Sistema Socio Sanitario
Ospedale Niguarda
Regione Lombardia
GiViTI

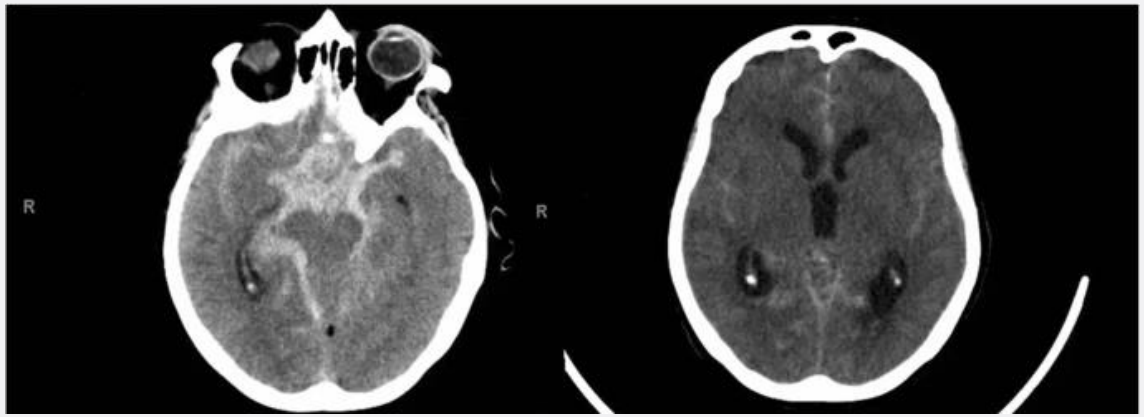
Emorragia subaracnoidea e timing della tracheostomia

CONFRONTO TRA DIVERSI APPROCCI

Jacopo Colombo
SC Neurorianimazione
ASST Grande Ospedale Metropolitano Niguarda

XXX Meeting GiViTI
Pesaro, 1 ottobre 2021

SAH & MV



Aneurysmal subarachnoid hemorrhage (**aSAH**):

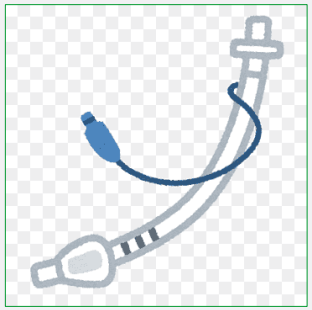
- occurs in 10–15 patients per 100,000 annually
- represents 10% of all strokes

- *Neuroepidemiology.2006;26(3):147–50*

38.5–65% of all aSAH patients require **Mechanical Ventilation**

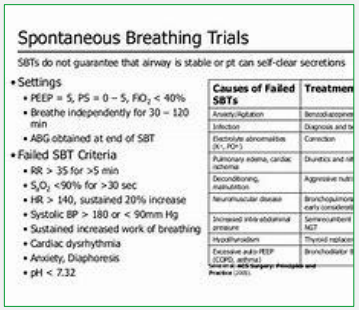
Crit Care Med. 2017;45(2):e138–e45.

MV IN NEURO-ICU



INTUBATION

MV



Spontaneous Breathing Trials

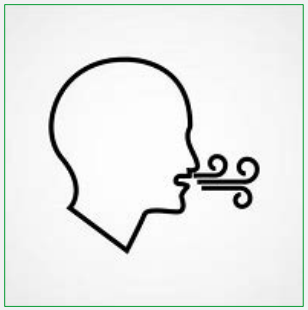
SBTs do not guarantee that airway is stable or pt can self-clear secretions

- Settings
  - PEEP = 5, PS = 0 – 5, FiO_2 < 40%
  - Breathe independently for 30 – 120 min
  - ABG obtained at end of SBT
- Failed SBT Criteria
  - RR > 35 for >5 min
  - S_pO_2 <90% for >30 sec
  - HR > 140, sustained 20% increase
  - Systolic BP > 180 or < 90mm Hg
  - Sustained increased work of breathing
  - Cardiac dysrhythmia
  - Anxiety, Diaphoresis
  - pH < 7.32

Causes of Failed SBTs	Treatmen
Anxiety/Agitation	Benzodiazepine
Infection	Diagnosis and te
Electrolyte abnormalities (K+, PO4-)	Correction
Pulmonary edema, cardiac ischemia	Diuretics and ot
Deconditioning, malnutrition	Aggressive nutri
Neuromuscular disease	Bronchopulmon early consideratio
Increased intra-abdominal pressure	Semirecumbent NGT
Hypothyroidism	Thyroid replace
Excessive auto-PEEP (COPD, asthma)	Bronchodilator t

Sarnoff et al. AER Surgery: Principle and Practice (2005).

MV



WEANING

SPONTANEOUS BREATHING

EXTUBATION IN NEURO-ICU

Extubation Failure in Brain-injured Patients

Risk Factors and Development of a Prediction Score in a Preliminary Prospective Cohort Study

Thomas Godet, M.D., Ph.D., Russell Chabanne, M.D., Julien Marin, M.D., Sophie Kauffmann, M.D., M.Sc., Emmanuel Futier, M.D., Ph.D., Bruno Pereira, Ph.D., Jean-Michel Constantin, M.D., Ph.D.

(Anesthesiology 2017; 126:104-14)

.

TBI, SAH, ICH, stroke, HIE: **31%** of patients with successful breathing trials **FAILED EXTUBATION** vs **10-20%** of general ICU patients

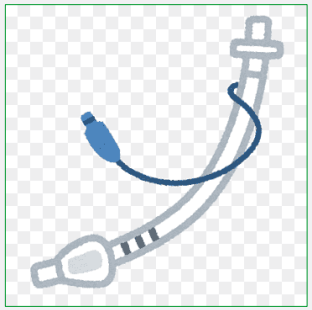
CAUSES:

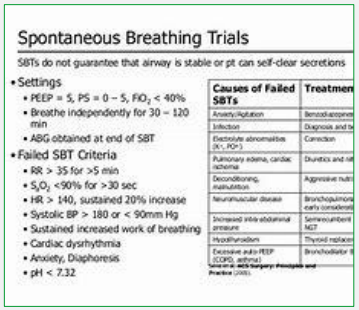
- Hypersecretion (67%)
- stridor (14%).

