Subject: Case Studies in optimizing inter-facility STEMI transfers: use of the F2F (Facility to Facility) performance benchmark in optimizing STEMI transfers.

The “Facility to Facility” (F2F) performance benchmark is a ratio that can be calculated independently as an expected measure of performance for individual STEMI conduits. Its function is to allow individual non-PCI centers (in collaboration with their receiving PCI center(s)) to set realistic goals for the Non-PCI (door) to PCI center reperfusion time in STEMI. The F2F benchmark (in part) is based on local conditions and accounts for important system-dependent variable - such as EMS response time and inter-facility chronologic transfer time. Since it functions independently of treatment guidelines, it allows systems to analyze their current strategies, optimize them as much as possible and then set benchmarks for performance.

Once conduit goals have been set and performance is then monitored and compared to these previously set benchmarks and regular feedback is provided to the transferring non-PCI center and inter-facility EMS organization. In this way a standardized approach is put in place: transfer time goals can be calculated, inter-facility transfer events can be measured, feedback can be provided and the system should move towards a steady state of optimized performance. Once optimal performance is obtained it can be monitored and maintained via the use of ongoing feedback.

The following are case studies on how the F2F benchmark may be utilized to set, monitor and promote efficient inter-facility STEMI transfers.

**Case I**: facility A is a small non-PCI facility 67 miles from the nearest PCI center. It is in a lightly populated area and normally utilizes air EMS helicopter transfer (when available) for emergency STEMI transfer. The PCI hospital involved in this conduit is a moderate volume PCI center that receives transfers from several outside facilities. It currently has a 1-800 number that allows outside facilities to easily access the on-call cardiologist. The on-call cardiologist will then take the call and activate the PCI center after discussion with the transferring physician.

Environment-wise, the transferring, non-PCI center is in charge of arranging EMS transfer for its emergency STEMI cases. It has access to one available air EMS agency that typically has a STEMI “response to arrival time” to this facility of 25 minutes. Records indicate that door-to-door transfer times (involving this air EMS agency) are approximately 25 minutes between the two facilities (58 air miles). It should be noted that this air agency is emergently available approximately 60% of the time when called for an emergency STEMI transfer, this is based on previous data and personal observation.

Additional information: This non-PCI facility transfers approximately 98% of its emergency STEMI cases for reperfusion. It currently administers thrombolitics in less than 15% of these cases. Over the last year it has been successful 68% of the time when attempting to transfer emergency STEMI cases for successful reperfusion (at the PCI center) in under 120 minutes from first medical contact.

Calculation of expected goals for this STEMI conduit: As discussed, the formula for the F2F benchmark: V1 + V2 +60 = F2F (expected). In this case EMS response time is 25 minutes and EMS air flight time (door to door) is 25 minutes. Thus the F2F expected for this conduit is 25 + 25 + 60 = 110 minutes. This indicates that when all components of the STEMI recognition and decision process are in place, that air transfer for emergency PCI is a reasonable strategy since the F2F(e) for this conduit should normally result in PCI reperfusion in under 120 minutes. However, it should be noted that this is contingent on air transfer being immediately available when summoned for an emergency STEMI transfer. Note also, that percent availability for air transfer in this SEMI conduit is only 60%. This indicates that 40% of the time ground EMS may be required. Therefore it is desirable that this facility look at its F2F benchmark for ground transportation as well.

In this situation, this facility usually has ground EMS available within ten minutes for an emergency STEMI transfer. The inter-facility ground transfer time is 50 minutes. Thus, the F2F expected for ground transfer within this conduit is (10 minutes + 50 minutes + 60 minutes = 120 minutes). Therefore, if ground transfer is immediately available and utilized for inter-facility STEMI transfer patients can be expected to
barely meet the inter-facility transfer goal of 120 minutes. This indicates that any delay of arrival of ground transport would cause patients to not meet the 120 minute benchmark. In addition, any delay in inter-facility drive time such as traffic and weather would indicate a likely failure to meet guideline-based therapy.

Summary: In this situation, it appears that air transfer would allow this facility to readily meet the 120 minute benchmark in most situations. However, ground transfer would barely meet guidelines even when immediately available. Thus it would appear that this facility should continue to use emergency air transfer for STEMI cases but anticipate that air will not be available 40% of the time. In these cases if immediate ground is available it would be reasonable to ship for emergent PCI. However, if these two conditions do not exist, patient should realistically be then given lytics if appropriate.

