Canada-Wide Neonatal & Pediatric Transport Systems

3rd Canada-Taiwan Symposium for Children's Health 2021



Presenter: Kyong-Soon Lee

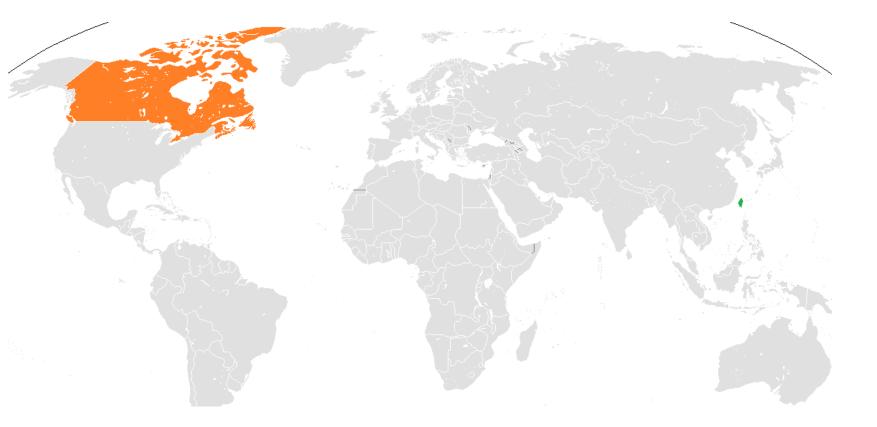
Outline

State of **pediatric** transport in Canada

State of neonatal transport in Canada

Utilization of national database and network for benchmarking and quality improvement

Future directions in neonatal and pediatric transport

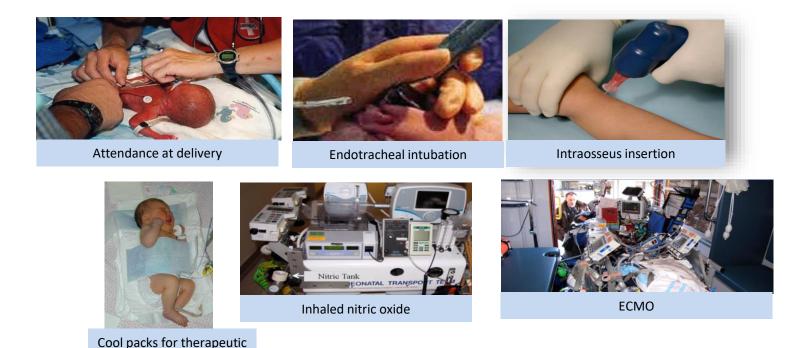


		Surface area in km ²	Births per year	Births /km2
Canada	*	9,980,000	388,000	0.039
Taiwan	*	36,000	200,000	5.556

Transport Regions

	Surface area in km ²		Births per year	Births /km2
England & Wales	24	.0,000	772,000	3.217
United States	9,83	0,000	4,036,000	0.411
Sweden	45	0,000	120,000	0.267
Canada	9,98	0,000	388,000	0.039
Australia	7,69	0,000	316,000	0.041
Taiwan	₩ 3	6,000	200,000	5.556

Transport Teams Bring Critical Care to Referral Sites



Skilled team + efficient system = effective transport

hypothermia

Wide variation in training, processes and quality assurance activities Karlsen et al. Pediatrics 2011;128:685-691

Pediatric transport in Canada

Hospital-based pediatric transport teams in Canada n=8, survey from Aug 2015

Transport program	Total transports	Pediatric transports	%Pediatric/ total transports	Population serviced	%pediatric to PICU (marker of acuity)
А	2300	1100	48	Peds & neo	18
В	1300	200	15	Peds & neo	75
С	714	117	16	Peds & neo	51
D	462	462	100	Peds only	45
E	350	150	43	Peds & neo	30
F	265	265	100	Peds only	65
G	250	240	96	Peds only	60
Н	45	42	100	Peds only	100

Non-hospital based provincial systems support majority of pediatric transport

Kawaguchi et al. Ped Emerg Care 2019;35(1)

Team composition

Among 8 hospital-based pediatric teams

	Number of teams Total = 8	%transports operated by the team composition
Registered nurse (RN); one only Respiratory therapist (RT); one only	0	
Paramedic only	1	85%
RN-RN	2	20% and 99%
RN-RT	5	Median 85%; range 70-98%
RN-paramedic	0	
RN-physician	0	
RN-RT-physician	6	Median 2%; range 2-100%
Other	3	

Team composition: most common: RN-RT Physicians rarely

Kawaguchi et al. Ped Emerg Care 2019;35(1)

Data recorded in database of 8 hospital-based transport teams

Data elements	N (%)
Patient demographics (ID, name, etc.)	8 (100%)
Referral site information (name, postal code etc.)	7 (87%)
Details of transport times/dates of transport	8 (100%)
Vital signs during transport	5 (63%)
Bloodwork result (blood gas etc.)	4 (50%)

Need for common database with standardized elements and definitions to study associations between systems and outcomes for improvement in practice and outcomes

Mode of transport for 8 hospital based pediatric transport teams

Mode of transport	N (%)
Ground – local EMS	8 (100%)
Ground – private transport service	2 (25%)
Ground – dedicated to transport team	2 (25%)
Helicopter -dedicated to transport team	4 (50%) 2 (25%)
Fixed wing propeller -dedicated to transport team	4 (50%) 2 (25%)
Fixed wing jet -dedicated to transport team	5 (63%) 1 (13%)
Mode of transport used	Proportion of transports Median (range)
Ground	43% (15-100%)
Helicopter	10% (0-39%)
Fixed wing jet/propeller	38% (0-65%)

Kawaguchi et al. Ped Emerg Care 2019;35(1)

Who does the triaging for pediatric transports?

