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New normal limits for the paediatric electrocardiogram

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Lesd		0-1 m	cords	1-3 months	3-6 months	6-12 months	1-3 sm	rs 3-5	years.	5-8 years	8-12 years	12-16 years
Heart	rate (Sents: min	-1) 160 (12	19. 192) 1	S2 (126, 187) I	M/112 165	128 (106, 194)	119.67.1	95) 95/2	5. 12 h	88 (62, 113)	78 (55, 100)	71(48.99)
P axis i	0	56 (17	. 99)	\$2 (10, 73)	39 (122, 191) 49 (- 5, 70)	134 (106, 187) 49 (9, 87)	48 (- 12	70 414	15, 691	89 (68, 115) 41 (-54, 72)	80 (58, 110) 39 (17, 76)	76 (54, 107) 40 (- 24, 76)
P dent	tion (mo)	52 (24 78 (64	1, 850	79 (65, 96)	51 (16, 80) 81 (64, 103)	50 (14, 69) 80 (86, 96)	47 (1, 90 90 (63, 1	135 87 (6	6, 903	42 (-13, 77) 92 (73, 108)	42 (- 15, 82) 98 (78, 117)	45(-18, 77 100 (82, 118)
PR into	gryal (mo)	29 (66 99 (77			78 (63, 106) 06 (87, 134)	80 (64, 87) [14 (82, 14))	83 (62, 1 118 (86, 1		6, 101) K. 152)	89 (71, 107) 129 (99, 160)	94 (75, 114) 134 (105, 174)	99 (78, 122) 139 (107, 178
QRS=	sis (")	97 (72	121)	ET (37, 138)	06-(84, 127) 66-(- 6, 107)	109 (88, 133) 68 (14, 122)	113 (78, 1 64 (- 4	10.00 2017	112)	124 (92, 156) 70 (- 10, 112)	129 (103, 163) 70 (- 21, 114)	135 (106, 176 654 - 9, 112
ORSI	uration (ma)	110-667 67 (50	1, 85)	14 (52, 77)	50 (17, 108) 66 (54, 85)	67 (1, 102) 69 (52, 86)	69 (Z, 12 79 (54, 8	6) 75-(5	(06)	74 (27, 117) 89 (63, 98)	66-(5, 117) 85-(67, 105)	66-(5, 101) 99 (78, 111)
QTc in	terval (m@*	67 (54 413 (37 420 (37	3, 443) 4	19 (394, 458) 4	64 (50, 78) 22 (391, 453) 18 (386, 448)	64 (52, 90) 411 (779, 449) 414 (381, 446)	68 (54, 8 412 (183, 417 (181,	455) 402(3		77 (59, 95) 411 (371, 443) 409 (375, 449)	82 (66, 99) 411 (373, 440) 419 (363, 447)	87 (72, 100) 407 (362, 449 414 (370, 437
Bold vo	alses indicate th			ervals of the perce								
Misses	end OT sores	L according to	Basel's fo	male O'E-O'T	/heart sate					_		
_				rys (upper rose				_		_		
Load	0-1 months	1-3 months	3-6 most	ts: 6-12 month	s 1-3 years	3-5 years	5-8 years	B-12 years	12-16 yea	n		
11	0-15(0-23)	0-16 (0-25)	015 (0.2 016 (0.2	0 16 (0-26)	0-15 (D-25) 0-16 (D-25)	0-13 (0-23)	0-12 (0-22) 0-12 (0-24)	9-12 (0-22) 9-14 (0-24)	0-13 (0-2)			
V _i	0-12 (0-22)	0-10 (0-19)	0.09 (0.1)	0-10(0-17)	0-13 (0-20)	0-12 (0-19)	0-1249-201	0-11 (0-19)	0-11 (0-1)	0		
\mathbf{v}_{i}	0.15(0.25)	0.02(0.16)	010/03	011(021)	0 12 (0 20)	012 (020)	011(018)	011 (019)	0.10(0.17			
	0.16 (0.28)	013(023)	012 (01)	0 13 (9-23)	013 (023)	0.11 (0.29)	0 11 (0 17)	0 10 (0 18)	0.10/0.13	9		
_		1-3 months		oys (apper row to 6-12 month	_	3-5 years		th percentile 8-12 years) 12-16 ym	n n		
11	0 14 (0 23) 0 09 (0 26)	0-18 (0-32)	014103									
			015(04	0 18 (0-48)	0.15 (0.44)	0-11 (0-26) 0-13 (0-27)	0-10 (0-28) 0-08 (0-20)	0 09 (0-24) 0 08 (0-21)	0-08 (0-21	9		
