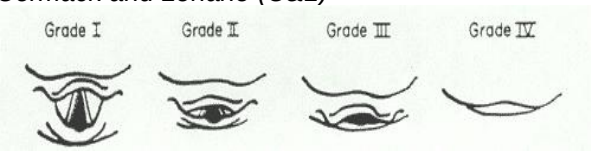
6200.06: ADULT AIRWAY MANAGEMENT

INTRODUCTION

Successful airway management requires competent decision-making and sound procedural skills. This guideline stresses the importance of uninterrupted oxygenation and ventilation.

Definitions:

Cormack and Lehane (C&L)



Grade I – full glottic opening visible
Grade II – lower portion glottic opening visible
Grade III – only epiglottis seen
Grade IV – neither epiglottis nor glottis seen

Difficult Bag Mask Ventilation (BMV) – Difficulty or inability to attain and maintain oxygen saturations >90% after optimizing technique.

Intubation Attempt – When a clinician performs direct laryngoscopy in an effort to visualize the glottic opening with the intent to introduce an endotracheal tube. Each attempt begins when the blade is introduced into the mouth and ends when it is removed.

GENERAL CONSIDERATIONS

Consider '*reversible causes'* requiring emergent airway management such as: overdose, hypoglycemia, airway obstruction, arrhythmia, etc.

Manage the airway appropriately recognizing: [1] the broader physiological status of the patient (e.g. hemodynamic stability); [2] physical location of the patient (e.g. proximity to healthcare facility); and [3] potential associated comorbidities (e.g. spine trauma, and other time sensitive emergencies).

SAFETY

Invasive airway management is an aerosol generating medical procedure. Interventions such as intubation and suctioning all expose the paramedic to aerosolized particulate matter that has the potential to be infectious. Since infectious status of patients is not usually known at the time of assessment, paramedics should always approach every airway using universal precautions, i.e. goggles, gown, gloves and mask, for any airway intervention. For a suspected airborne or droplet spread illness, if airway interventions are required then PPE should further include N-95 mask and face shield and fluid-resistant gown. Donning and doffing should be observed by a partner as this can help detect potential self-contamination before it occurs.

In cases of respiratory pathogens, having the patient or their caregiver place a mask on them prior to assessment can help in containing sources of contamination, if tolerated by the patient.

From both the novel coronavirus as well as the 2003 SARS outbreak it is well recognized that transmission of the virus to health care workers is often a result of incomplete or rushed PPE. And it's important to remove PPE properly once the patient interaction is complete as this is another frequent source of self-contamination.

ASSESSMENT

The premise of airway management is to optimize oxygenation while minimizing risk of harm to the patient. The dynamic out of hospital environment increases the complexity of airway management due to lack of resources, high-risk / low-volume nature of airway management and a host of other uncontrollable factors (e.g. weather, scope of practice, extrication time, family influence, etc.).

A number of factors must be considered when selecting whether to intervene with airway management as well as the method (BMV vs. EGD vs. ETI). Such factors include:

Clinical: Is an airway intervention required?

- **Obtain and Maintain** – the patient does not have the ability to maintain his or her own airway. This is your highest priority for airway management. In the absence of an intervention, the patient will not survive (e.g. obstruction, etc.).
- **Correction** – a gas exchange problem exists with either oxygenation or the removal of carbon dioxide. Also to be considered is correction of hypo or hyperventilation (e.g. asthma, respiratory failure, pulmonary edema, etc.).
- **Protection** – if a patient is unable to manage excessive secretions, gastric contents or blood through normal protective measures such as swallowing or coughing, support may be

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required (e.g. deeply obtunded patient, vomiting, esophageal varices, etc.).

- **Prediction** – patients that present with clinical conditions that have the potential to further deteriorate and result in a compromised airway (e.g. airway swelling, etc.).

Anatomical: What could make a patient's airway difficult to manage?