- For decisions re: mode of transport and team composition
 - PICU staff 6/8 (75%)
 - Rest: PICU fellows, transport RNs and RTs
 - Pediatric emergency physician not involved for decisions, but are involved in discussion for 2/8 programs

Pediatric transports in Canada

- Challenging to determine current state due to wide variation in types of teams
 - Few hospital based teams
 - Majority of transports by non-hospital based teams (provincial) or local emergency medical systems
 - Lack of standardization of data collection and elements



Neonatal transport in Canada

CNTN

Canadian Neonatal Transport Network

A National Quality Collaborative

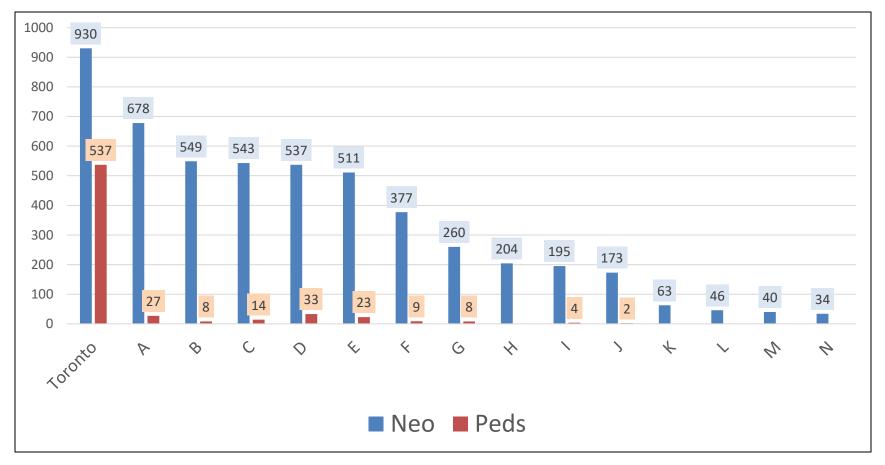


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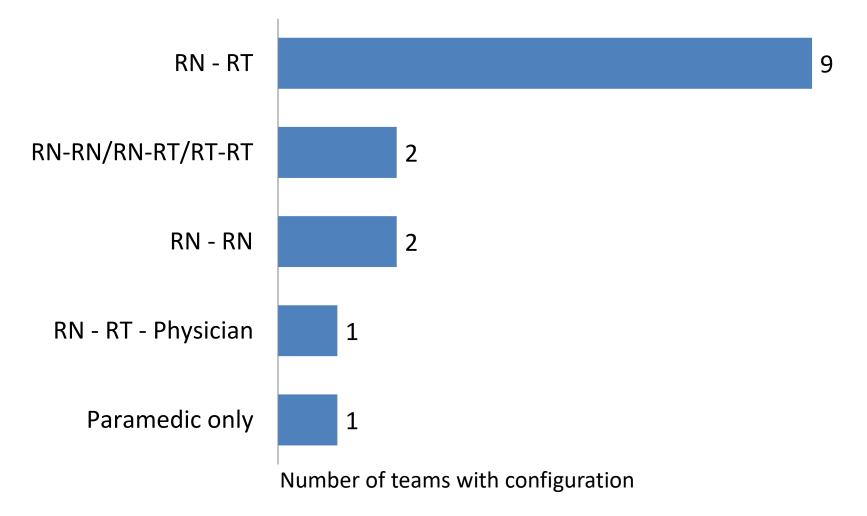


- Network created 2013, includes all 16 neonatal transport teams in Canada
- Currently, data collection ongoing from all 16 sites
- Captures majority of critically ill transports for neonates

Volume of transports entered onto CNTN Fiscal year 2019/20, 15/16 teams 16th team restarted entering data in 2021