111	0-15(0-26)	0 14 (0 32) 0 29 (0 50)	011(04	0.15(0.44)	0.16 (0.48)	0-13 (0-27)	0-08 (0-26) 0-15 (0-36)	0-08 (0-21) 0-10 (0-26)	0.09 (0.2)	ls N		
	0 15 (9 26) 0 18 (9 35) 0 13 (9 23)	0.29 (0.50) 0.24 (0.50) 0.29 (0.15)	011 (04 031 (07 021 (06 030 (04	0 18 (0-44) 0 035 (0-79) 0 034 (0-79) 0 022 (0-58)	0 16 (0 48) 0 30 (0 74) 0 31 (0 73) 0 20 (0 54)	0-13 (0-27) 0-19 (0-46) 0-18 (0-40) 0-14 (0-34)	0-08 (0-26) 0-15 (0-36) 0-16 (0-30) 0-12 (0-25)	0-08 (0-21) 0-10 (0-25) 0-10 (0-27) 0-09 (0-25)	0-09 (0-2) 0-10 (0-2) 0-10 (0-2) 0-08 (0-2)	9 9 0		
aVF	0-15 (9-26) 0-18 (9-25) 0-13 (9-23) 0-10 (9-27)	0-29 (0-50) 0-24 (0-50) 0-20 (0-35) 0-17 (0-35)	011(04 031(07 028(06 030(04 020(04	0 16 (0-44) 0 35 (0-79) 0 34 (0-79) 0 0 22 (0-58) 0 0 23 (0-52)	0 (6 (0 48) 0 30 (0 74) 0 31 (0 73) 0 30 (0 54) 0 20 (0 54)	0-13 (0-27) 0-19 (0-86) 0-18 (0-80) 0-14 (0-34) 0-12 (0-31)	0-08 (0-26) 0-13 (0-36) 0-16 (0-30) 0-12 (0-25) 0-11 (0-31)	0-08 (0-21) 0-10 (0-28) 0-10 (0-27) 0-09 (0-25) 0-08 (0-21)	0 10 (0 2) 0 10 (0 2) 0 10 (0 2) 0 00 (0 2) 0 09 (0 1)	9 9 0 0		
aVF V _e	0 15 (0 26) 0 18 (0 35) 0 13 (0 27) 0 10 (0 27) 0 11 (0 22) 0 (0 (0 17)	0.29 (0.50) 0.24 (0.50) 0.20 (0.35) 0.17 (0.35) 0.16 (0.31) 0.15 (0.37)	015 (0.4 031 (0.7) 028 (0.6) 030 (0.4) 017 (0.7) 015 (0.4)	0 18 (0 44) 0 035 (0 79) 0 034 (0 79) 0 022 (0 53) 0 023 (0 52) 0 030 (0 66) 0 031 (0 79)	0 16 (0 48) 0 30 (0 74) 0 31 (0 73) 0 20 (0 54) 0 20 (0 54) 0 20 (0 56) 0 17 (0 48)	0-13-(0-27) 0-19-(0-46) 0-18-(0-40) 0-14-(0-34) 0-12-(0-31) 0-15-(0-42) 0-15-(0-42)	0 (0 (0 26) 0 15 (0 36) 0 16 (0 30) 0 12 (0 25) 0 12 (0 31) 0 12 (0 37) 0 10 (0 41)	0 (08 (0-21) 0 10 (0-28) 0 10 (0-27) 0 (0-25) 0 (0-25) 0 (0-21) 0 12 (0-43) 0 11 (0-34)	0.09 (0.2) 0.10 (0.2) 0.10 (0.2) 0.00 (0.1) 0.11 (0.4) 0.09 (0.2)	9 97 00 10 10 10 10		
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aVF V _e V _e	0 15 (0 26) 0 18 (0 25) 0 13 (0 27) 0 10 (0 27) 0 10 (0 27) 0 11 (0 22) 0 (0 (0 17) 0 (0 (0 15)	0.29 (0.50) 0.24 (0.50) 0.39 (0.35) 0.17 (0.35) 0.16 (0.31) 0.15 (0.37) 0.13 (0.28) 0.13 (0.28)	015 (0.4 031 (0.7) 028 (0.6) 030 (0.8) 017 (0.2) 015 (0.4) 014 (0.3) 013 (0.3)	0 18 (0-44) 0 35 (0-79) 0 34 (0-79) 0 021 (0-51) 0 020 (0-60) 0 018 (0-52) 0 017 (0-52)	0 16 (0 48) 0 30 (0 74) 0 31 (0 73) 0 30 (0 54) 0 20 (0 54) 0 17 (0 48) 0 17 (0 43)	0-13 (0-27) 0-19 (0-46) 0-18 (0-40) 0-14 (0-34) 0-12 (0-31) 0-15 (0-42) 0-15 (0-42) 0-15 (0-33)	0 (01 (0 26) 0 15 (0 36) 0 16 (0 35) 0 12 (0 25) 0 12 (0 25) 0 11 (0 31) 0 12 (0 29) 0 11 (0 30) 0 11 (0 30) 0 09 (0 36)	0-08 (0-21) 0-10 (0-26) 0-10 (0-27) 0-09 (0-25) 0-08 (0-21) 0-12 (0-43) 0-11 (0-26) 0-09 (0-26)	0.09 (0.2) 0.10 (0.2) 0.10 (0.2) 0.00 (0.1) 0.11 (0.4) 0.09 (0.2) 0.11 (0.4)	9 97 9 9 9 9 9		
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Volunteering