Predictors for Difficult Airway Management	
Bag Mask Ventilation	Direct Laryngoscopy
B – Beard O – Older O – Obesity T – Toothless S – Stridor / Snoring	M – Mallampati Grade M – Measurements A – Atlanto-Occipital Extension P – Pathological Obstruction

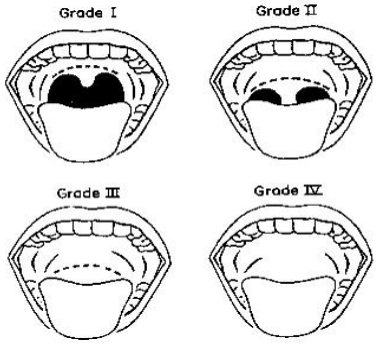
Bag Mask Ventilation (BOOTS):

- **B** – Beards and other facial hair can interfere with the seal on the mask.
- **O** – Obesity makes it difficult to obtain a good seal due to excess facial tissue. It also creates difficulty in ventilating due to the excess weight on the chest.
- **O** – Older patients often have limited neck mobility, which makes it difficult to obtain ideal positioning.
- **T** – Teeth provide the mouth structure. The absence of teeth can cause the patient's cheeks to collapse causing a difficult seal.
- **S** – Sounds such as stridor or snoring indicate functional airway obstructions due to the tongue or excess pharyngeal tissue.

Direct Laryngoscopy (MMAP):

- **M** – Higher Mallampati grades reflect escalating difficulty for laryngoscopy. **This evaluation can only be done in awake and upright patients.**
- **M** – Measure the anatomy in relation to expected values (patient's fingerbreadth):
  - Mouth opening = 3 fingers
  - Mentum of chin to hyoid = 3 fingers
  - Hyoid to thyroid cartilage = 2 fingers
  - Mandible jaw protrusion = 1 finger
- **A** – Atlanto-Occipital Extension. Decreased range of motion may make it difficult to align the airway axes.
- **P** – Pathological obstructions that increase difficulty during airway management are functional (tongue), mechanical (foreign body) or pathological (tumor, swelling).

Mallampati Grade Scale



AIRWAY MANAGEMENT DECISION PRINCIPLES

While no algorithm will fit all patients, there are some basic guidelines to follow that will help ensure patient safety.

With the clinical indications for airway management present, and no difficulty predicted, the method of airway management comes down to scope of practice. **ETI** (**PEP 1 neutral**)**, EGD** (**PEP varies by device and situation**) **or BMV (PEP 1 supportive) are all acceptable methods with an end goal of adequate oxygenation and ventilation**. If proceeding with a difficult ETI, the number of attempts should be limited. In the event that ETI is unsuccessful, BMV or an EGD should be used, with a focus on optimizing oxygenation and ventilation.

Time: When is the right time to intervene?

Transport time should be considered when deciding to intubate if the patient can be adequately oxygenated and ventilated using a BVM or an EGD. When faced with an anticipated difficult airway, proximity to more experienced personnel and additional resources must be considered. If the patient's condition is deteriorating such that an airway obstruction is evolving (e.g., airway burn or anaphylaxis), early intubation may be warranted. With a **long transport time**, the paramedic may elect to attempt ETI or rely on BMV or an EGD.

Personal Skills: Who is the most appropriate person to manage the patient's airway?

Consideration must be given to the experience and proficiency of the provider when deciding whether it is appropriate to proceed with BMV, EGD or ETI. It is appropriate to defer invasive interventions if the

airway can be managed with less invasive measures until more skilled clinicians are available.

TEAM PREPARATION PEARLS

Regardless of past experience, the paramedic must approach every patient in anticipation of a difficult airway until the procedure is complete. Success is dependent upon adequate preparation of the team, patient and equipment prior to any intervention.

Communicate airway management strategy with the team. All people involved in patient care should be aware of their individual role as well as the steps to be taken in the event that difficulty is encountered.

BAG MASK VENTILATION PEARLS:

- BMV requires a combination of experience, skill and knowledge to be successful. The most appropriate person for BMV in the prehospital environment is a paramedic.
- Air follows the path of least resistance meaning that BMV requires an airtight seal.
- The C-E clamp technique is advised to achieve an airtight seal.
- A jaw thrust is the most effective method to relieve functional airway obstructions.
- For the spontaneously breathing patient, time the ventilation to align with patient's inspiration.
- Ventilation volume should produce a small amount of chest rise. Over-ventilation results in gastric distention.
- Squeeze the BVM steadily over one full second.
- Avoid hyperventilation. Rate should not exceed 10 to 12 breaths per minute.
- A pressure manometer should be used (**PEP 3 supportive**)

Assessing adequacy of ventilations:

