy within the system, One single event can be misleading and you can draw conclusions based on it. The combinations of a variety of events or a variety of diagnostic methods along with a sequencing of events that ten

minutes earlier was good and now is bad, should prompt a lot of skepticism.

Q. Should the use of an end-tidal CO2 colorimetric device be used in this setting during the code?

Am In my opinion yes, If you have a question about the adequacy of the tube placement, then a colorimetric device or some sort of CO2 device I think is an excellent idea.

The issue comes up, of course, whether it's standard of care or standard of practice. And that's been a matter of some dispute. It's certainly standard of practice in anesthesia to accept the fact that the production of CO2 and the detection of CO2 is the sinequanon of adequacy of the airway and integrity of the airway.

That standard has been debated in various other specialties that also have responsibility for securing the airway and resuscitating the patients. There is absolutely no question in my mind that it is the single best way to know that the tube is in. And other methods can fool you and this tends to fool you less.

Should it be used continuously during a cardiac arrest is a complicated question, because the detection of C02 is based not only on the elimination of C02 through the lungs but the adequacy of the cardiac output. And if you have an inadequate cardiac output, then you may not be able to detect C02 even if the tube is in the lungs.

Q. If they used an end-tidal C02 monitor during the arrest, and if it showed the appropriate color change which would be indicative of a tracheal placement, would that lead one away from thinking that they had the tube in the esophagus?

A. Yes.

Q. Can one have an esophageal placement and still obtain normal readings or appropriate readings on an end-tidal C02 monitor?

A. You can, but not for long.

Q. How long?

A. Several breaths is the usual amount of time that it takes to extinguish a CO2 response from an intraesophageal tube.

Q. Dr. Douglas's note would indicate that an end-tidal C02 monitor was used during the arrest?

A. I might have to refer back to that, This

was his dictated note?

Q. It was.

A. I might have to refer back to that, because it wasn't my recollection that he said it was used during the arrest. He said it was used, but I don't recall if he said during the arrest. Can we review that?

Q. Yes, sure, Here I've got it. Down at the end of that,

A, "Of note was that the CO2 monitor was used during the arrest and the ET tube was in place in the trachea according to the CO2 detector."

That's not compatible with the events as I would recreate them,

Q. Why do you say that?

A, Because if the CO2 detector was in the trachea, it should have been detecting CO2. I can't imagine that a patient who so quickly resolved her hypoxia ten minutes earlier would remain persistently hypoxemic leading to a bradycardia, leading to a cardiac arrest with a tube in the trachea. I find absolutely no pathophysiology in the chest x-ray or in the history or in the course of events that's

compatible with that.

As a corroboration of that and having the advantage of hindsight, the problem clearly resolved once a surgical airway was established, And in fact within seconds or a minute of the establishment of a tracheostomy, the patient showed rebound hypertension, adequate oxygenation, adequate saturation and stable vital signs and resolution of the EKG abnormality. So that almost would prove the hypothesis.

Q. Of what?

A. Of an intraesophageal endotracheal tube leading to sinus bradycardia, hypoxemia and cardiac arrest that was almost immediately resolved with the placement of a surgical airway.

Q. Once the arrest started, at what point do you believe it should have been recognized that the patient's airway had not been adequately protected?

A. Well, I believe that I answered this before. There were two phases of opportunity. And understanding the epidemiology of how children respond to hypoxemia, there were warning signs. There was a sinus bradycardia. So once the second

putative intraesophageal tube was placed, there were sentinel signs of the inadequacy of that placement. There was progressive sinus bradycardia. There was impaired oxygenation and the saturation couldn't go above the 60's according to the note. At that point skepticism should have been directed toward the adequacy of placement.

So that was what I would conceptualize as the reversible period. That if the tube had been changed to an endotracheal tube, then that probably would have reversed, and the sinus bradycardia and the oxygenation problem would have been resolved much as it did ten minutes earlier.

After that the patient progressed inexorably to ventricular fibrillation and a full CPR code status for some minutes, perhaps ten or 12, something Bike that, until a surgical airway was placed. And at least according to my review of the depositions, there seemed to be some controversy right in the moments just prior to the tracheostomy about whether the tube was truly in, not in, don't try to manipulate it, or reposition it I think was the word that was used. And at

least a deposition statement suggested that Dr. Irefin said "I've almost got it."