Making ECG interpretation in the Paediatric Emergency Department easier and safer by introduction of an ECG checklist



Wood J₁, Foster S₂, McLeod K₁ Cardiology Department₁, and Emergency Medicine₂, Royal Hospital for Children, Glasgow

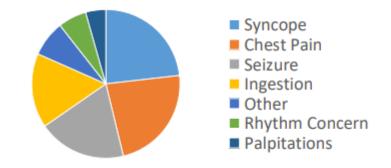
Results

Between May and November 2018, 600 electrocardiograms were performed in paediatric ED. 48 electrocardiograms of patients known to cardiology services or discussed with the on-call team were excluded.

Of the remaining 552 electrocardiograms;

- 30 were identified by the emergency clinicians as abnormal
- 13 of these were considered normal by cardiology and discharged.
- The other 17 patients were allocated to cardiology outpatient clinic.
- 3 of these 17 required ongoing follow-up.

Indications for ECG



Red Flags

Syncope

- · Whist lying down / supine or sitting
- On swimming
- On exercise
- Family history of sudden explained death
- Family history of epilepsy

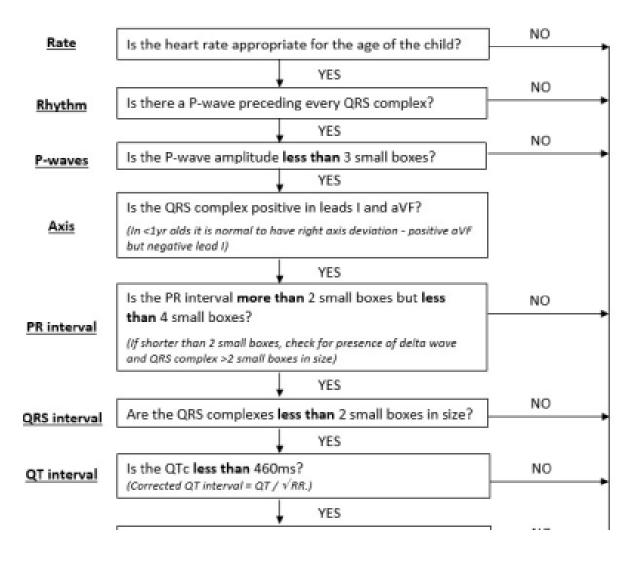
Prolonged QTc

- Syncope with QTc > 450ms
- Otherwise QTc > 460ms in both boys and girls

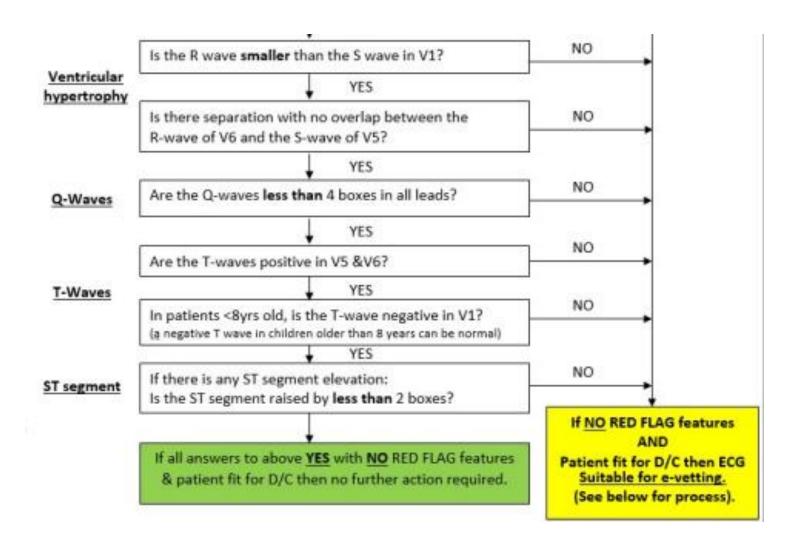
ELGG GROCKLIST 1: the heart rate appropriate for the age of the child? 1: the next preceding every CRS complex? NO 1: there a F-wave preceding every CRS complex? NO 1: there is wave applicable last within 5 would bown? 1: the CRS complex positive in leads 1 and avX? 1: the CRS complex positive in leads 1 and avX? 1: the CRS complex positive in leads 1 and avX? 1: the CRS complex positive in leads 1 and avX? 1: the CRS complex positive in leads 1 and avX? 1: the CRS complex positive in leads 1 and avX? 1: the CRS complex positive in leads 1 and avX? 1: the CRS complex positive in leads 1 and avX? 1: the CRS complex positive in leads 1 and avX? 1: the CRS complex positive in leads 1 and 1 an