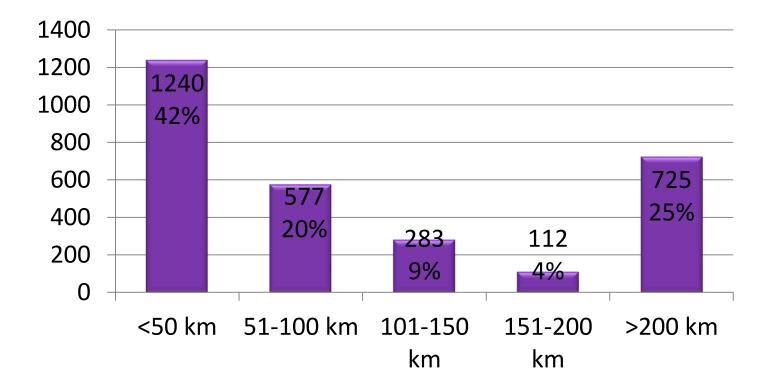


Team configuration for majority of acute neonatal transports



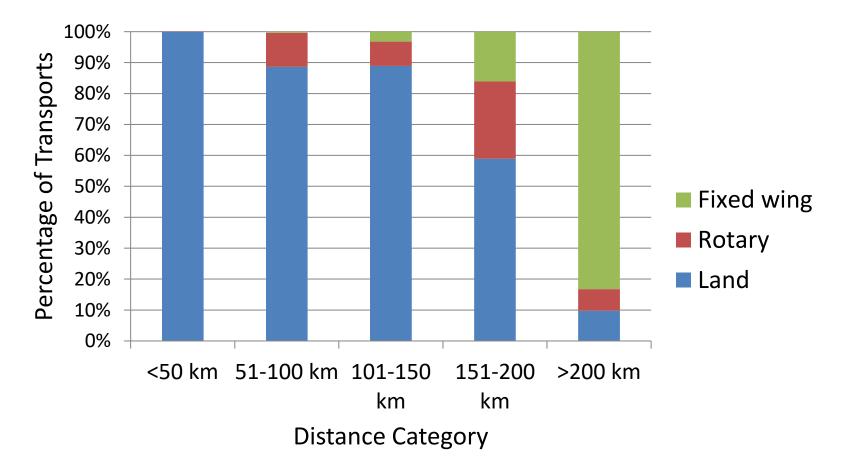
CNTN Survey Feb 2018

Distances Travelled

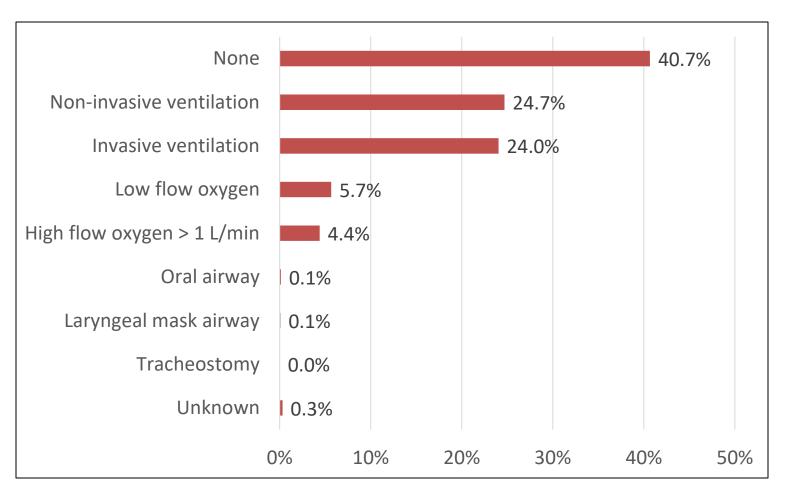


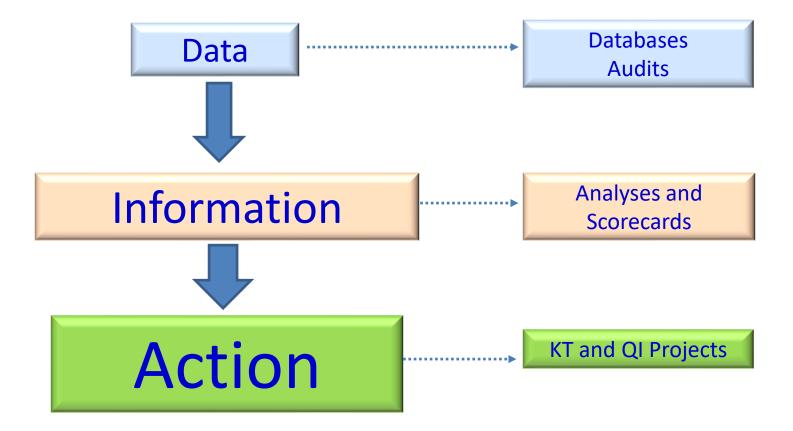
CNTN 2015

Mode for First Leg of Transport by Distance



Respiratory support at destination site Neonatal transports, FY 2019/20, n=4768







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Acuity at Time of Call CNTN Definition

	Descriptor	Examples
Emergent	 Referral site are having difficulty with resuscitation or stabilization; OR Infant born or to be born in a facility where resources (equipment/expertise) are unavailable/inadequate to meet resuscitation or stabilization needs 	 Ongoing cardiorespiratory arrest, shock, neurologic unresponsiveness, inadequate ventilation or oxygenation Bilious vomiting Request for attendance at delivery for <28 wk infant in non-tertiary center
	Reason emergent: 1. medically unstable; 2. surg inadequate; 4. other (specify as free text)	ical emergency; 3. local medical resources
Urgent	Patient with an ACUTE condition which requires a higher level of care (medical, surgical or diagnostic) than locally available	•30 wk ventilated infant with RDS with stable saturations in a non-tertiary centre
Elective	Patient whose initial medical/surgical needs have been met, whose condition has stabilized but requires transfer to access resources (medical / surgical / diagnostic) that are not available locally	 Infant with cleft palate, stable airway referred for Plastics Team consultation

Transport Time Definitions								
Dispatch time	Time of call	Time of dispatch (team 'decision to go' from home base; team must be available to dispatch)						
Vehicle response time –	Time vehicle called to depart	Time vehicle arrived at home						
home base	home base	base						
Wheels up time: home to referral	Take off from home	Landing from home						
Vehicle response time –	Time vehicle called to depart	Time vehicle arrived at referral						
referral site	referral site	site						
Wheels up time: referral	Take off from referral	Landing from referral						
to destination								
Vehicle response time –	Time vehicle called to depart	Time vehicle arrived at						
destination site	destination site	destination site						
Wheels up time:	Take off from destination	Landing from destination						
destination to home								
Mobilization time	Time of dispatch	Time depart from home base						
Travel time	Time depart home	Time arrival at referral site						
Response time	Time of call	Time of arrival at referral site						
Stabilization time	Time of arrival at referral site	Time of departure from referral						
		site						
Time to NICU admission	Time of call	Time of arrival at destination						
		site						
Total transport time	Time of dispatch	Time of arrival back to home						
		base						



