

# Normal Ranges

## Established at Children's Hospital of Buffalo

Children's Hospital, founded in 1892, provided care for just 12 children in a single house in Buffalo, New York. Under constant expansion since 1908, the now 313-bed acute care hospital is celebrating its 100th Anniversary.

Affiliated with the State University of New York at Buffalo School of Medicine and Biomedical Sciences, it is the only university-affiliated freestanding children's hospital in New York state and one of only three in the country with a maternity division. Children's Hospital has one of the largest neonatal units in the nation, caring for more than 1,000 critically ill newborns annually.

Since Children's Hospital of Buffalo, unlike many pediatric institutions, has a large maternity and newborn unit, it gives them a distinct advantage: they have been able to establish their own reference [pediatric ranges](#). The hospital has spent several years collecting data on the COULTER® S-PLUS IV on approximately 400 well children.

"It was difficult," says Joanne Jakiel, M.T. (ASCP), hematology supervisor, who worked with John Fitzpatrick, M.D., and Ray Hadley, lab manager on the project. "Together with Dr. Fitzpatrick, who is hematology director at Children's Hospital and director of laboratories at Roswell Park, we analyzed the data closely taking clinical and dietary factors into consideration when establishing the ranges."

Eventually age range overlaps were noted. "We were able to narrow down our age groups to five sets, because in reviewing the data we noted that overlaps occurred." Currently the lab reports the following age groups for males and females: newborns; 1-23 months; 2-9 years; 10-17 years and 18+ years. See Chart A for the breakdown of samples in each age group.

Chart A	Sample Number	
	CBC	Diff.
Newborn	999	100
1-23 mos.	475	455
2-9 yrs.	1489	1475
10-18+ yrs. (Both male and female)	450	400

"This is based totally on our own population," says Jakiel. "We were able to test the newborn population, all of whom get a CBC at one day of age. Others were obtained on well children through the outpatient clinics over a number of years." The normal ranges are reported to physicians on the back of the CBC report.

The data are extremely interesting. At the Buffalo facility, the normal newborn WBC range goes as high as  $34.0 \times 10^9/L$ , Hgb to 24 g/dL, with a 70% Hct. Platelet counts are remarkably stable at  $150-450 \times 10^9/L$  from birth to 21 years. The normal range for MCV is high in newborns, then drops dramatically at 1 month.

Jakiel has two COULTER® MAXM instruments in her laboratory, which replaced an S-PLUS IV. "The MAXM appeared to have a number of advantages for a pediatric hospital: a primary mode, a secondary mode and a predilute mode, along with the 5-part differential using the

same technology as on the STKS instrument." Half of the hematology specimens are capillary and are run in the secondary mode. Buffalo uses the Sarstedt EDTA system for micro samples. The balance of the specimens are received in 3ml BD dry EDTA tubes.

"Surprisingly," notes Jakiel, "little difficulty was experienced in obtaining the 125 µl amount of blood for use on the instruments, even though phlebotomists had to get used to drawing more."

Studies have been completed on the automated differential, which appears to correlate quite well with the manual method. However, initially, Jakiel plans to scan a slide on all differentials. "I expect that the monocyte range may shift, since the instrument analyzes so many more cells." She also expects to continue to do manual differentials on oncology patients and patients from the neonatal intensive care unit.

Jakiel keeps one MAXM in the primary mode (closed vial sampling) and the other in the secondary mode (open vial or pre-dilute), which works extremely well for them. "We have two instruments running all the time, and this is a wonderful backup system in case one goes down. If the MAXMs can match our previous workhorse, the S-PLUS IV, it will be great."

**THE CHILDREN'S HOSPITAL OF BUFFALO CLINICAL LABORATORIES  
HEMATOLOGY REFERENCE RANGES**

**COMPLETE BLOOD COUNT**

	RBC	Hgb	Hct	MCV	MCH	MCHC	RDW	PLTS	MPV
Age Group	X 10 <sup>12</sup> /L	g/dL	%	fL	pg	g/dL	%	x 10 <sup>9</sup> /L	fL
Newborn	4.1-6.7	15.0-24.0	44-70	102-115	33-39	32-36	13.0-18.0	150-450	6-9.5
1-23 Mos	3.8-5.4	10.5-14.0	32-42	72-88	24-30	32-36	11.5-16.0	150-450	6-9.5
2-9 Yrs	4.0-5.3	11.5-14.5	33-43	76-90	25-31	32-36	11.5-15.0	150-450	6-9.5
10-17 Yrs									
Male	4.2-5.6	12.5-16.1	36-47	78-95	26-32	32-36	11.5-14.0	150-450	6-9.5
Female	4.1-5.3	12.0-15.0	35-45	78-95	26-32	32-36	11.5-14.0	150-450	6-9.5
18+ Yrs (Adult)									
Male	4.7-6.0	13.5-18.0	42-52	78-100	27-31	32-36	11.5-14.0	150-450	6-9.5
Female	4.2-5.4	12.5-16.0	37-47	78-100	27-31	32-36	11.5-14.0	150-450	6-9.5

**DIFFERENTIAL WHITE CELL COUNT**

	WBC	*Total Neutrophils	Segs	Bands	Lymphs	Monos	Eos	Basos
Age Group	X 10 <sup>9</sup> /L	X 10 <sup>9</sup> /L	X 10 <sup>9</sup> /L	X 10 <sup>9</sup> /L	X 10 <sup>9</sup> /L	X 10 <sup>9</sup> /L	X 10 <sup>9</sup> /L	X 10 <sup>9</sup> /L
Newborn	9.1-34.0	6.0-23.5	6.0-20.0	<3.5	2.5-10.5	<3.5	<2.0	<0.4
1-23 Mos	6.0-14.0	1.1-6.6	1.0-6.0	<1.0	1.8-9.0	<1.0	<0.7	<0.1
2-9 Yrs	4.0-12.0	1.4-6.6	1.2-6.0	<1.0	1.0-5.5	<1.0	<0.7	<0.1
10-17 Yrs								
Male	4.0-10.5	1.5-6.6	1.3-6.0	<1.0	1.0-3.5	<1.0	<0.7	<0.1
Female	4.0-10.5	1.5-6.6	1.3-6.0	<1.0	1.0-3.5	<1.0	<0.7	<0.1
18+ Yrs (Adult)								
Male	4.0-10.5	1.5-6.6	1.3-6.0	<1.0	1.5-3.5	<1.0	<0.7	<0.1
Female	4.0-10.5	1.5-6.6	1.3-6.0	<1.0	1.5-3.5	<1.0	<0.7	<0.1

Differential Shown as Absolute Numbers. To Convert % to

Absolute Number = WBC X %/100

\* Total Neutrophils = SEGS + BANDS.