PREDICTORS of EXTUBATION FAILURE:

- Classical respiratory parameters: not significant
- Capability to **cough**, the **deglutition** ability, and the **gag** reflex, were strongly associated with extubation failure when absent

MV IN NEURO-ICU





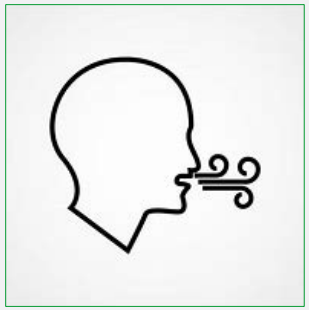
Spontaneous Breathing Trials

SBTs do not guarantee that airway is stable or pt can self-clear secretions

- Settings
  - PEEP = 5, PS = 0 – 5, FiO_2 < 40%
  - Breathe independently for 30 – 120 min
  - ABG obtained at end of SBT
- Failed SBT Criteria
  - RR > 35 for >5 min
  - S_pO_2 <90% for >30 sec
  - HR > 140, sustained 20% increase
  - Systolic BP > 180 or < 90mm Hg
  - Sustained increased work of breathing
  - Cardiac dysrhythmia
  - Anxiety, Diaphoresis
  - pH < 7.32

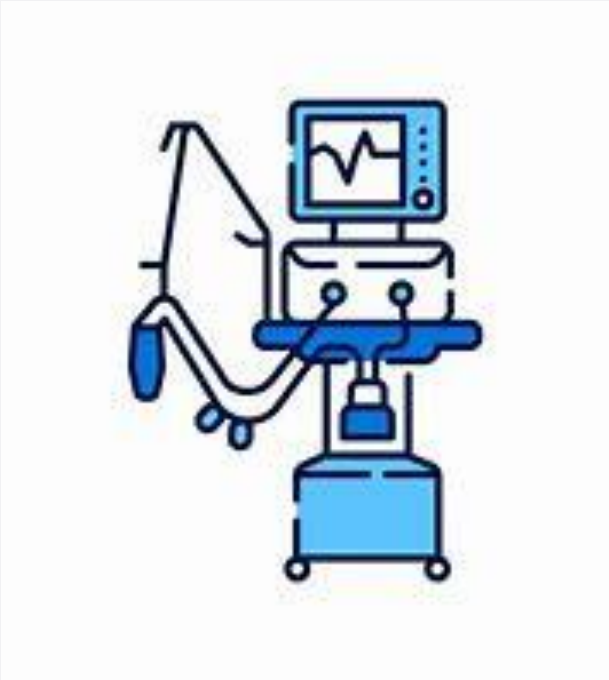
Causes of Failed SBTs	Treatmen
Anxiety/Agitation	Benzodiazepine
Infection	Diagnosis and te
Electrolyte abnormalities (K+, PO4-)	Correction
Pulmonary edema, cardiac ischemia	Diuretics and ne
Deconditioning, malnutrition	Aggressive nutri
Neuromuscular disease	Bronchopulmona early consideratio
Increased intra-abdominal pressure	Semirecumbent NGT
Hypothyroidism	Thyroid replace
Excessive auto-PEEP (COPD, asthma)	Bronchodilator th

Source: Critical Care Surgery: Principle and Practice (2008).



INTUBATION → **MV** → **WEANING** → **SPONTANEOUS BREATHING**

MV DURATION & OUTCOME



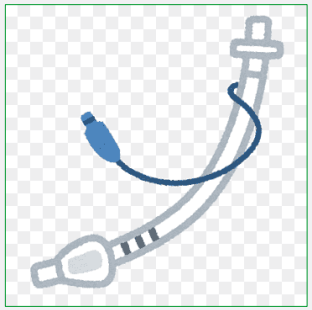
PROLONGED MV:

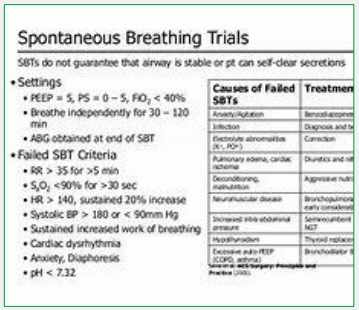
- > ICU LOS
- > costs
- > mortality

Ann Intensive Care 2020; 10:53.

Intensive Care Med 2014; 40:749–751

MV IN NEURO-ICU





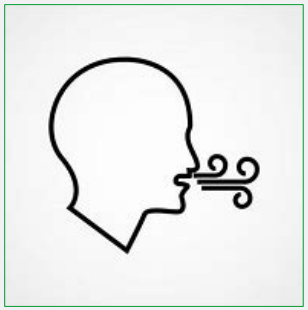
Spontaneous Breathing Trials

SBTs do not guarantee that airway is stable or pt can self-clear secretions

- Settings
  - PEEP = 5, PS = 0 – 5, FiO_2 < 40%
  - Breathe independently for 30 – 120 min
  - ABG obtained at end of SBT
- Failed SBT Criteria
  - RR > 35 for >5 min
  - S_pO_2 <90% for >30 sec
  - HR > 140, sustained 20% increase
  - Systolic BP > 180 or < 90mm Hg
  - Sustained increased work of breathing
  - Cardiac dysrhythmia
  - Anxiety, Diaphoresis
  - pH < 7.32

Causes of Failed SBTs	Treatmen
Anxiety/Agitation	Benzodiazepine
Infection	Diagnosis and te
Electrolyte abnormalities (K+, PO4-)	Correction
Pulmonary edema, cardiac ischemia	Diuretics and ne
Deconditioning, malnutrition	Aggressive nutri
Neuromuscular disease	Bronchopulmona early consideratio
Increased intra-abdominal pressure	Semirecumbent NGT
Hypothyroidism	Thyroid replace
Excessive auto-PEEP (COPD, asthma)	Bronchodilator t

Kirby et al. ACS Surgery: Principle and Practice (2008).