- *Look for:*
  - Chest rise and fall - best place to look is upper chest, just beneath clavicles
  - Improvement in patient colour
  - Improving pulse oximeter reading
  - Hemodynamic changes
- *Listen for:*
  - Leak of air from poor mask seal – always consider a functional or mechanical obstruction
  - Tone of pulse oximeter, if activated.
  - Abnormal upper airway sounds. May be indicative of airway pathology or complete obstruction.
- *Feel for:*
  - Leaking air from a poor mask seal
  - Bag compliance

Response to difficult BMV:

- Insert an airway adjunct (OPA/NPA).
- Perform an exaggerated jaw thrust
- Reposition: the head (*unless contraindicated*), the patient (e.g., ramping), the clinician, and/or the mask.
- **Perform a two-person technique**
- Change mask size
- Consider obstruction
- EGD / ETI

EXTRAGLOTTIC DEVICE PEARLS:

EGDs are an effective alternative to ETI or BMV (**PEP varies by device and situation**). It can be used as a primary airway device for BLS providers in the cardiac arrest population. ALS providers may elect to use an EGD for patients who are predicted to be difficult intubations, or as an airway device used following an unsuccessful intubation attempt or due to difficult BMV.

Contraindications for the use of an EGD include patients with an intact gag reflex and laryngeal trauma or pathologies affecting laryngeal anatomy.

ENDOTRACHEAL INTUBATION PEARLS:

Direct laryngoscopy should not begin until the appropriate support personnel are immediately available to assist as airway management requires a minimum of two people to optimize patient safety (i.e. assistants need to be ready to help – not otherwise occupied with interventions such as IVs).

Equipment Preparation:
Failure to adequately prepare equipment in advance may result in an increased number of intubation attempts.

STOP I CC BBARS

Suction – prepared and ready for use for every ETI.
Tubes – ETT is styletted to its natural curvature.
Oxygen – Pre-oxygenate prior to procedure.
Pharmacology – Prepare in advance.
Intravenous access

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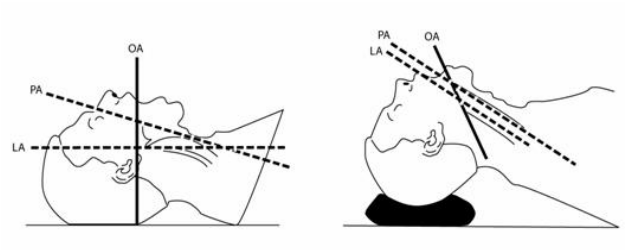
Connect to monitors – ECG, SpO_2
Confirmation equipment – $EtCO_2$ device, esophageal detector device (EDD).
Blades – Have both straight and curved available.
Bougie – Placed on patient's chest
Alternative intubation device
Rescue technique readily available
Surgical airway kit available

Laryngoscopy is a series of maneuvers designed to manipulate the anatomy to provide the paramedic with a direct line of sight to the patient's glottis (**PEP 2 neutral**). Therefore success relies on the paramedic's knowledge of the airway anatomy and how it responds to manipulation.



Patient Preparation:

- Place patient in "sniffing position" by aligning the ear lobe to sternum. This aligns the airway axes (oral, laryngeal, and pharyngeal) to improve a direct line of site to optimize visualization (see above diagram).
- Consider ramping when indicated (i.e. morbid obesity) by using pillows or blankets.
- Expose the chest to observe chest rise.
- Attach cardiac monitor and pulse oximetry.

Preoxygenation:
Attempts to place an airway device in a patient with oxygen saturation below 90% will lead to critical hypoxemia within seconds. By adequately oxygenating the patient the clinician helps avoid critical hypoxemia. The goal in the EMS environment is to bring oxygen saturation as close to 100% as possible. Several methods can be utilized to adequately pre-oxygenate the patient based on their level of consciousness.

Cooperative / spontaneously breathing patients can be oxygenated by placing a NRB mask with the oxygen set as high as possible. Flow rates of 15 lpm will provide approximately 60 – 70% oxygen. Higher flow rates (above 30 lpm) allow oxygen delivery to be closer to 90%. Patients should receive pre-oxygenation for 3 minutes or take 8 breaths, with maximal inhalation and exhalation.

Apneic patients can be pre-oxygenated using BMV.

Creating an oxygen gradient between the oropharynx and the lungs will allow oxygenation to continue in the apneic patient during attempts to place an airway device. If feasible, apply a nasal cannula set to 15 lpm and leave on throughout procedure (**PEP 2 neutral**).

