Butterfly™

Implementation of Butterfly iQ into EMS

A Playbook

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Why a Playbook?

Point-of-care ultrasound (POCUS) is well established in emergency medicine, yet there is a significant lag in the acceptance and utilization by pre-hospital providers. This is despite a large body of evidence showing that POCUS alters management and improves outcomes in many patients with emergent presentations. Emergency Medical Service (EMS) providers initially encounter many of these patients, yet the practice- and outcome-changing potential of ultrasound is largely unavailable and underutilized in the pre-hospital setting. While barriers to pre-hospital POCUS have been identified and discussed (equipment cost, training logistics, quality assurance, regulatory concerns, etc), there is little guidance on how to overcome the common issues.

This playbook is designed to provide solutions to the frequently encountered barriers of ultrasound adoption by EMS providers. In addition, it will illustrate a real-world example of a successful EMS implementation. This is intended as a step-by-step guide for creating a pre-hospital POCUS program, so that the potential of ultrasound can be realized in patients before they enter the emergency department doors.

Identifying Need

EMS providers have the first exposure to critically ill patients. Statistics show that over 800,000 pre-hospital providers transport up to 16 million patients each year. While rapid transport, assessment and intervention are critical components of many of these transports, **certain conditions can be diagnosed and potentially treated with POCUS while still in transport to the emergency department.**

Ultrasound is unique relative to traditional imaging methods including-ray or CT, in that it has no harmful effectssuch as radiation. The fact that it can be performed in real-time and can assess for anatomic and physiologic abnormalities, makes it an ideal bedside and on-the-go test.

Historically, ultrasound machines have been large and practically immobile, but technological advances have cleared the way to dramatically decrease the size of machines. Butterfly iQ, for example, can now be carried in your pocket. This increase in portability has occurred without sacrificing imaging quality, \leading to renewed interest in addressing some of the barriers to prehospital POCUS, such as the scope of practice, regulatory concerns, training logistics and cost, selection of equipment, and cost of equipment.

Game Plan

I've successfully implemented POCUS into SMFR (South Metro Fire Rescue) in south-west Denver, CO. This is a 200-medic, 29-station division that serves an area of 300 square miles and a residential population of 500,000, in which there was a desire to incorporate ultrasound into the skillset of pre-hospital providers to improve patient care.

Play 1. Define the Stakeholders

To implement this new clinical practice incorporating POCUS, a working group at SMFR was convened. This group included motivated individuals who were committed to incorporating the POCUS tool into their practice to improve patient care. Defined stakeholders included representatives from the SMFR, the medical director, an emergency physician consultant, and emergency and pediatric emergency physicians with POCUS expertise. They were selected for their ability to define, address and find solutions to the common barriers to prehospital POCUS.

Play 2. Know What You Are Up Against

Implementing a new practice into an established medical workflow isn't easy – even with a group of individuals committed to success. A plan to address an identified set of factors for implementation is critical. The factors we encountered are described in the game plan below. I have described in some detail how we faced these issues and the steps taken to resolve them over a period of around 6 months. The list below may not be exhaustive for all prehospital settings, but I'm confident it will get you off to a solid start. Just remember: POCUS has the potential to save lives, regardless of where it is implemented. Staying in solidarity with each other, and the end goal of improving patient outcomes during the implementation process is key.

"POCUS has the potential to save lives, regardless of where it is implemented."

Play 3. The Game Plan

a) Scope of practice: Defining scope for prehospital POCUS should be thoughtful and methodical. Questions such as: "Is the application technically feasible for prehospital providers?", "Will the results have an immediate impact on patient care?", and "Can the study be done quickly without interrupting other interventions or transport?", should govern the decision about which applications to pursue.