INTUBATION → MV → WEANING → SPONTANEOUS BREATHING

TRACHEOSTOMY

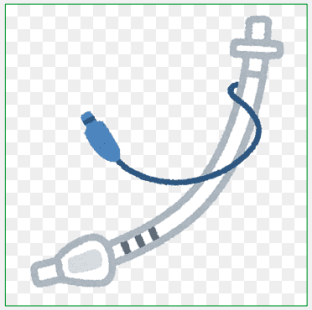
Sistema Socio Sanitario

Ospedale Niguarda

Regione Lombardia

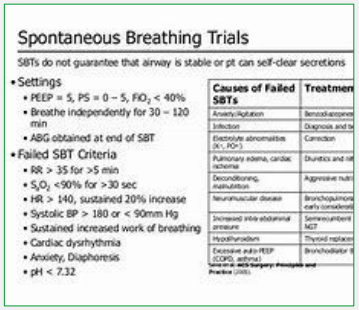
GiViTI

TRACHEOSTOMY IN NEURO-ICU



INTUBATION

MV



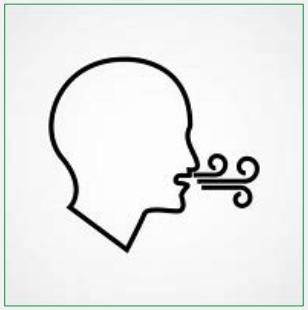
Spontaneous Breathing Trials

SBTs do not guarantee that airway is stable or pt can self-clear secretions

- Settings
  - PEEP = 5, PS = 0 – 5, FiO_2 < 40%
  - Breathe independently for 30 – 120 min
  - ABG obtained at end of SBT
- Failed SBT Criteria
  - RR > 35 for >5 min
  - S_pO_2 <90% for >30 sec
  - HR > 140, sustained 20% increase
  - Systolic BP > 180 or < 90mm Hg
  - Sustained increased work of breathing
  - Cardiac dysrhythmia
  - Anxiety, Diaphoresis
  - pH < 7.32

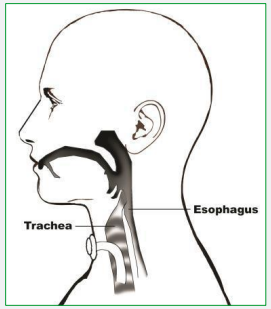
Causes of Failed SBTs	Treatmen
Anxiety/Agitation	Benzodiazepines
Infection	Diagnosis and th
Electrolyte abnormalities (K+, PO4-)	Correction
Pulmonary edema, cardiac ischemia	Diuretics and ot
Deconditioning, malnutrition	Aggressive nutri
Neuromuscular disease	Bronchopulmona early consideratio
Increased intra-abdominal pressure	Semirecumbent NGT
Hypo/Hyperadism	Thyroid replace
Excessive auto-PEEP (COPD, asthma)	Bronchodilator th

Arora et al. ACS Surgery: Principles and Practice (2008).



SPONTANEOUS BREATHING

WEANING

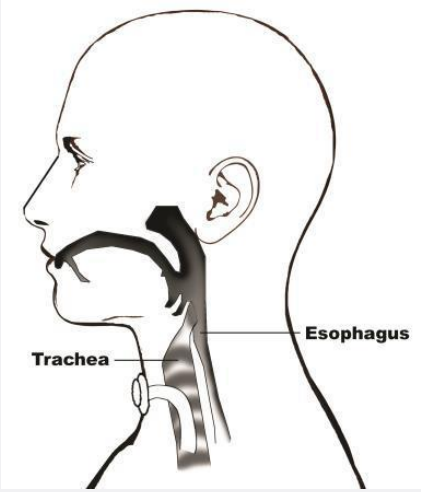


TRACHEOSTOMY

Sistema Socio Sanitario
Ospedale Niguarda
Regione Lombardia
GiViTI

TRACHEOSTOMY PRO & CONS

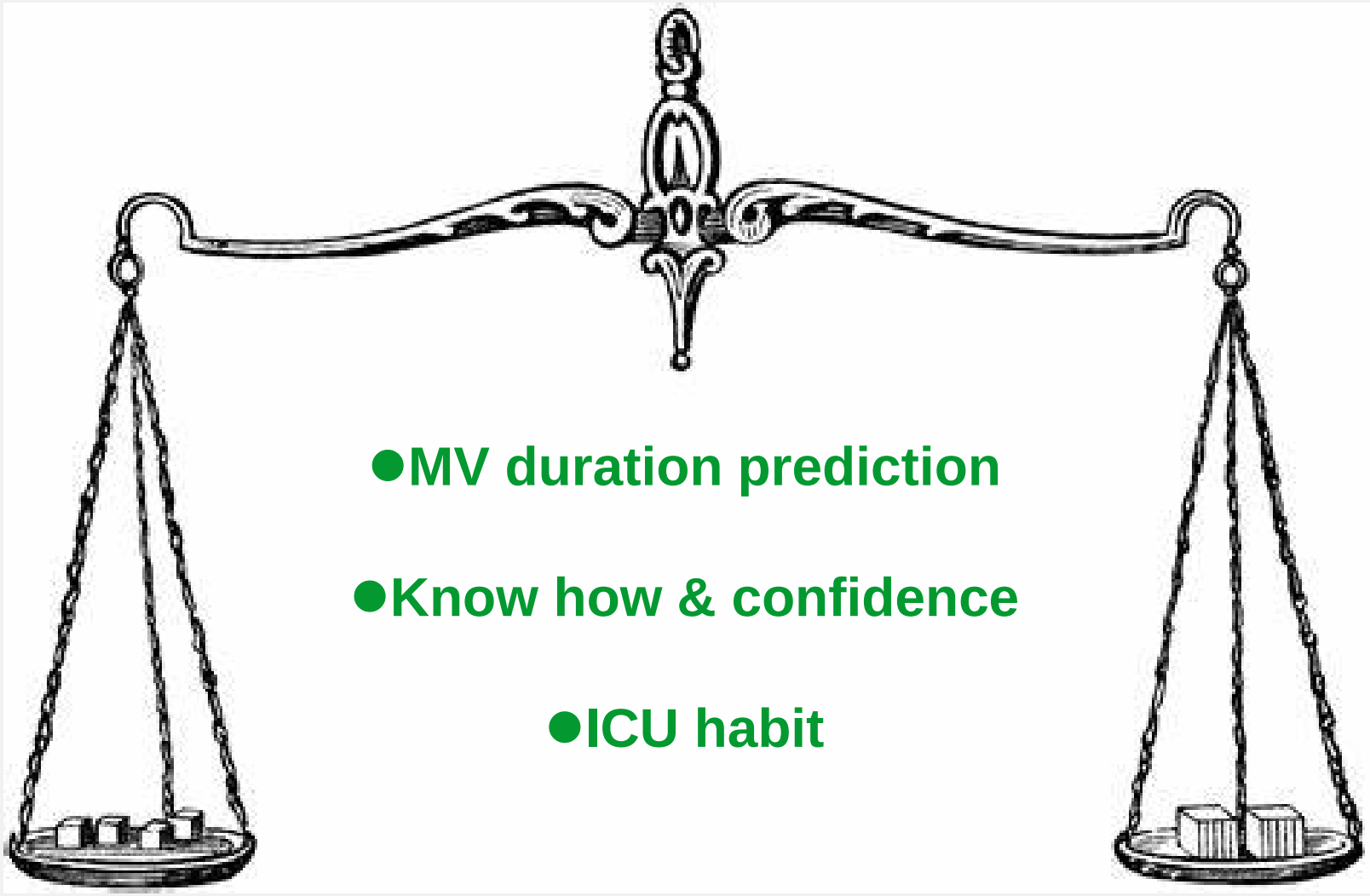
- **PRO**
  - Airway protection
  - Less/No sedation
    - Mobilization
    - Oral hygiene
  - Manageable outside ICU