Quality Indicators

Systems	Clinical
 Dispatch time Time of referral call to team dispatch 	Parent accompanied transport
Vehicle response time: home to referral	Unintended hypothermia temperature <36.0°C
 Mobilization time Time of dispatch to leave home base 	Dislodgment of therapeutic tubes
 Response time Time of call to team arrival at bedside 	Patient or crew injury
Stabilization time	Intubation success first attempt
 Total transport time Time team dispatched to return to home site 	PIV insertion success first attempt
Number of deliveries GA <32 wk and age <3 days (potentially preventable outborn deliveries)	Age when therapeutic hypothermia initiated Age when target temperature of 34.0°C reached

Institute of Medicine's Six Domains of Quality

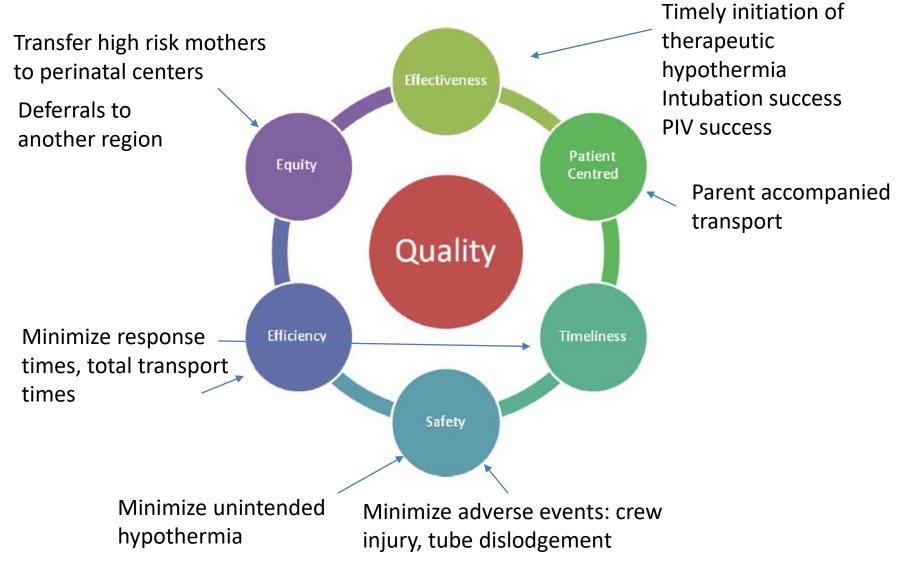


Figure 1: CNTN Scorecard - 2015 Data

TRANSPORT TEAM

																National	National
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INDICATOR																	
SYSTEMS (median, in minutes)																	
Dispatch time, emergent or urgent runs	5	8	0	5.5	0	0	5	15	12	10	8	2	5	15	14	0, 19*	8
Vehicle response time, emergent or urgent runs	84	50	29.5	0	37.5	30	29	45	10	36	25	53	56	30	12	11, 50	25
Mobilization time, emergent or urgent runs	75	58.5	50	13	56.5	30	38	90	25	31	30	60	45	50	25	21, 56	35
Stabilization time, emergent or urgent runs	95	58	57	50	85	- 30	90	175	85	87	55	65	70	130	89	47, 115	75
Total transport time	411	351	240	251	350	180	320	580	215	321	160	350	342	300	223	175, 380	260
CLINICAL (%)																	
Parent accompanied transport	12.82	2.7	0	40.33	2.7	0	0	0	10.12	6.12	1.5	0	1.86	0.86	6.2	0, 6.2†	1.86
Hypothermia temp <36.0°C	0.00	0.00	6.25	0.24	0.00	2.81	0.45	0.00	0.96	1.02	4.49	4.42	0.47	4.01	0.16	0, 4.01*	0.47
Unplanned tube dislodgements	0.00	0.00	0.00	0.71	1.35	1.61	1.36	3.13	0.72	2.04	0.90	2.65	1.63	1.43	1.24	0.71, 1.63	1.35
Intubation success any number of attempts	100	100	50	100	100	80	100	100	85	86	85	100	97	93	82	85,100*	97
Intubation success, first attempt	94	100	0	70	78	80	85	80	65	86	59	60	79	60	56	60, 85	78
Intravenous success any number of attempts	98	100	100	74	59	81	100	100	62	73	29	91	88	83	69	69, 100*	83
Intravenous success, first attempt	93	100	100	42	24	43	79	86	41	63	13	45	66	59	59	42, 86	59

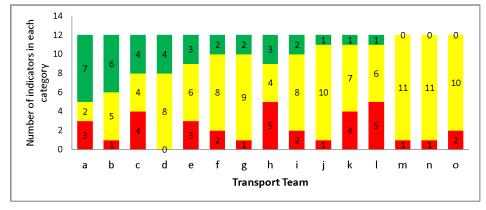


Within interquartile range (IQR 25-75%)