Q. What does that mean to you?

A. I don't know. I don't know what that means. Perhaps on laryngoscopy he recognized that it was either in the pharynx or in the esophagus and was trying to redirect the tip of the tube. That's not always an easy thing to do, especially in the middle of CPR.

As I suggested earlier, sometimes you're simply better off taking the tube out and using the fastest means possible, which is the application of a mask, to oxygenate and ventilate. But it would suggest at the very least that there was doubt at that point about whether the tube was truly in.

To fuel that hypothesis, the immediate resolution by surgical tracheostomy would suggest that in fact the tube wasn't in. Now with the tube being repositioned, it would be difficult for the surgeon to know whether he saw the tip of the intraoro tube or the transoro tube within the trachea,, So he might or might not have seen it. That I don't know. And I don't see any evidence of

that in the statements. But one would think that if one is placing a surgical airway, you might see the tip of the transoro tube in the trachea if it was in the trachea, There is no comment about that so I really can't say.

The salient feature is that the problems resolved as soon as an airway was reestablished, which would suggest that the rapidity of the resolution was dependent on the establishment of an airway and virtually nothing else.

a. Was this patient's course also consistent with the child intermittently being tracheally intubated and esophageally intubated during the arrest as a result of repositioning attempts by Dr. Irefin?

A, I think the patient's course was attributable entirely to hypoxemia. Whether one could even make a case that there was intermittent tracheal intubation, I would need to see continuous monitoring data to know whether oxygenation ever improved. And I really don't have that information. And it probably wouldn't be material to the eventual course, because until the airway

was resecured in a more permanent fashion, there was clearly no resolution, On the other hand, the resolution took place virtually instantly.

Q. Do you have any criticisms of anyone besides Dr. Irefin? I mean standard of care criticisms.

A. I think that's a difficult question because of the collaborative nature of the process. Do I think that -- I'm asking a Socratic question. Do I think that members of the team have an obligation to raise questions with each other? Yes, I do,

I think that Dr. Douglas to some degree, and apparently he did, at a point just prior to the tracheostomy questioned that, questioned the adequacy of the tube placement. And he certainly had the skills available to him as a trained surgeon to surgically access the airway, And as a cardiac surgeon he certainly knew the importance of the adequacy of oxygenation and ventilation and had opportunity within his training I'm sure with some exposure to children in cardiac surgery knowing that bradycardia is a manifestation of severe hypoxemia in children,

On the other hand, he placed great reliance on Dr. Irefin to be an anesthesiologist, And I think that that reliance is appropriate.

Qe The abnormalities in this child's airway that we saw documented in the subsequent records at UH, do you believe that they played a role in the difficulty in intubating her?

A. No, I don't think so,

Q. Why is that?

A. Because the airway anatomy for accessing the larynx by all accounts was perfectly normal. Even in patients with subglottic stenosis, and she had mild subglottic stenosis on subsequent epiglottoscopy (phonetic). We have patients with subglottic stenosis all time. The anatomic difficulties that lead to difficult intubation don't have to do with subglottic stenosis, they have to do with the development of the jaw, the development of the mid-face, their embryological in nature and they really don't have to do with subglottic stenosis. You might have to use a smaller tube. But if that's the only abnormality, you should be able to easily visualize the airway.

Q. You're also then referring to edema of

the epiglottis, false vocal cords?

A. I am.

Q. If she had edema of the epiglottis, the false vocal cords, the true vocal cords, would that have an impact upon being able to intubate her?

A. Yes, it would.

Q. In what fashion?

A. It might make it more difficult to visualize the airway, and in addition to that an edematous epiglottis would make the airway more reactive. So that such patients may be more susceptible to laryngospasm or coughing and simply struggle more.

But this patient didn't have epiglottitis nor did she have signs and symptoms of epiglottitis. She had a history that was not compatible with epiglottitis.