- **CONS**
  - Invasive procedure
  - GL timing and indications are based on low quality evidence

Immediate	Early	Late
Bleeding	Tracheal ring fracture	Subglottic stenosis
Loss of airway	Tracheal tube obstruction	Unplanned decannulation
Hypoxia	Paratracheal placement	Tracheoinnominate artery bleed
Pneumothorax	Posterior tracheal wall injury	Displaced tracheal tube
False tract	Pneumothorax/pneumomediastinum	Delayed healing after decannulation
Pneumomediastinum	Surgical emphysema	Tracheoesophageal fistula
Posterior tracheal wall injury	Atelectasis	Stromal infection
Esophageal injury	Raised intracranial pressure	Scarring of the neck
Surgical emphysema		Swallowing difficulty
Needle damage to bronchoscope		Permanent voice changes
Raised intracranial pressure		

TRACHEOSTOMY PRO & CONS



- MV duration prediction
- Know how & confidence
- ICU habit

Sistema Socio Sanitario

Ospedale Niguarda

Regione Lombardia

GiViTI

MV DURATION PREDICTION IN NEURO-ICU

NEUROLOGIC CRITICAL CARE

Critical Care Medicine®

Factors Associated With Prolonged Mechanical Ventilation in Patients With Subarachnoid Hemorrhage—The RAISE Score

Rass, Verena MD[1]; Ianosi, Bogdan-Andrei MD[1,2]; Lindlbauer, Moritz MD[1]; Lindner, Anna MD[1]; Kofler, Mario MD[1]; Schiefecker, Alois J. MD, PhD[1]; Pfausler, Bettina MD[1]; Beer, Ronny MD[1]; Helbok, Raimund MD[1]

[1] Department of Neurology, Medical University of Innsbruck, Innsbruck, Austria.

[2] Institute of Medical Informatics, UMIT: University for Health Sciences, Medical Informatics and Technology, Hall in Tirol, Austria.

Critical Care Medicine: July 2, 2021 - Volume - Issue -
doi: 10.1097/CCM.0000000000005189

METHODS

NEUROLOGIC CRITICAL CARE
Critical Care Medicine

Factors Associated With Prolonged Mechanical Ventilation in Patients With Subarachnoid Hemorrhage—The RAISE Score

STUDY

Retrospective analysis of prospectively recorded data

7y (2010 - 2017) @ NeuroICU of **Innsbruck** hospital

Nontraumatic SAH, **≥ 18 y**, **ICU stay ≥ 24 h**

Excluded: arteriovenous malformations, admission > 7 d after SAH onset

METHODS

GOALS

1) To identify **factors associated with mechanical ventilation** greater than 48 hours, greater than 7 days, and greater than 14 days compared with mechanical ventilation less than or equal to 48 hours, less than or equal to 7 days, or less than or equal to 14 days
2) To create a new prognostic score (the **RAISE score**) to predict prolonged mechanical ventilation greater than 7 days and to internally validate it

METHODS

NEUROLOGIC CRITICAL CARE
Critical Care Medicine
Factors Associated With Prolonged Mechanical Ventilation in Patients With Subarachnoid Hemorrhage—The RAISE Score

DATA INCLUDED in UNI and MULTIVARIATE ANALYSIS

- age,
- sex,
- H&H at admission,
- APS,
- loss of consciousness,
- mFisher Score at admission,
- ICH present at admission CT scan,
- Hydrocephalus requiring an external ventricular drain (EVD),
- aneurysm size,
- SEBES,
- aneurysm treatment modality (coiling/clipping),
- aspiration pneumonia
- vasospasm and DCI were only included in the model of greater than 14 days

RESULTS

NEUROLOGIC CRITICAL CARE

Critical Care Medicine

Factors Associated With Prolonged Mechanical Ventilation in Patients With Subarachnoid Hemorrhage—The RAISE Score

PTS:

- 297 enrolled.
- **MV** in 242 (81%), median duration 9 days

RESULTS

NEUROLOGIC CRITICAL CARE
Critical Care Medicine
Factors Associated With Prolonged Mechanical Ventilation in Patients With Subarachnoid Hemorrhage—The RAISE Score