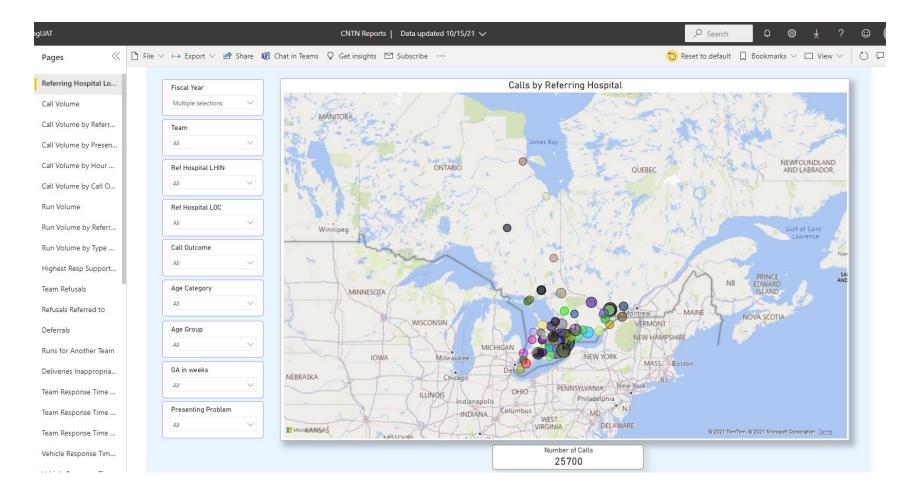
Worse than IQR

*values of zero or 100 categorized as green rather than yellow

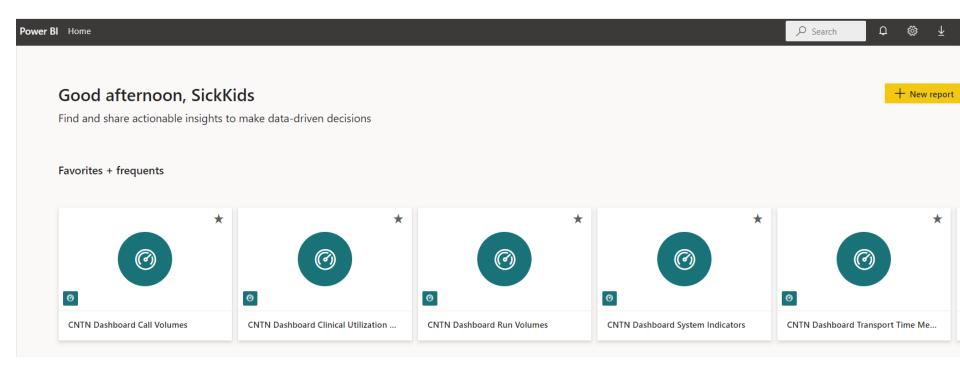
 $\ensuremath{^\dagger\!values}$ of zero categorized as red rather than yellow



CNTN Webportal - launched for Ontario in 2021



CNTN Webportal - Dashboards



CNTN Webportal - Dashboard for Call Volumes

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Improvement in vehicle response time after funding for dedicated ambulances



Median Team Response Time - Land Fiscal Year Multiple selections 131+ Team 123 All 90-130 Age Category Minutes All Mode of Land Transport All 0-89 0 15/16 16/17 17/18 18/19 19/20 20/21 ONT Median Team Response Time - Land Team 15/16 16/17 17/18 18/19 19/20 20/21 Total **124** 145 131 145 140 147 ONT 98 100 101 98 93

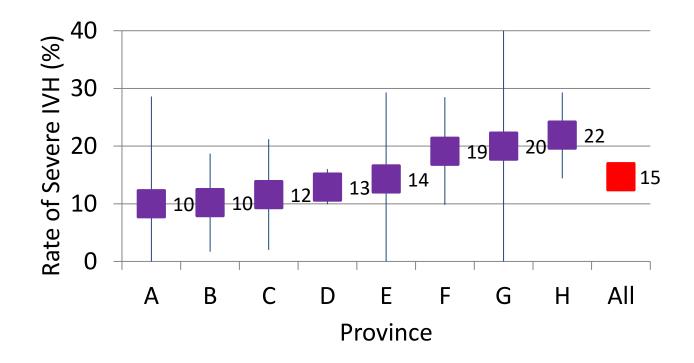
Improvement in response time for land transports after funding for dedicated ambulances

Improving family presence on run





Severe IVH Rates for Transported Infants GA <33 wk by Province; n=781



2014 & 2015 CNTN and CNN data linked

Risk Factors for Severe IVH

Multivariable Analysis

Variable	Adjusted OR (95% CI)	
GA (per week)	0.77 (0.71, 0.85)	
Compressions or epinephrine	1.81 (1.08, 3.05)	
Transport team arrived prior	0.83 (0.51, 1.33)	
to delivery		
Fluid bolus received	1.61 (1.00, 2.58)	
Hypothermia	1.89 (0.83, 4.35)	
Transport team	Significant for 3 teams	

Risk factors were

- Condition at birth
- Immediate postnatal management
- NOT related to transport factors

Redpath et al. on behalf of CNTN & CNN. J Perinatol 2019;40:385-393

Procedures performed by transport team & success rates CNTN 2014-16

Procedure	Frequency N (% of transports)	Success N (% attempts)
Peripheral intravenous	1586 (47.3)	1351 (85.2)
Arterial blood gas	1410 (42.1)	1257 (89.1)
Endotracheal intubation	829 (24.8)	790 (95.3)
Venipuncture	569 (17.0)	511 (89.8)
Umbilical venous	293 (8.8)	273 (93.2)
catheter		
Umbilical arterial	170 (5.1)	121 (71.2)
catheter		
Peripheral arterial line	99 (3.0)	48 (48.5)
Oral airway	64 (1.9)	60 (93.8)
Chest tube	48 (1.4)	47 (97.9)
Laryngeal mask airway	8 (0.2)	8 (100)

Contents lists available at ScienceDirect

Air Medical Journal

journal homepage: http://www.airmedicaljournal.com/

Original Research

Procedural Interventions and Stabilization Times During Interfacility Neonatal Transport

Aravanan Anbu Chakkarapani, MD^{1,2,3}, Hilary E. Whyte, MB^{1,4}, Edith Massé, MD⁵, Michael Castaldo, MD⁶, Junmin Yang, MSc⁷, Kyong-Soon Lee, MD^{1,4,*}, on behalf of the Canadian Neonatal Transport Network

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⁷ Maternal-Infant Care Research Centre, Department of Paediatrics, Mount Sinai Hospital, Toronto, Ontario, Canada

- Canadian national transport data ٠
- Identified most common procedures during neonatal transport
- Type and frequency of procedures had impact on stabilization time
- Limit non-essential and lower success rate procedures such as **UAC** insertion

ABSTRACT

Objective: Transport teams perform multiple procedural interventions during the stabilization of critically ill neonates. The setting of this study was a national cohort of interfacility neonatal transports from nontertiary centers.