When those questions were considered by the SMFR, it was decided that focused echocardiography in cardiac arrest and lung ultrasound to assess for pneumothorax were the two most appropriate applications. These applications were included to provide EMS personnel with additional information to determine the appropriateness of transporting patients in cardiac arrest and to glean further diagnostic or therapeutic information about patients with shortness of breath. Each EMS agency will have unique needs and points of emphasis, so applications incorporated in one location may not be the same as another.

b) Regulatory concerns: State agencies define the scope of practice for each EMS provider level. State regulations typically include language such as, "Any skill, procedure or medication that is not expressly permitted in the EMS provider's

scope of practice is prohibited unless reviewed and approved through the waiver request process."

As a result, before POCUS is used by prehospital providers, a waiver for a pilot project needs to be submitted and approved by the state regulatory agency. The SMFR submitted a waiver to the State of Colorado, which was approved as a pilot project 3-months later. Data from the pilot project (scene time, transport time, adherence to protocols, accuracy of ultrasound interpretation, alteration in emergent versus non-emergent transport), is then submitted to the state as an application to expand the scope of practice to include ultrasound for specific prehospital applications.

c) Training logistics and cost: Let's be real. Ultrasound is not something you learn overnight, nor is it without cost. In order to keep these challenges to a minimum, it was our approach to set ourselves up for success by adopting a refined approach and being upfront and realistic on the budget as possible. Factors we included were:

i. Confined scope: the scope of training will vary for different agencies, but the goal should be to teach the clinical applications that will be incorporated in the field and not beyond. While there may be interest in

learning a number of new, different, and potentially cutting-edge applications, starting off slow is the best approach for long term success. In other words, train to clinical practice and to complement existing EMS protocols.

ii. Emphasis of hands-on scanning: this may go without saying, but since ultrasound is a technical skill that many EMS personnel have likely not performed previously, spending a significant amount of time on the hands-on training is key. At least half or better yet the majority of any course should be devoted to hands-on trainingemergency physician consultant, and emergency and pediatric emergency physicians with POCUS expertise. They were selected for their ability to define, address and find solutions to the common barriers to prehospital POCUS.

"..if there were any fence sitters in the group, in terms of the efficacy of field ultrasound, they were baptized in the righteousness of the mission after that day"

– Rick Lewis, SMFR EMS Chief

iii.   Multiple exams performed under direct supervision: while the amount of time devoted to scanning is important, two additional factors ensure successful learning. First, learners should have the opportunity to perform studies on multiple different scanning models. This simulates the varying anatomy they will encounter when scanning in the clinical environment. Second, the studies should be directly observed by an ultrasound expert. This allows for immediate feedback and correction of technique and, ultimately, accelerates learning. For example, the SMFR course allowed for each learner to complete 10 proctored exams on 10 different models for each new application that was taught.

iv..   Utilize purchased equipment: this cannot be overemphasized, but the training should be done with machines that the prehospital providers will ultimately use in the field. Building this familiarity is a key component to short term acceptance and adoption.

v.   Objective assessment of performance before and after training: there are multiple methods to objectively assess performance of an ultrasound exam, such as observed structured clinical evaluation (OSCE), score cards, or check offs. More advanced techniques include hand motion analysis or eye tracking, but they are likely beyond the scope of most EMS agencies. Whichever technique is utilized, it is important for the instructors to assess the performance of learners to assure they are competent to perform POCUS before using it in a clinical situation.

vi.   Refresher training: a key component to the SMFR training program was offering refresher courses. This allows the learners to refine their skills, identify gaps, and further solidify their technique. While the time to offer the refresher has not been quantified, 1–2 months after the initial training is likely a good interval.

vii.   Quality review: there is no substitute for quality review and without it, prehospital POCUS programs will likely falter. While describing a robust quality assurance program is beyond the scope of this playbook, there are other resources that can help guide efforts. There are a number of methods, but the most common is image review by a POCUS expert. During the initial stages, all images should be reviewed, but after a program is more established this number can be scaled back.

viii   Cost of training:

• Paramedic time – the logistics and costs of freeing up EMS providers for a POCUS course is difficult. Including the training in the CME budget and then planning in as far in advance as possible are key factors for success. For example, planning for the SMFR course started months ahead of time. The training itself occurred over two days that were a month apart. Each day had a morning and afternoon training session, which allowed for a large number of medics to be trained over a fairly short period of time. Refresher courses were then given at the individual fire stations on a rotating schedule.

