

Variability in the Rate of Milk Flow from Infant Bottle Nipples: Guiding Decision-Making for Nurses, Parents, and Researchers

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BACKGROUND

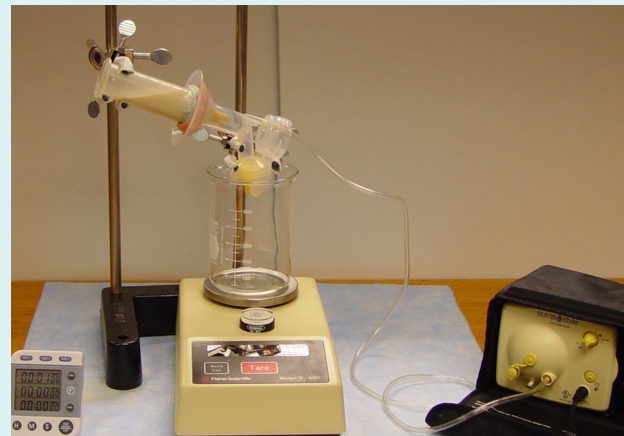
- Feeding can be physiologically challenging for medically fragile infants.
- Milk flow, or the rate of milk transfer from the bottle to the mouth during feeding, contributes to the extent of physiologic instability encountered.
- Nurses, parents and researchers are faced with decisions about nipple selection for bottle feedings.
- There is little current data on milk flow rates from available bottle nipples.

AIMS

- Describe milk flow rates from bottle nipples commonly used to feed infants in the hospital and after discharge home.
- Guide decision-making for nurses, parents, and researchers.

METHODS

- Ten each of 38 types of nipples (n=373) were tested using a standardized procedure.
- Power analysis: 10 nipples of each type sufficient for 80% power with an alpha of 0.05.
- Nipple attached to breast shield and positioned at 30 degree angle.
- Similac Advance ready-to-feed 20 calorie/ounce formula used for all tests.
- 60mL Grad-U-feed bottle filled with 50mL of formula.
- Formula expressed using breast pump for 1 minute and the milk transferred recorded.



- Sucking rate and pressure tested using Samba Micro-Pressure Measurement System every 50 trials.
- Formula was changed every 10 trials to maintain milk consistency.
- For nipples requiring bottles of different shapes and sizes, efforts made to ensure consistent hydrostatic pressure.

ANALYSIS

- Mean and Coefficient of variation (COV, SD/mean) of milk flow (mL/min) calculated for each nipple.
- One-way ANOVA with Duncan's post-hoc analysis used to compare milk flow between nipples.
- Non-parametric one-way ANOVA and pairwise Wilcoxon rank sum tests, adjusting alpha to 0.001, used for non-normally distributed nipples.