FACTORS ASSOCIATED WITH MV from multivariate analysis

	MV > 48h (154 pts)	**MV > 7gg (124 pts)**	MV > 14 gg (86pts)
Age	X	-	-
APS	X	X	X
HC req EVD	X	-	-
SEBES	X	X	-
H&H	-	X	X
ICH	-	X	-

Sistema Socio Sanitario
Ospedale Niguarda
Regione Lombardia
GiViTI

RESULTS

NEUROLOGIC CRITICAL CARE
Critical Care Medicine

Factors Associated With Prolonged Mechanical Ventilation in Patients With Subarachnoid Hemorrhage—The RAISE Score

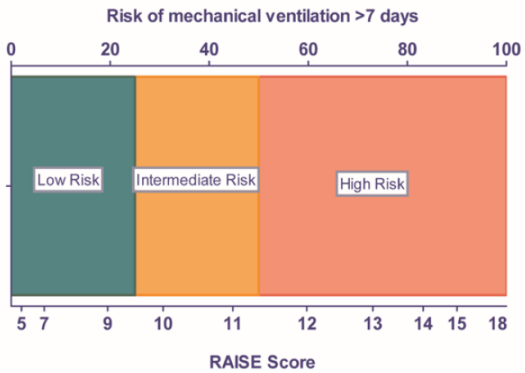
RAISE SCORE

RAISE Scorecard

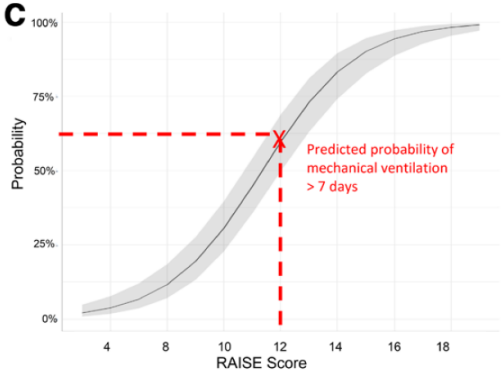
A

	Points
Baseline Points	11
APS	
<4	-2
4-5	-1
6-13	0
≥14	1
Age	
<61	-1
≥61	1
Hunt & Hess	
0-2	-2
3	0
4-5	3
SEBES	
0	-1
1-2	0
3-4	2
ICH on admission CT	
No	0
Yes	1

B



C



Example patient:

Baseline	11
APS = 25 pts	+1
Age = 54 years	-1
Hunt&Hess = 3	0
SEBES = 1	0
ICH on Admission CT	+1
Total	= 12

Score & MV>7d risk

- **< 10:** 0–25%,
- **10–11**: 26–50%,
- **12-13**: 51-75%,
- **≥ 14:** > 75%

RESULTS

NEUROLOGIC CRITICAL CARE

Critical Care Medicine

Factors Associated With Prolonged Mechanical Ventilation in Patients With Subarachnoid Hemorrhage—The RAISE Score

PTS:

- 297 enrolled.
- **MV** in 242 (81%), median duration 9 days
- **Tracheostomy**: 17% pts, median 22 days (17-27)
- **Pneumonia**: 49% pts
- **ICU LOS**: median 20 (11-31)