Methods: A retrospective cohort study of neonatal transports having interventional procedures using the Canadian Neonatal Transport Network database during 2014 to 2016. Demographics and procedures associated with stabilization times < 120 versus > 120 minutes were analyzed. Predictors of stabilization time were evaluated using multivariable logistic regression analysis.

Results: Among 3,350 neonatal transports analyzed, the 3 most frequently performed procedures were peripheral intravenous insertion, arterial blood gas sampling, and endotracheal tube insertion, with success rates of 85.2%, 89.1%, and 95.3%, respectively. The frequency of procedures varied across gestational age subgroups, and success rates were lower for umbilical arterial catheter insertions. After adjustment for confounders, more invasive procedures and a higher number of interventions were associated with longer stabilization times.

Conclusion: The type and frequency of procedures performed had a significant impact on stabilization time. Any procedures that are nonessential for stabilization at the nontertiary center, such as umbilical arterial catheter insertion, could be minimized to promote timely admission to tertiary centers. The demonstrated variations in procedural success among teams provide useful information for benchmarking and promote the sharing of training practices.

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Paediatrics & Child Health, 2021, 1–7 doi: 10.1093/pch/pxab019 Original Article

OXFORD

Original Article

Evaluation of transport-related outcomes for neonatal transport teams with and without physicians

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Abstract

 $\label{eq:objective: The aim of this study was to evaluate if the presence of a physician in the neonatal transport team (NTT) affects transport-related outcomes and procedural success.$

Design: Retrospective cohort study with propensity score matching.

Setting: Canadian national study.

Patients: Neonatal transports from nontertiary centres between January 2014 and December 2017. **Interventions:** Comparison of transports conducted by NTTs with physicians (MD Group) and without physicians (noMD Group).

Main outcome measures: The primary outcome was the change in patient acuity as measured by the transport risk index of physiologic severity (TRIPS) score. Secondary outcomes included mortality within 24 hours of NICU admission, clinical complications during transport, procedural success, and stabilization time.

Results: Among 9,703 eligible cases, 899 neonatal transports attended by NTTs with physicians were compared to 899 neonatal transports without physicians using propensity score matching. No differences were seen in the improvement of TRIPS score or mortality \leq 24 hours of NICU admission. The MD Group had more clinical complications (7.7% versus 5.0%, P=0.02). No differences were seen in success rates of invasive procedures. The MD Group had shorter stabilization times. In multivariable analysis, the MD Group was not a significant predictor for the improvement in TRIPS score after adjustment for covariates.

Conclusions: Neonatal transports conducted by teams including physicians compared to teams without physicians, did not have higher improvement in TRIPS scores and had similar success rates for procedures. These results provide insights for the planning of the structure and training of specialized interfacility neonatal transport programs.

- Canadian national transport data
- Propensity-score matched analysis for more acute transport runs
- Runs with MDs vs noMDs have no difference in procedural success
- MD group had more clinical complications e.g. hypothermia
- Supports current Canadian model of noMD routinely on transport runs



March 26, 2018 12:00-13:00 EST

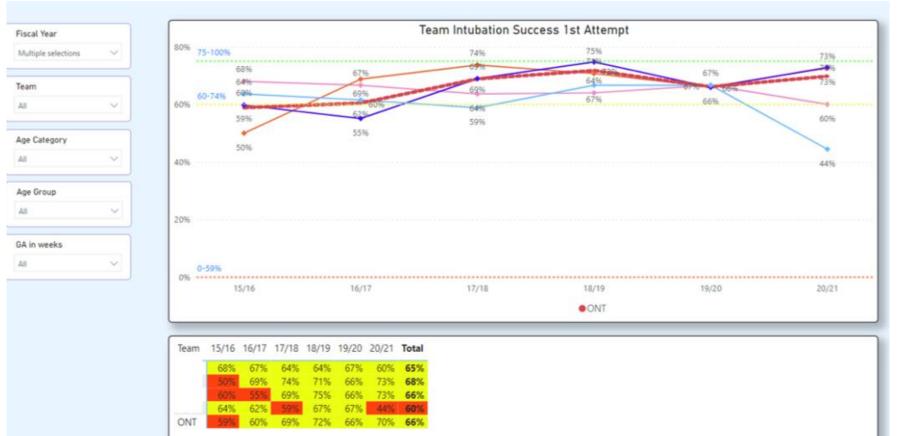
Focus on Metrics:

Procedural Skills and Team Training in Neonatal Transport: A review of network data and survey results

Hosted by: Kyong-Soon Lee, MD Director of CNTN Join from PC, Mac, Linux, iOS or Android: https://zoom.us/j/784125430 Canada: +1-647-558-0588 Meeting ID: 784 125 430

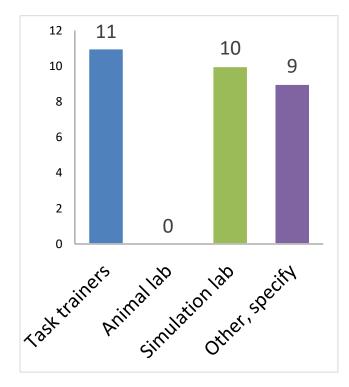
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Intubations first attempt success