Sedation:
Adequately preparing the patient for intubation includes ensuring the patient is appropriately medicated given their presentation. There is an added complexity with intubation for patients who are spontaneously breathing.

The use of benzodiazepines such as midazolam and diazepam or opioids such as morphine and fentanyl may help facilitate intubation but their limitations must be appreciated.

For patients who are awake and cooperative, adequate topical airway anesthesia (**PEP 2 neutral**) with light to moderate doses of benzodiazepines (i.e. 1-2 mg of midazolam) can produce a clinical presentation that allows for a controlled intubation. While this approach may take additional time (i.e. 10+ minutes) it provides a much safer alternative to deep sedation.

For patients who are spontaneously breathing and uncooperative / unconscious, higher doses of benzodiazepines may be required (i.e. 2-5 mg of midazolam) in combination with topical anesthesia. Consideration of transport time must be made to determine if invasive interventions are emergently required or if oxygenation and ventilation can be maintained until adequate resources (e.g. RSI or DSI) can be accessed.

Deep sedation using high dose benzodiazepines and/or opioid is fraught with risk when attempting to alleviate clenched teeth or mistakenly using it to produce RSI-like conditions. These risks include:

- Unwanted airway reflexes such as gag/vomiting or laryngospasm are not

eliminated though the use of sedatives and must be anticipated.
- High doses can result in hemodynamic compromise
- Reduction in respiratory drive without the elimination of airway reflexes

ENDOTRACHEAL INTUBATION TECHNIQUE*:*

During direct laryngoscopy there are several maneuvers the clinician can employ to improve visualization of the glottis. The '3-2-1 Rule' describes three ways to use two hands on the first attempt at intubation.

Right hand under occiput
- By controlling the patient's head with the right hand, it allows the clinician to perform an exaggerated sniffing position, and reduces arm fatigue and unnecessary force.

Backwards Upwards Rightward Pressure (BURP)
- Manipulating the thyroid cartilage back, upwards and to the patient's right will help bring the glottic opening back into anatomical alignment (**PEP 2 supportive**).

Both hands on laryngoscope handle
- This improves control and reduces intubator fatigue.

Bougie Use:
When preparing for intubation, a bougie should always be within arm's reach. If after optimizing laryngoscopy a poor view is encountered, a bougie becomes extremely valuable (**PEP 1 supportive**). Although ideal for C&L III views, the bougie can be a useful adjunct in any airway. A bougie should be considered on first attempt when predicting a difficult airway. Some general principles include:
- Distal resistance in a small airway occurs in the adult at 30cm (+/- 5cm) on the bougie. If unobstructed travel is still occurring at 40 cm, the bougie is probably esophageal.
- Tube passage is best done with ongoing laryngoscopy, to help control the tongue and create space in the hypopharynx.
- If resistance to tube passage is encountered, it is probably due to the right leading edge of the beveled ETT holding up on right vocal fold, false cord or aryepiglottic fold. To address this, twist the tube counterclockwise while gently advancing.

Unsuccessful First Attempt:
The premise of subsequent attempts at endotracheal intubation is to identify and address difficulty. Attempting intubation using the same technique as initial efforts will logically end in similar results. Consider the following steps on subsequent attempts:
- Position change – patient or intubator
- Blade change – curved to straight, size, etc.
- Intubator change

After two unsuccessful attempts at intubation, alternative airway management strategies should be employed including:
- EGD
- BMV (**PEP 2 supportive**)
- If unable to ventilate via BVM and/or EGD and the SpO_2 is rapidly declining, reevaluate for obstruction and prepare for a surgical airway.

Surgical Airway:
The purpose of a surgical airway is to provide oxygenation and ventilation to patients who otherwise would die as a result of hypoxia (**PEP 2-3 supportive**). It is reserved for the infrequent situation where the clinician is **unable to intubate and unable to ventilate with the patient deteriorating to a near-death status**. Every effort should be made to optimize oxygenation through BMV or EGD prior to considering a surgical airway. The only contraindication for surgical airway is patients under the age of 12. Consider online medical consultation early in the case management of the difficult airway. Contact the receiving hospital as early as possible.