Sistema Socio Sanitario

Ospedale Niguarda

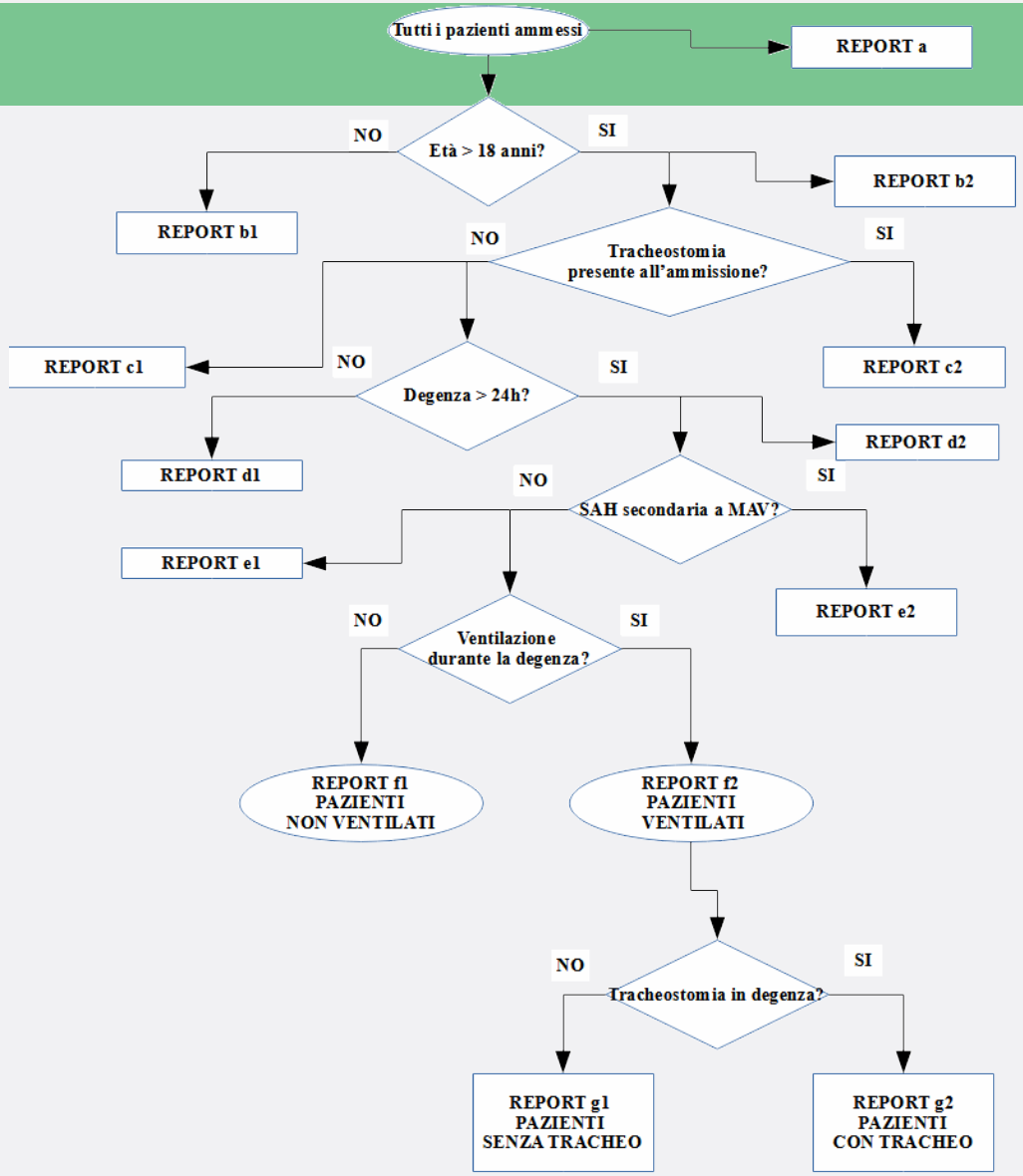
Regione Lombardia

GiViTI

SAH - PROSAFE

2016-2019

13 ITA NeuroICU
(12 + Niguarda)



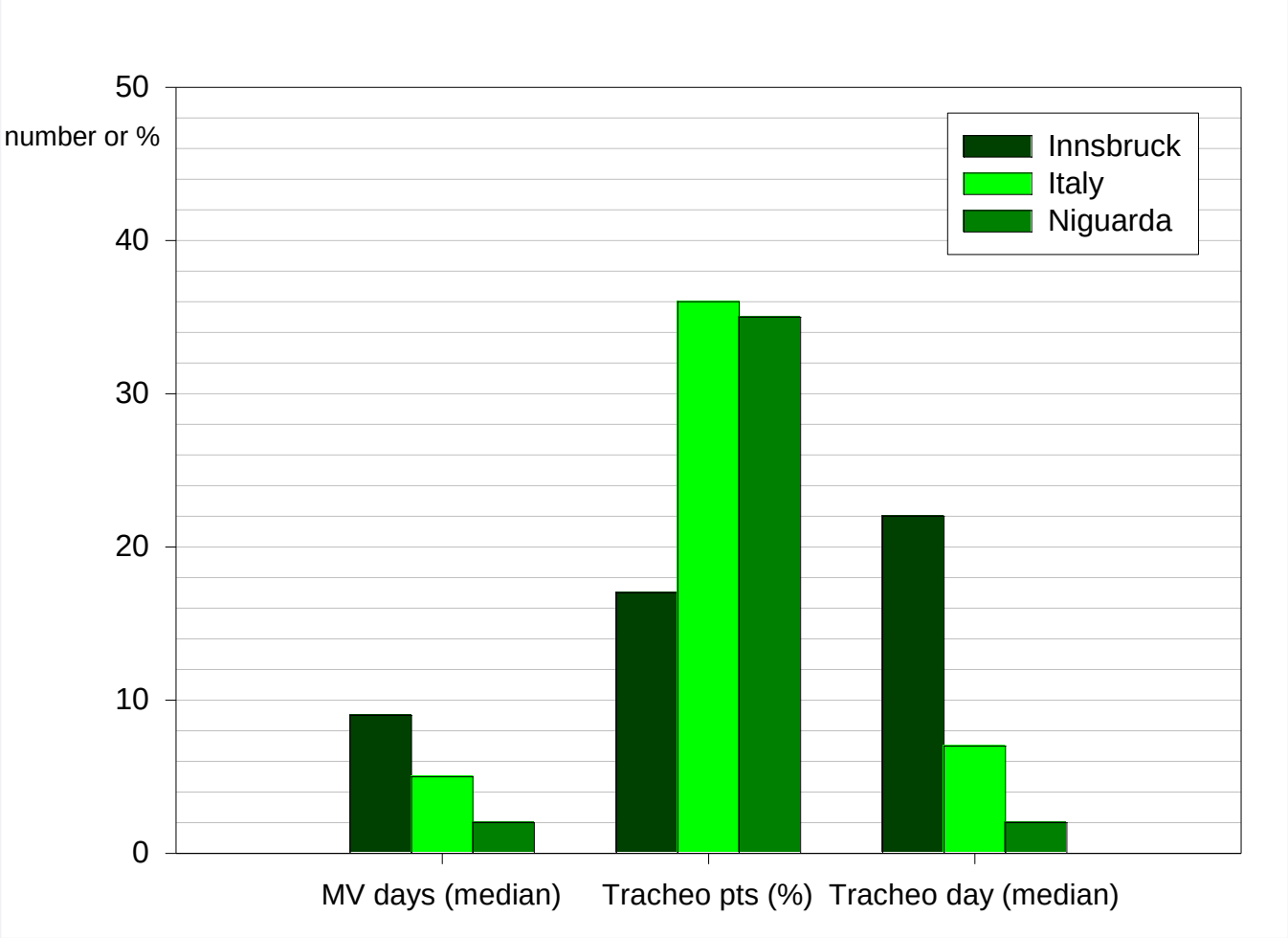
Sistema Socio Sanitario
Ospedale Niguarda
Regione Lombardia
GiViTI

SAH in ICU

Variables			Ospedale Niguarda
n/MV %	297/81%	1041/81%	131/86%
Female sex , n (%)	182 (61%)	662 (64%)	82 (63%)
Age (years), median (IQR)	57 (47-68)	60 (51-70)	58 (48-68)
Interventional neuroradiology, < 24h ICU admission, n (%)	140 (47%)	547 (53%)	99 (76%)
Neurosurgery, < 24h ICU admission, n (%)	73 (25%)	553 (53%)	32 (24%)
External ventricular drain, n (%)	140 (47%)	434 (42%)	71 (54%)