Patient Name:			QRS axis					
DOB:	Age:		NB RAD normal in <3/12, normalising to LAD by 1y & progressing to adult parameters by 8y.					
Hospital Number:	ECG Date:		Causes of superior RAD: -90° AVSD, Tricuspid atresia,					
Presentation:			Ebstein's phenomenon,					
ECG Calibrated at 1mm:10mV? Lead position: right arm clocky RATE	☐ Paper at 25 mm/ vise (R,Y,G,B) + V4R in all under-	_	WPW, Dextrocardia					
Regular (300 / R-R interval):			/ E					
Irregular (6 x pnumber of comp RHYTHM	olexes in rhythm strip) :		/ -					
	1 small square = 0·04s therefore	1 big square = 0·2s	/					
P wave before every QRS? ?SVT, ?Heart Block		•	110° = limit of RAD in all pts >1y					
PR Interval	QRS Duration	QTc Interval	MORPHOLOGY					
< 2 y 0.08 - 0.16s	<2y = <0.08s >16y = <0.12s	< 6 months Variable	P wave (lead II)					
2y - 15y 0.09 - 0.18s	NB Lengthens with age:	> 6 months < 0.44s	Normal amplitude < 3mm Normal duration: < 0.07s (infants) / < 0.09s (children)					
>16 y 0·12 – 0·2s	'normal' can represent slight	QTc = QT/Vpreceding R-R(s)	RED FLAG: tall (RA) and wide (or bifid, LA) = combined					
210 y 0-12 - 0-25	prolongation i.e. BBB		atrial hypertrophy					
			QRS complex Normal Variants:					
			- RSR' in V1-V3 in neonates, persisting in 7% of under-5s					
AXIS			- R wave dominance generally regresses by 4y					
P wave axis (i.e. SAN location) Normal = positive in I, III and a	I		RED FLAGS: - Delta Wave - Q waves in I and aVL - Deep Q waves (>5mm) inferolaterally - BBB (WiLLiaM MaRRoW)					
			ST segment					
			Normal variant: Upsloping ST depression					
			RED FLAGS:					
			1) Down-sloping ST 2) Horizontal ST depression > 0.08s					
			T wave					
			'Juvenile pattern': Inverted T waves in V1-V4 are physiological after 48hrs of age, persisting in V1 until 8y and often into					
			adolescence.					
			RED FLAGS: Tall (>2/3 R wave), peaked // Flat // Deeply inverted	1				

ECG checklist



continued.....



Paediatric ECG Interpretation

CHECK

Lead position matches machine diagram Vertical 10mm/mV Horizontal 25mm/sec



Anna McCorquodale

Rate Calculation
Regular - 300/(no. large
squares between R-R)
Note if irregular

7 Rhythm

Assess in rhythm strip (lead II), 1 small square = 0.04 sec

Normal sinus rhythm:

- . P wave before each QRS
- · Normal P wave morphology
- Normal P wave axis (upright II, III, aVF)
- · Normal PR interval
- · Appropriate rate for age

RS Axis

Use vector addition plotting arrows along lead! (positive to right) and aVF (positive downwards)

0-90° normal 1-8 years. Mild LAD (-30°) normal puberty- adulthood. RAD 90-180° normal <1 year

🔼 P Wave

Amplitude <3mm <2 year 0.08-0.16 2-15 years 0.08-0.2 >15 years 0.12-0.2

Tall - P pulmonale - RA dilatation Bifid & wide - P mitrale - LA dilatation

5 ST Segment ST should be isoelectric

QTC QTc = QT/√ (preceeding RR) 0-6m - variable - max 0.46 secs >6m - < 0.45 secs



7 QRS Complex

Duration increases with age and bradycardia Max duration usually 0.12 secs during childhood Bundle branch block – prolonged QRS duration and interruption in flow of R/S waves Partial BBB (i.e. without QRS prolongation) normal finding

In BBB look for the pattern:





Then look at complex height across the chest leads:

Tall Complexes V1-V3 - ?RVH Tall V4-V6 complexes - ?LVH

👤 🛮 T Wave

Physiological inversion V1-V3 after birth Return to upright in reverse order during childhood, persisting inversion of V1 normal variant

Check if very tall/peaked, broad and flat, abnormally inverted or bifid
U wave normal if bradycardic, should be same orientation as T wave