Q. Wouldn't a stridor be consistent with epiglottitis?

A. It could be. But she didn't have a high temperature. She wasn't toxic appearing. She had some drooling. She had some features that are compatible with epiglottitis, but they are also compatible with other findings of upper airway

obstruction.

She certainly had in her history a history of croup, and showing up in the emergency room with a history of croup, with a barky cough, with biphasic stridor without a fever would lead you to the diagnosis of croup as the most likely etiology of the problem.

Q. Do you have an opinion in this case as to the probable cause of Jennifer Mack's death?

A. Yes.

Q. 'What is your opinion?

A. Her cause of death was cerebral herniation from cerebral edema. And my opinion as to the cause of that cerebral edema was a hypoxic encephalopathy. The hypoxic encephalopathy was a result of the cardiac arrest and the apparent inadequate oxygenation.

Q. Do you have any other standard of care criticisms of Dr. Irefin that you've yet to tell me about?

A. No, I don't think so. I think that's really the central issue. The issue is one of detectability and vigilance and scepticism during a course of events that was perfectly compatible with

an inadequate airway. That's really the essence of the criticism.

Q. While this child was being resuscitated, and prior to the establishment of the surgical airway, would it have been reasonable for the physicians to attribute at least a portion of the child's poor response at that time to an underlying disease process?

A. I really don't find any reason to do that.

Q. Why is that?

A. Because all of it is perfectly accounted for by unitary explanation.

Q. By?

A. By a single explanation. One could look for several different explanations that dovetail to produce this picture. On the other hand, it's much easier and more compatible with a straightforward course of events to say that this was an airway problem that led to a cardiac arrest that resolved when the airway problem resolved. I find no compelling reason to go beyond that.

Q. Have you ever had a situation where a child needed to have a surgical airway established,

but before that airway could be established sustained significant hypoxia?

A, Yes. And I must say that it wasn't a personal situation, But it was a situation that I witnessed as part of a large code team. It was a patient with an extremely difficult airway who couldn't be intubated nor could the patient be trached,

Q. In this setting would one expect to see Jennifer's stomach rise if she had been esophageally intubated during the code?

A. One would expect to see it rise if that was the only thing that you were devoting attention to, The reality of the situation is dramatically different than if you were in the laboratory, for example. So could you actually see it rise in the middle of a cardiac arrest? With everybody doing CPR and trying to ventilate and trying to draw up drugs? I think it would be difficult to do that, Could you if that was the only thing that you were paying attention to? Yes, you could,

Q. But looking for whether or not the stomach is rising is something that somebody ought to be looking for in this scenario, true? One of

the things?

A. Well, in my opinion yes. But not if you don't believe that the tube is in the esophagus, So if you have an index of suspicion and you're devoting attention to it, then you would look for it. If you don't have an index of suspicion, you wouldn't necessarily devote attention to it.

It's much easier to imagine, for example, that people were listening to the chest than listening to the stomach or watching the stomach. Should you be able to see it? Yes. In the best of all possible circumstances. But that's like asking if you should be able to listen to heart sounds in a busy emergency room. Well, you should be able to, but it's extremely difficult.

As I said before, it's part of a portrait. It's one sign out of many.

MR. GROEDEL: I'm done. Thanks.

THE WITNESS: Okay,

(The deposition was concluded at 12:14 p.m.)

COMMONWEALTH OF MASSACHUSETTS)

SUFFOLK, SS.)

I, Maxine D. Marshall, Registered Professional Reporter and Notary Public in and for the Commonwealth of Massachusetts, hereby certify that there came before me on the 29th day of January 1998 at 10:20 a.m., the person hereinbefore named, who was by me duly sworn to testify to the truth and nothing but the truth of his knowledge touching and concerning the matters in controversy in this cause; that he was thereupon examined upon his oath, and his examination reduced to typewriting under my direction; and that the deposition is a true record of the testimony given by the witness,

I further certify that I am neither attorney or counsel. for, nor related to or employed by, any attorney or counsel employed by the parties hereto or financially interested in the action,

In witness whereof, I have hereunto set my hand this ---- day of _____ ----.

_____
Notary Public
My commission expires:
3/15/02