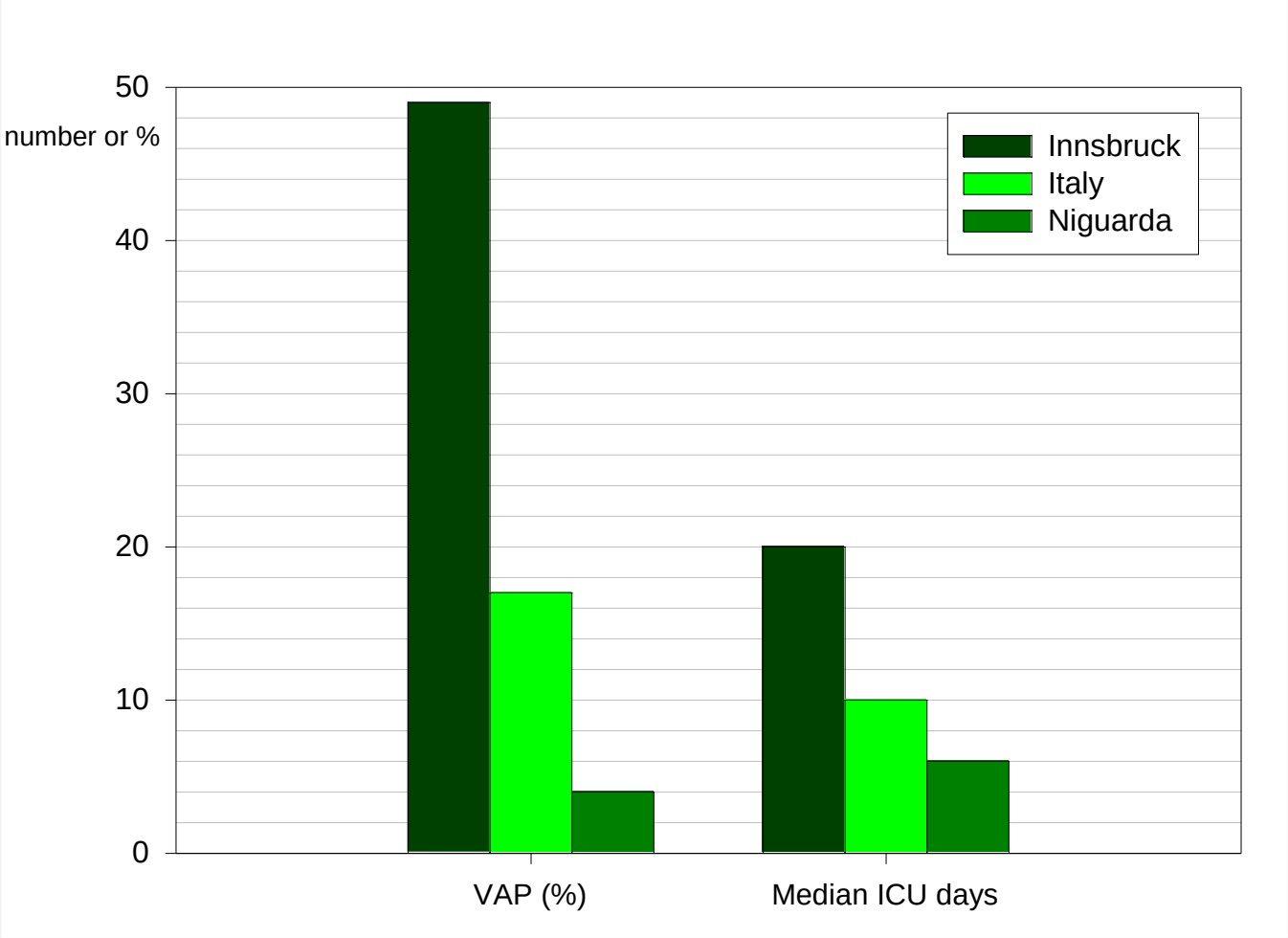
Colombo et al, Crit Care Med., accepted

SAH IN ICU



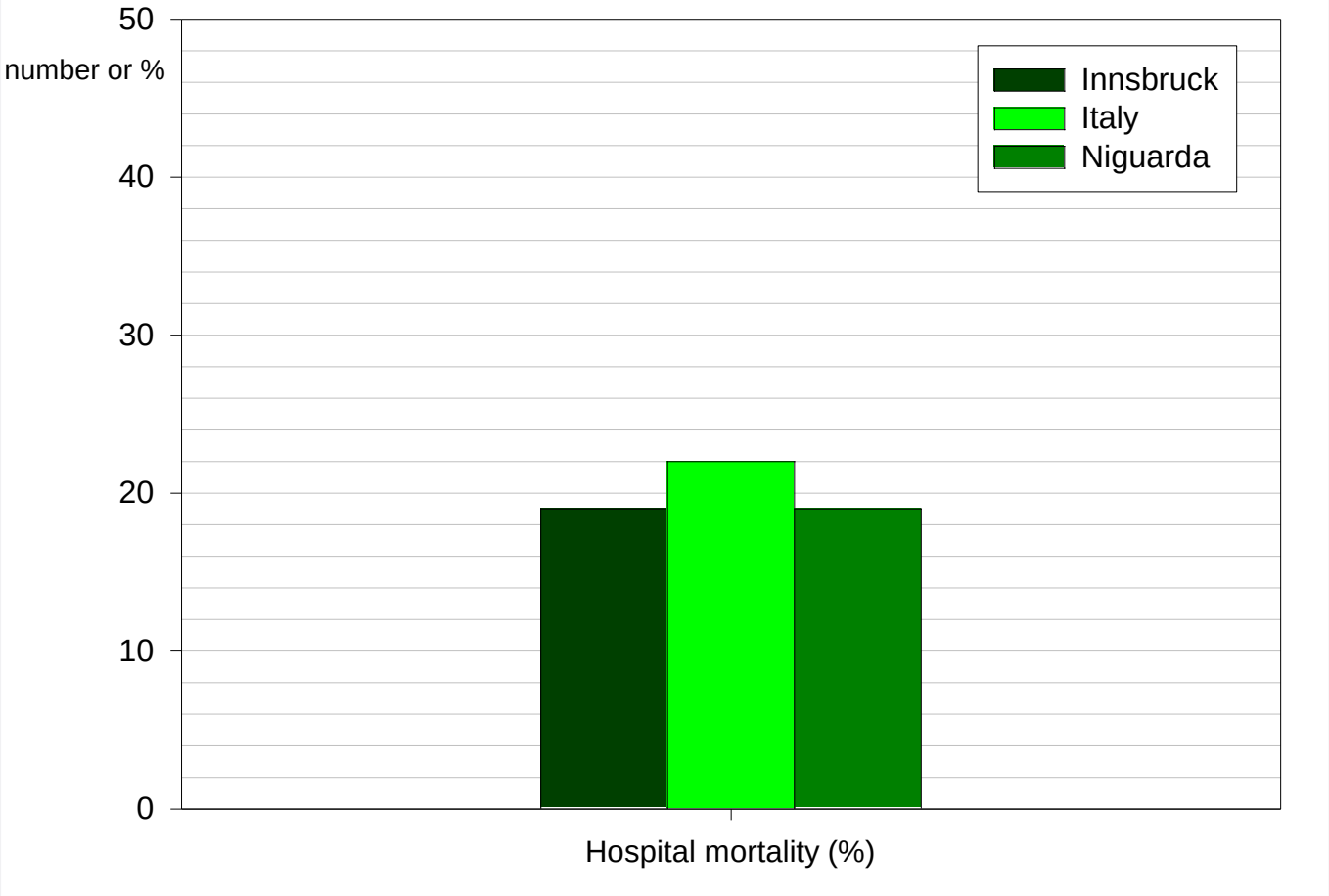
Colombo et al, Crit Care Med., accepted

SAH IN ICU



Colombo et al, Crit Care Med., accepted

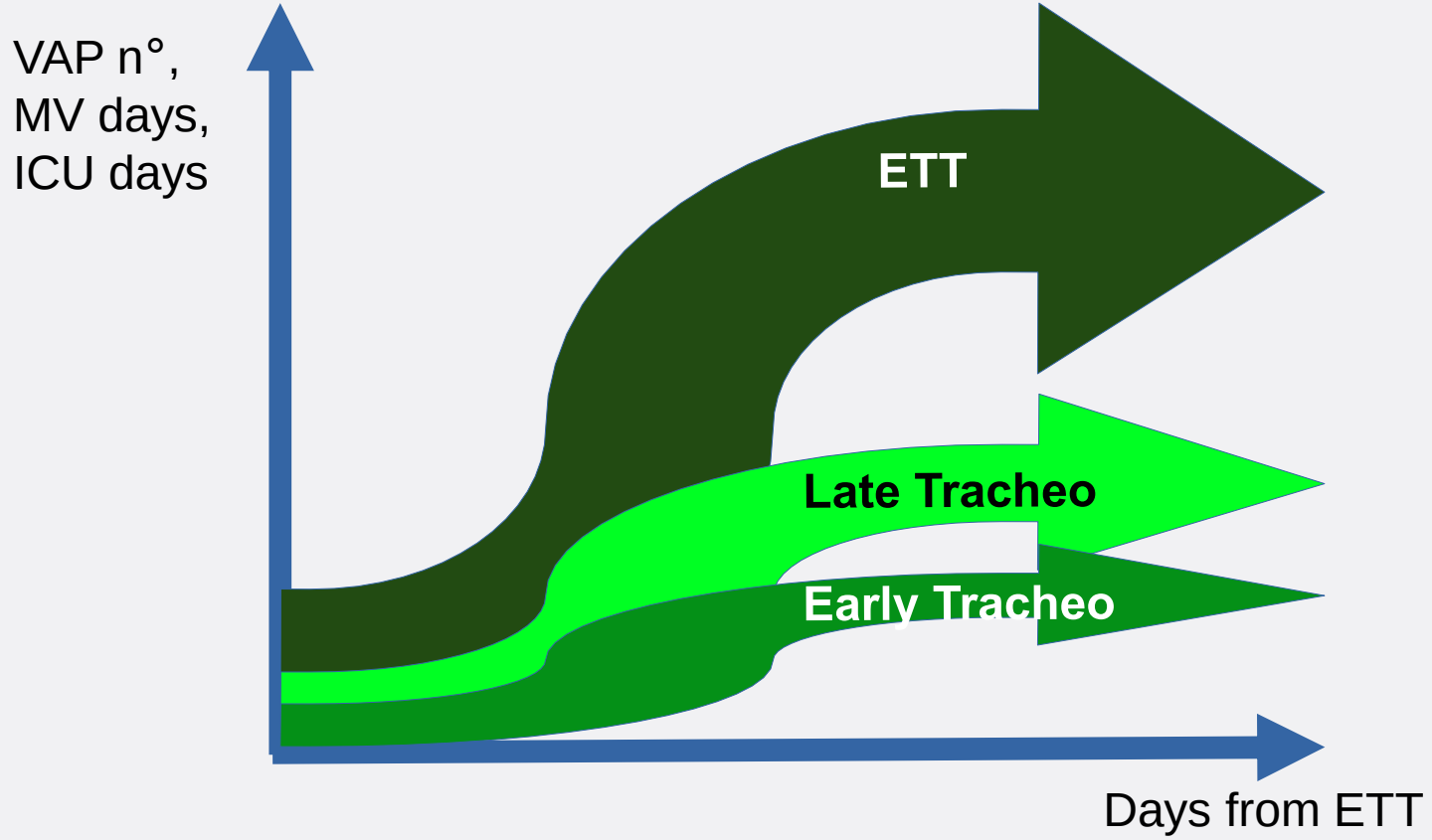
SAH in ICU



Colombo et al, Crit Care Med., accepted

TRACHEOSTOMY in SAH

TRACHEOSTOMY (> EARLY)



CONCLUSION

TRACHEOSTOMY IN SAH

- safe
- Improve resources allocation (> early)
- Reduce respiratory adverse events (> early)
- In patients with pedicted prolonged MV it should be performed as early as possible

Sistema Socio Sanitario

Ospedale Niguarda

Regione Lombardia

Grazie

jacopo.colombo@ospedaleniguarda.it