Canadian Neonatal Transport Network

Intubation teaching for new team members



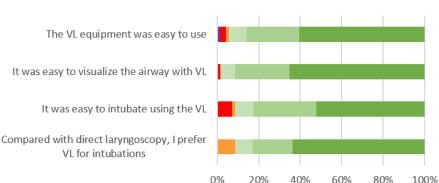
BC	Time in OR paired with anaesthetist		
Saskatoon	Under direction supervision they attempt on live neonates		
Regina	Under supervision, should have 10 intubations before working in NICU		
Hamilton	Didactic class & simulation, followed by observation of 10 successful intubations prior to certification		
Toronto	Training in the OR with staff anesthetists		
Ottawa	Skills day - low fidelity and hi fidelity 3 days in OR		
Montreal	Minimum 5 intubations under observation		
Halifax	Cadavers also		
Nfld & Lab	RTs must show competency for intubation in NICU before being certified to do independent transport		

Transport Network

CNTN Survey Dec 2014 Responses n=15/16 teams

Use of video laryngoscopy to improve intubation success during neonatal and pediatric transport **Nicole Coutu RRT**, L Yap, M Culjat, H Whyte, K-S Lee

- First pass intubation success rates pre and post 72% and 77% (p=0.37)
- Overall intubation success improved from 89% to 99% (p=0.002)
- VL made intubation easier in 7/7 (100%) known difficult airway cases
- Adverse events during intubation with VL rare n=2/103



Somewhat disagree

Completely agree

■ Completely disagree ■ Disagree

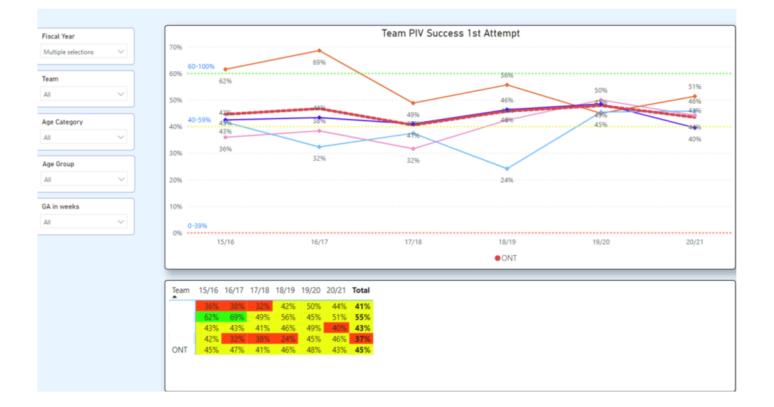
Agree

Somewhat agree

Figure 1. User evaluation responses

PIV first attempt success





US guided PAL insertion

Marko Culjat (Senior Fellow), N Ruse, M Soreta, H Colangelo, J Gardiner, H Whyte, K-S Lee

- Improved first-attempt success rates
- Overall success rate of 96%
- Decrease in #attempts
- Lower complication rates
- Currently training more NICU providers
- Goal of making USgPAL new standard of care for our NICU
- Also using US for PIVs

	Traditional PAL N=159	USgPAL N=93	p-value
1 st attempt success	53.0%	84.9%	<0.00001
rate [%]	(79/149)	(79/93)	
Overall success rate [%]	unknown	95.7% (89/93)	n/a
Line days, median	2.7	2.9	0.25
[IQR]	[1.3, 4.1]	[1.9, 4.0]	
Complication rate [%]	47.1% (66/140)	30.4% (24/79)	0.02
Major complication	16.7%	16.7%	1.00
rate [%]	(11/66)	(4/24)	
Time to failure days,	1.9	1.5	0.79
median [IQR]	[0.4, 3.5]	[0.2, 2.8]	



Marko Culjat. Ultrasound-guided Vascular Access in Acute Care Transport Services and Neonatal Intensive Care Unit, March 2021



Wednesday November 28, 2018 12:00-13:30 EST

Therapeutic hypothermia in transport:

Review of our network data and sharing our practices including Tecotherm

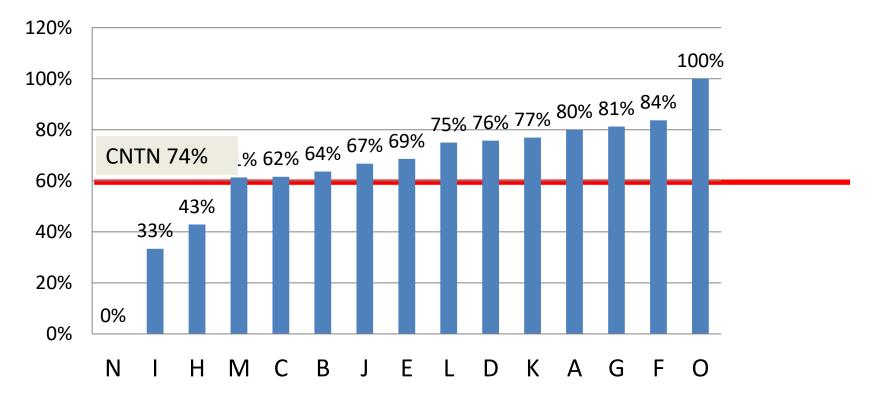
Presenters: Sumesh Thomas/Renee Paul, Calgary Stephanie Redpath, Ottawa Kyong-Soon Lee, Toronto