• Instructors – POCUS instructors can usually be found in local or regional emergency medicine groups. Payment for their time will vary, although depending on the relationship that an EMS agency has with a local hospital, the cost may be offset.

• Models – scan models can come from a number of different sources, although scanning fellow medics is one option. Students from the professional schools such as nursing, medical, or physician assistant programs are alternatives. Guidelines for ultrasound scanning of models are available and instructors can help ensure they are followed during a course. They key is to have a large number of models so students can scan on a number of different body types.

d.   Selection of equipment: this is critical, and cannot be emphasized enough. The shoe needs to fit! The following factors should be considered:

i.   Portability – the physical confines and layout of an ambulance are unique, which has a direct impact on the size and type of equipment that can be utilized in this environment. While it may seem like any portable machine will suffice, the reality is that only certain devices, such as the Butterfly iQ are actually built to function adequately in the prehospital environment. This is largely due to not needing an external monitor, only needing one transducer and not having to mount the equipment, so that it can be performed from multiple different locations both inside and outside the rig.

5

ii. Image quality excellence – this may seem like an unavoidable trade-off for prehospital POCUS programs, but that is incorrect. In fact, current hand carried ultrasound devices, such as the Butterfly iQ, have equivalent diagnostic accuracy to large cart-based ultrasound machines. Ultrasound devices producing excellent quality images is a key component to build the confidence and allow novice users to acquire adequate images.

iii. Ability to perform multiple different applications while the initial scope of a prehospital POCUS program may be limited to a few applications, invariably the uses will expand and the ultrasound equipment needs to have the flexibility to scan the heart, lungs, abdomen, vessels and other structures. For most ultrasound devices, this would require a minimum of two separate transducers and possibly three, which triples the cost of equipment. In contrast, the Butterfly iQ can scan all of the different organs and body systems with a single transducer, which allows the equipment to grow as the prehospital POCUS program grows

iv. Wireless connectivity – More so than most clinical environments, wireless connectivity is a key for prehospital POCUS in order to transmit images/videos in real-time or to upload to a medical record or PACS after completing the transport. Most traditional ultrasound machines require the user to download a patient worklist before acquiring images, whereas the Butterfly iQ is unique in that the images can be obtained and a worklist/patient name can be attached afterwards. The importance of this

functionality cannot be overstated for EMS providers, since it will allow for images to be entered into the medical record and quality assurance performed.

V. Intuitive documentation of findings – Collecting images is one aspect of ultrasound study performance and documentation of findings is the second. It may be self-explanatory, but an intuitive and efficient interface for completing the documentation is a critical element for archiving and reviewing studies.

vi. Image review/QA-capable – As was mentioned in the training section, quality review is a critical element of a successful program, so consideration for how this will be done is an important aspect of any ultrasound hardware or software solution. While most ultrasound companies rely on 3rdparties to provide a quality assurance solution, Butterfly is the only company that incorporates a quality assurance system into their documentation platform. The importance of this additional functionality and integration cannot be overstated, especially for a new program.

vii. Integration with other technology, eg electronic medical record (EMR) and PACS – A final consideration is how, and the ease of, the ultrasound device integrating with existing systems. For instance, is additional hardware or software needed for it to function effectively in the prehospital and hospital environment? The best way to address this issue is to do extensive testing before deciding on ultrasound equipment to ensure that it integrates seamlessly.

It is also important to consider the type/amount of support an ultrasound company devotes to helping with the integration into systems such as the EMR or PACS.

viii. Cost of Equipment:

• Start up – It may not be a surprise, but there is a wide range of costs for specific ultrasound devices. Most systems start at over $6,000 for a single transducer and if additional transducers are needed to expand the ability to perform certain applications, the cost can double or even triple. This is one of the most significant distinctions with the Butterfly iQ from other ultrasound devices, since the price is $2,000 for a single device, which functions equivalently to three transducers.