ETI Confirmation:
Confirmation of proper placement of an ETT is vital. Unrecognized esophageal intubations carry significant complications up to and including death. In addition to visualization of passage through the glottic opening, the clinician must assess other objective signs of tracheal placement including:
- $EtCO_2$:
  - quantitative (**PEP 1 supportive**) or
  - qualitative (**PEP 2 supportive**)
- EDD (**PEP 2 supportive**)
- No air heard over epigastrium
- Air entry heard in the lungs

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- Air entry heard over trachea
- Good rise and fall of chest
- Clinical indicators present (improved SpO_2 and color)

If in doubt of whether tracheal placement has been achieved: [1] relook with direct laryngoscopy, or [2] insert a bougie through the ETT to verify its placement. **If still unable to confirm tracheal placement, it is essential that the clinician err on the side of caution by removing tube and optimizing oxygenation and ventilation through BMV or EGD.**

POST INTUBATION

Securing the Airway Device

After confirming placement of the device, secure with twill tape (**PEP 2 supportive**). Consider other ways to limit device movement such as using a c-collar, removing BVM from device prior to lifting the patient, and having someone maintain control of the head and device during patient movement.

After any movement of the patient, reassess the airway as even a secured device can become dislodged.

Assessment

A detailed assessment must be conducted following successful placement of an ETT in an effort to identify any adverse events or change in patient presentation. Ensure that you have a clear awareness of the triad of [1] size of tube, [2] position at lips in centimetres, and [3] position in patient (i.e. intratracheal).

Complications/adverse events that may present with airway management include:

- Hypoxia
- Hypotension
- Aspiration – gastric contents / blood
- Arrhythmias – brady / tachycardia
- Airway trauma

The following assessment should be completed for patients with an ETI or EGD who are deteriorating.

D – displaced tube
- Auscultate for breath sounds bilaterally (rule out main stem or esophageal intubation)
- Check $EtCO_2$
- Visualize ETI with laryngoscopy

O – obstructed tube
- Try suctioning
- If unable to pass the suction catheter, remove the tube and use basic techniques

P – pneumothorax
- Auscultate for breath sounds, look for tracheal deviation and/or chest asymmetry
- If the exam is suggestive, consider needle decompression

E – equipment failure
- Check O_2 supply, the function of the BVM and ensure the cuff is inflated

TRANSFER OF CARE

Describe any difficulty with airway management or ventilation during prehospital care. Report and document all interventions, clinical response and changes in patient condition to the receiving facility.

Clearly communicate the size of tube, position at lips, and confirmation of tracheal placement at time of transfer of care.

CHARTING

Record in detail the factors considered when deciding on an airway strategy. Be sure to record the following accurately:

- the best Cormack-Lehane view obtained during laryngoscopy
- the number of intubation attempts
- size of tube and depth of insertion
- method of confirmation of placement
- challenges experienced during management.

Ensure the airway registry is completed in the ePCR.

KNOWLEDGE GAPS

The optimal airway management strategy in EMS remains in question. The specific patient population, device selection, provider training, and timing are the subjects of ongoing research.

The use of EGD by PCPs in the management of adult airways in non-cardiac arrest scenarios requires further evaluation.

EDUCATION

Procedural skills involving airway management are low volume and require efforts to maintain

competency. Clinicians must remain current with contemporary guidelines to ensure an appropriate airway management strategy is employed.

QUALITY IMPROVEMENT

The following elements will be assessed to determine the quality of airway management care: appropriateness of airway indications, episodes of hypoxia, oxygenation prior to the procedure, number of attempts, success of airway management (first attempt and per patient), and confirmation technique.

REFERENCES

Kovacs, G., & Law, J.A. (2011). *Airway Management in Emergencies* (2nd ed.). Shelton, CT: People's Medical Publishing House–USA

http://www.gov.ns.ca/health/ehs/

PEP 3x3 TABLES for ADULT AIRWAY MANAGEMENT

Throughout the EHS Guidelines, you will see notations after clinical interventions (e.g.: **PEP2 neutral**).PEP stands for: the Canadian **P**rehospital**E**vidence-based **P**rotocols Project.

The number indicates the Strength of cumulative evidence for the intervention:
1 = strong evidence exists, usually from randomized controlled trials;
2 = fair evidence exists, usually from non-randomized studies with a comparison group; and
3 = weak evidence exists, usually from studies without a comparison group, or from simulation or animal studies.

The coloured word indicates the direction of the evidence for the intervention:
Green = the evidence is supportive for the use of the intervention;
Yellow = the evidence is neutral;
Red = the evidence opposes use of the intervention;
White = there is no evidence available for the intervention, or located evidence is currently under review.