Active Cooling during Transport? Survey Feb-Mar 2018

Team	Active cooling	
BC	Yes	Cool packs
Calgary	Yes	Tecotherm
Toronto	Yes	Cool packs
Ottawa	Yes	Tecotherm since Aug 2017
Sherbrooke	Yes	Cool packs
Halifax	Yes	Cool packs
Nfld & Lab	Yes	Cool packs
Edmonton	No	stopped using cool packs due to overcooling
Saskatoon	No	
Regina	No	stopped using cool packs due to overcooling
Winnipeg	No	
London	No	
Hamilton	No	
Montreal Children's	No	
Quebec City	No	stopped using cool packs due to overcooling

CNTN Survey Feb 6 - March 5, 2018 - Responses 15/16 teams

Proportion of cases where target temperature of 34.0°C reached at ≤6 hours age



2014-2016

Neo-Paeds Virtual Critical Care Pilot Project







Goal to improve neonatal & paediatric health care



Enhanced patient stabilization and care



Optimize patient transfers



Improved patient and provider experiences



Enhanced capacity to deliver quality care closer to home Reduce risk infection spread



Health system savings



How adding video enhances the transport process...

- Teams are able to determine if the patient can safely be kept closer to home at the local community hospital or if more specialized care is required
- The addition of video allows the consulting team to provide direction to keep the patient stable until the ACTS team arrives



PNTN **Pediatric Neonatal**

Transport Network

Database Upgrade

New Call Save First Name: D/T of Call: Nov 20, 2021 21:44 Admin Admin Maternal Transfer Image: Case ID T00000001 Team Date/Time of Call Nov 20, 2021 Image: Case ID Transport Call Taken by Image: Case ID Acuity Staff MD on Call Image: Case ID	PNTN - Demo Hospital					
First Name: Last Name: Dyf of cit: Nor 20, 2021 (2):4 Admin	File Tools Help					
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PRNTN Pediatric Neonatal Transport Network

Runs by non-hospital based team screen

PNTN - Demo Hospital		
File Tools Help		
) New Call 🛛 🔎 Search	🛃 Save	
First Name:	Last Name:	D/T of Call: Nov 20
Admin		
Maternal Transfer	Runs Completed by Non-hospital Based Team	Reviewed
uns by Non-H based Team		
Team	Team Configuration Highest level of ventilatory suppress Physician Provincial/External Team destination	ort at arrival at
Transport	Nurse EMS Artificial Airway	
Acuity	RT Other	~
/ledications/Interventions		
Complications	IV access during run Respiratory Support Yes No Unknown	~
Post Transport	Mode of Transport - Referral to destination	~
Validate	Land Rotor Fixed wing	
	Arrive at Referral Site Nov 20, 2021 V : Unknown time Response Time N/A	Mins.
	Depart Referral Site Nov 20, 2021 V : Unknown time Stabilization Time N/A	Mins.
	Arrive at Dest. Site Nov 20, 2021 V : Unknown time Adm to Dest. Time N/A	Mins.

PNTN **Pediatric Neonatal Transport Network**

Acuity screen

💈 PNTN - Demo Hospital						
File Tools Help						
New Call 🔎 Search	🚽 Save					
First Name:		Last Nan	ne:		D/T of Call: Nov 20, 20	21 21:44
Admin	A					
Maternal Transfer	Acuity					Reviewed
uns by Non-H based Team						
Team	CTAS		~	Elective admission	Yes No	
Transport	A		Ť	Recovery from surgery or		
Acuity	Access	PAL UAC [Unknown	procedure is main reason for admission		~
Medications/Interventions		PICC UVC	_	Low-risk diagnosis,		
Complications	0 0	PIV Other		main reason for ICU		~
Post Transport	Inotropes			High-risk diagnosis		~
Validate	Ves [No Unknow	vn	Very high-risk diagnosis		~
	Mod (RR > 60	D Unknown Unknown Unknown Unknown (gasping, intubated) (min and/or SpO2 < 85) 60/min and SpO2 >= 85) unsponse to Stimuli nt torose, no cry	Lowest pH	Unknown Unknown Scale ponse	Highest Level of Ventilatory Artificial Airway Respiratory Support	Data N/A Support
					Glasgow Coma	Scale = N/A

Pediatric Neonatal Transport Network

Materna data screen

🙎 PNTN - Demo Hospital		
File Tools Help		
] New Call 🔎 Search	🚽 Save	
First Name:	Last Name:	D/T of Call: Nov 20, 2021 21:
Admin	Maternal Transfer Details	
Maternal Transfer		
luns by Non-H based Team	Maternal Transfer Info available?	
Team	Yes No Unknown	
Transport	Date / Time of Maternal Admission at referral site	
Acuity	Attempt for maternal transfer	
Medications/Interventions	Yes No Other Unknown	
Complications		
Post Transport	If Yes Date / Time Attempt made [Enter date] V III Unknown Time	
Validate	Outcome of request for maternal transfer	
	\sim	
	Reason aborted	
	Other outcome	
	If no maternal transfer attempted, reason	
	Imminent delivery	
	Need for urgent delivery for fetal reason	
	Need for urgent delivery for maternal reason	
	Not attempted based on referral level of care	
	Other Unknown	

Volume of preterm transports <32 weeks & <3 days old from CNTN non-tertiary sites – as surrogate of outborn deliveries



Canadian Pediatric Transport Initiatives



Outreach education

Team education

Royal College transport certificate

Database/research

Future Directions in Canadian Transport

Expansion of neonatal database to facilitate data collection for

- Pediatric transports
- Non-hospital based transports

Increase utilization of database through webportal

- Timely reporting of utilization data and metrics
- Benchmarking and trends over time

Increase collaboration across neonatal and pediatric transport networks to share resources and practices





Thank you and best wishes from Toronto to Taipei