• Maintenance – Ultrasound equipment is known to be relatively fragile, so environments such as the emergency department or the prehospital setting are a significant test to the durability of a machine. As a result, it is important to critically compare the initial warranty and replacement costs of damaged equipment. Additionally, this is an instance where extended warranties are typically worth the expense just for the peace of mind alone.   Unfortunately, every ultrasound vendor has a different initial warranty and options for warranty extensions, so the best approach is to compare them head-to-head. ButterflyiQ offers a 1-year warranty inclusive in the base price.

"every single thing we put on our wish list was on Butterfly iQ"

– Rick Lewis, SMFR EMS Chief

e. Fleet Management: given a rig is a very limited space that needs to accommodate a lot of essential equipment, the durability and small size of ButterflyiQ is critical. However, it did afford us to think about how we would manage the equipment. Here are a couple of things we implemented to help this:

i. For the initial deployment, the Butterfly iQs were kept in the battalion chief's car. That approach allowed the devices to be used in circumstances that fell under the state waiver, such as cardiac arrest. After the initial deployment, the devices will be housed on the individual ambulances.

ii. Charging is done weekly for all of the Butterfly iQs, depending on their use. For example, all of the iQs are scheduled to be charged consistently on a Sunday. This provides a consistent cadence to encourage habitual compliance. If the station has a weekly inventory checklist, I would suggest charging of ButterflyiQ be included as its own line item.

iii. Cleanliness is a key to long-term maintenance. After each use, the devices are cleaned with the recommended wipes, which we ensure are housed on all ambulances.

7

Play 4. Keep the End Goal in Mind

In the end, developing and instituting an EMS POCUS program is about improving patient care. Validation of that fact didn't take long for the SMFR program as 2 cases of pulseless electrical activity (PEA) presented shortly after instituting the program. In each case, ultrasound detected that the patients were in fact in pseudo-PEA with organized and vigorous cardiac activity. Altering decision making and potentially outcomes is the power of ultrasound and invariably additional cases will occur, not only for the SMFR, but also your program if you institute an EMS POCUS program.

"Altering decision making and potentially outcomes is the power of ultrasound"

Play 5. Never. Say. Die

Since the introduction of this program 1 month ago, there have been some iterative actions to ensure continued success. Here are a couple of things we have learned:

1. Skill maintenance is critical. We found that medics who had large gaps in not performing ultrasound had their skills degrade. This can occur as quickly as a month and is most pronounced in more advanced applications such as cardiac ultrasound.

2. Review, highlight and disseminate cases. EMS providers being assigned to a particular station may limit exposure to clinical cases were ultrasound was particularly impactful. Therefore it is important to regularly review and disseminate information about cases to all medics, both to build enthusiasm and to provide education.

3. Ultrasound can lead to increased emergency department communication. One of the unanticipated actions that came out of prehospital POCUS was sharing the images with the receiving physicians. Showing images or video clips allows the physician to better understand decision making and the case presentation at the point the EMS provider first encountered the patient. Invariably, this type of communication enhances the continuity of care.

4. Anticipate for fleet expansion. Even though the initial purchase was for six Butterfly iQs, another six were ordered shortly afterwards because of the amount they were being used. Predicting how often they will be used and how many units will need to be purchased is a challenge, so being nimble in the purchasing process is important.

5. Don't get too far out over your skis. While it may be tempting to think about the next application or expansion, the key to developing a solid program is focusing on a strong and successful deployment. Success in that aspect of program development will invariably lead to future advances such as expansion of applications, integration with the PACS/EMR, or additional personnel being trained.

Conclusion

Prehospital POCUS has and will save lives, the only real question is how long adoption and widespread utilization will take. I sincerely hope this playbook expedites that process by giving clear transparency to the major hurdles to implementation and providing solutions that have worked successfully in another EMS agency. This way, you too can implement a technology in the prehospital setting that will improve outcomes. Your community will thank you.

References

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