Review: For this particular STEMI conduit the F2F benchmark goal should be 110 minutes (air transport). Since this is less than the 120 minute guideline proposed by the ACC/AHA it appears to be a reasonable first line strategy. When air is unavailable (40% of the time) ground EMS transfer for PCI is a viable option only if it is immediately available and only if there are no anticipated delays in the ground transfer drive time. Finally, if air is not readily available and/or ground is not immediately available appropriate patients at this facility should be given thrombolytics prior to transfer.

Final Comments on Case Study I: In this case, analysis of a few simple data points have allowed calculation of conduit-specific F2F benchmarks for air transfer and ground transfer. It indicates that both are reasonable options in defined circumstances. If there is any question of the non-availability of air combined with delayed ground transfer, lytics should be considered as the preferred therapy.

Case II: Hospital X is a non PCI center located approximately 10 minutes' drive time from its PCI center with which it has collaboration. It has onsite EMS transfer capability 24/7. This is accomplished by having an on-site EMS vehicle available at all times for emergency patient transfers. Records indicate that this EMS rapid transit system has been available 90% of the time over the past year when summoned for emergency STEMI transfer. At other times it has been out of commission or already in use for other transfers. Analysis also indicates that the usual drive time from this facility to its PCI receiving center is approximately 15 minutes. Although this hospital is in an urban setting it does not appear that drive time between the two facilities is significantly impacted in most situations. On one occasion there was a significant traffic pile up on the interstate corridor between the two facilities but EMS vehicles with knowledge of the system of traffic were able to navigate around this quite quickly.

The PCI center with which this hospital collaborates is owned by the same hospital system. The cardiologists at this institution work closely with the non-PCI center and have a good track record of activating the cath lab after a quick conversation with the emergency medicine physician at the transferring institution. However, since the two facilities are so close together it was recognized that in this case that might cause a slight delay in optimizing transfer. Therefore, it has recently been discussed at the receiving PCI center (and approved) that the ER docs at the sister facility are authorized to auto-activate the STEMI alert system at the receiving facility in straightforward STEMI cases. They do reserve the right to call the cardiologist beforehand on any given case. This has been agreed upon by all involved parties.

With respect to EMS transfer, the EMS transfer agency in this arrangement has an agreement to be on site or available for emergency STEMI transfers within ten minutes. Records indicate that this has been the expectation and performance over the past year. In addition, door to balloon times on pre-alert activations at the receiving hospital have hovered around 27 minutes over the past year. There have been occasional outliers but these have been reviewed and are usually due to anatomic variation, patient stability issues, or other factors that could not have been reasonably foreseen. Thus once a patient reaches the PCI center “door” they are consistently reperfused within 30 minutes.

Calculation of the F2F ratio in this case indicates an inter-facility transfer time of 15 minutes. This would be variable V2. Calculation of the V1 variable (EMS response time) was assigned a value of 10 minutes. It is recognized that sometimes EMS is instantly available but rather than assign a value of 0 they
assigned a value of 10 to give the EMS agency personnel a small amount of heads up time. It was also recognized that given the rapid EMS arrival that there might be some addition patient prep time needed at this facility. Therefore V1 was calculated at 10 minutes (EMS response time) and inter-facility transfer, V2, was calculated at 15 minutes. This gives an F2F benchmark of 60 + 10 + 15 for a total of 85 minutes. Note that this is under the AHAACC guideline of 120 minutes but appears to be an appropriate individualized goal for this institution given the fact that they are only 15 minutes apart and have instant EMS access for STEMI transfers.

Analysis: Computation of this goal revealed an F2F benchmark of 85 minutes. A review of STEMI transfers from the past year (9) reveal first ECG at the non PCI center to PCI reperfusion times of 78, 81, 82, 85, 95, 100, 110, 124 and 140 minutes. Retrospective chart analysis revealed that the 140 -minute event was secondary to obtaining informed consent and pre-transport patient instability. The 124 minute even was a patient that required extended resuscitation at the transferring hospital. Both of these events were excluded from calculations secondary to non-system delays.

On average, inter-facility STEMI transfers in this conduit (minus the discussed 2 outliers) showed an average time of 91 minutes over the past year. However the F2F benchmark calculation revealed that this is longer than the calculated F2F(e). In addition, the past year indicated that a number of cases had met or exceeded the F2F benchmark therefore indicating that it is an achievable goal.

Conclusion: Based on this discussion, the institutions involved (both the non PCI and PCI center) agreed that a 85 minute benchmark was a reasonable goal for inter-facility STEMI transfers involving their two institutions. They did affirm and reach out to the transferring EMS agency who again agreed that the 10 minute response time for emergency STEMI transports was justifiable and appropriate. Therefore the three involved institutions agreed to set their new F2F benchmark at 85 minutes.

Note that this is dependent on an independent calculation of performance, even thought it is well under the 120-minute guideline.