PEP Recommendations for Respiratory Distress Interventions, as of 2013/05/09. PEP is continuously updated. See: https://emspep.cdha.nshealth.ca/TOC.aspx for latest recommendations, and for individual appraised articles.

Airway Management (Non-intubation)

Recommendation		RECOMMENDATION FOR INTERVENTION			
		SUPPORTIVE (Green)	NEUTRAL (Yellow)	AGAINST (Red)	NOT YET GRADED (White)
STRENGTH OF EVIDENCE FOR INTERVENTION	1 (strong evidence exists)	• BVM • I-Gel • Laryngeal Tube (without AW reflexes)	• NPA • OPA • Pharyngeal Tracheal Lumen (PTL)		
	2 (fair evidence exists)	• Laryngeal Tube (with AW reflexes) • Suction • Surgical Cricothyrotomy	• LMA (with AW reflexes)	• Combitube (without AW reflexes) • LMA (without AW reflexes) • Percutaneous Cricothyrotomy	
	3 (weak evidence exists)	• Bougie-assisted Cricothyrotomy • Pressure manometer		• Combitube (with AW reflexes)	

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Intubation

Recommendation		RECOMMENDATION FOR INTERVENTION			
		SUPPORTIVE (Green)	NEUTRAL (Yellow)	AGAINST (Red)	NOT YET GRADED (White)
STRENGTH OF EVIDENCE FOR INTERVENTION	1 (strong evidence exists)	• Bougie	• Direct Laryngoscopy (No airway reflexes) • Direct Laryngoscopy (with airway reflexes) • ETI via a SGA device • Lighted Stylet • NO DESAT/Nasal apneic oxygenation • Optical (non-video) Visualization (e.g. Airtraq) • Video Visualization (e.g. Glidescope)		• Suction
	2 (fair evidence exists)	• Laryngeal Manipulation • Oxymetry Monitoring • Securing tube	• Nasotracheal intubation	• Cricoid Pressure	
	3 (weak evidence exists)		• Digital Intubation		

Airway Confirmation

Recommendation		RECOMMENDATION FOR INTERVENTION			
		SUPPORTIVE (Green)	NEUTRAL (Yellow)	AGAINST (Red)	NOT YET GRADED (White)
STRENGTH OF EVIDENCE FOR INTERVENTION	1 (strong evidence exists)	• Quantitative ETCO2 (with circulation)	• POCUS		
	2 (fair evidence exists)	• EDD • Qualitative ETCO2 (with circulation)	• Oxymetry Monitoring • Qualitative ETCO2 (no circulation) • Quantitative ETCO2 (no circulation)		
	3 (weak evidence exists)				

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Medication for Airway Management

Recommendation		RECOMMENDATION FOR INTERVENTION			
		SUPPORTIVE (Green)	NEUTRAL (Yellow)	AGAINST (Red)	NOT YET GRADED (White)
STRENGTH OF EVIDENCE FOR INTERVENTION	1 (strong evidence exists)	• RSI (CCT)	• Topical anaesthetic		
	2 (fair evidence exists)	• Sedation	• Rapid Sequence Induction • Sedation (CCT)		
	3 (weak evidence exists)	• DSI (CCT) • Sedation scale	• RSA		

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Program Document Number Management System

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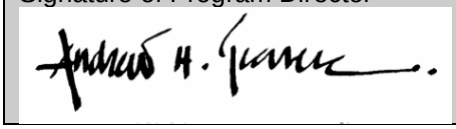
Signature of Program Director 	Signature of program Document Coordinator *Electronically Signed* *Tanya Fraser*	

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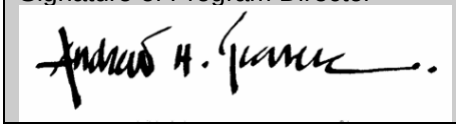
Signature of Program Director 	Signature of program Document Coordinator *Electronically Signed* *Tanya Fraser*	

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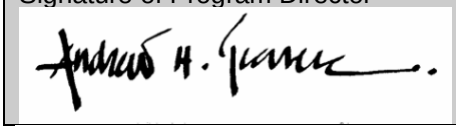
Signature of Program Director 	Signature of program Document Coordinator *Electronically Signed* *Tanya Fraser*	