RESULTS

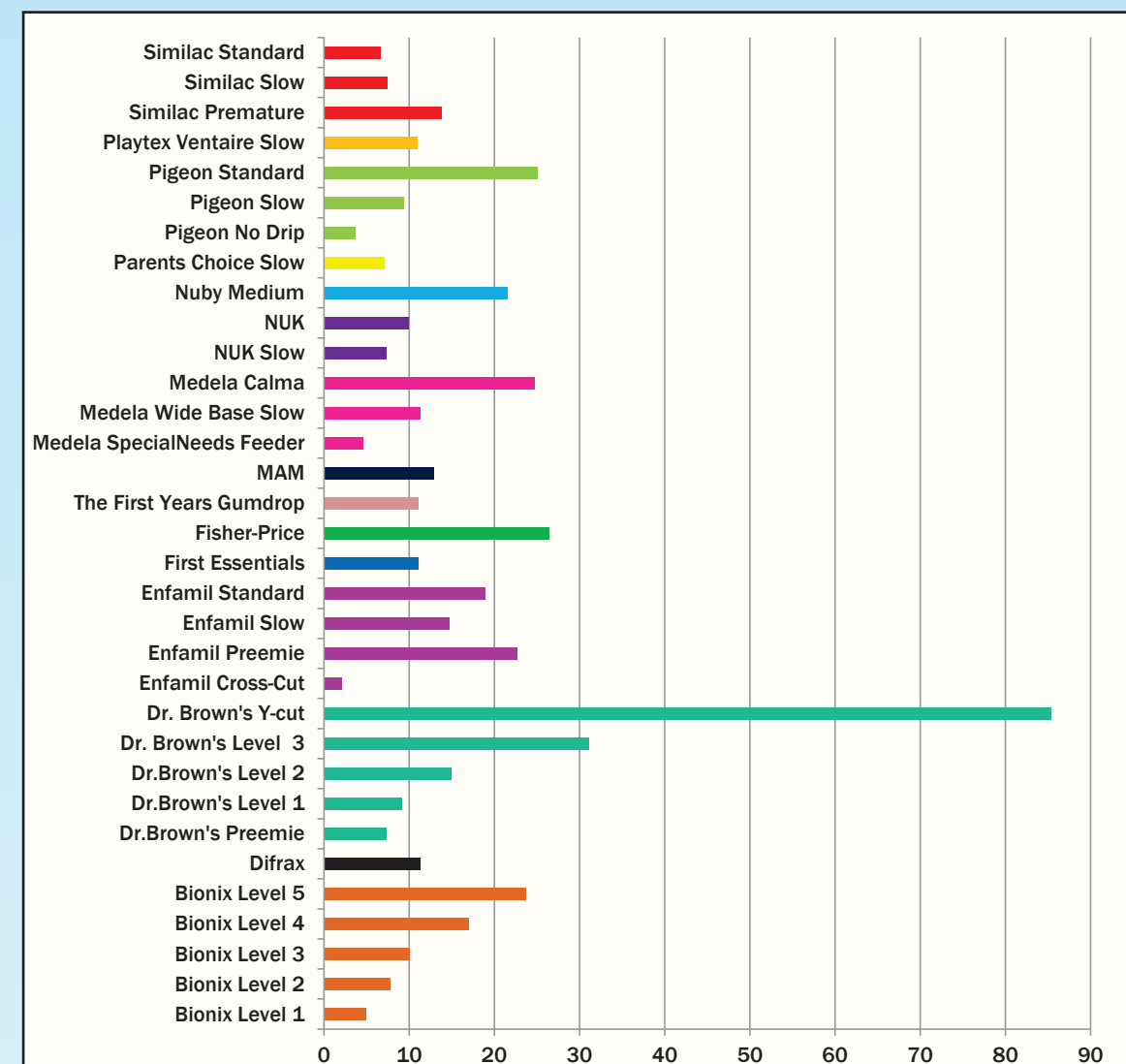
SUCKING RATE AND PRESSURE

- Mean sucking rate was 110 sucks/minute. ■ Mean sucking pressure was 14.3 mmHg.

MILK FLOW RATES

- Milk flow varied significantly between different types of nipples, from 2.1 (Enfamil Cross-Cut) to 85.3 mL/min (Dr. Brown's Y-cut).

Mean Milk Flow Rate (mL/min)

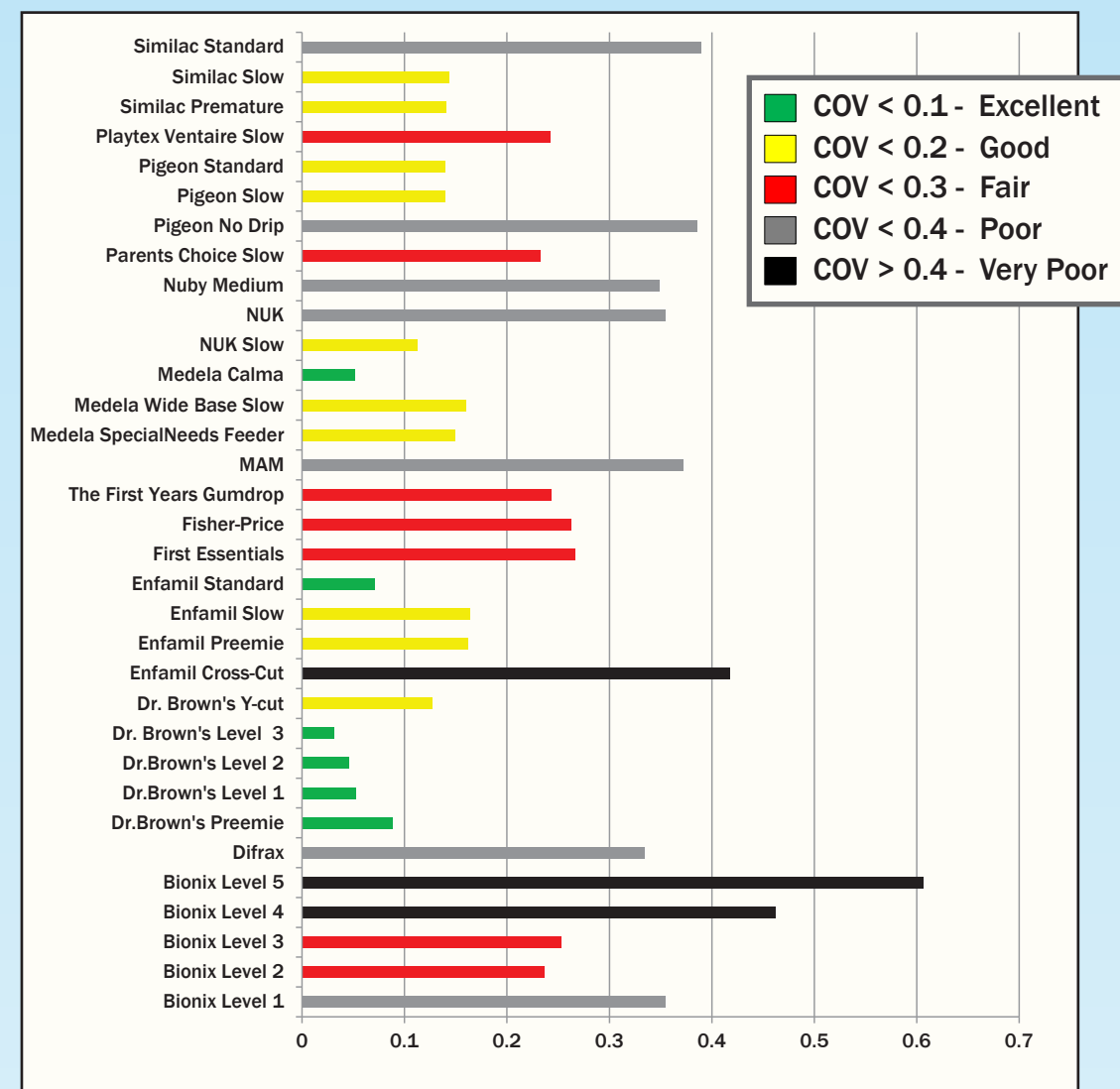


Note. Nipples are color coded according to brand.

VARIABILITY IN FLOW RATES

- There was a wide range in variability in flow rates amongst the nipples tested. COV ranged from 0.03 (Dr. Brown's Level 3) to 0.61 (Bionix Level 5).

Coefficient of Variation (SD/mean)



Note. Nipples are color coded according to category of coefficient of variation.

OTHER SIGNIFICANT FINDINGS

- Some nipples were found to have holes that were not open.
- As formula was exposed to air for prolonged periods of time, it thickened and reduced flow rate.

DISCUSSION

- Bionix:**
 - Changing the nipple or collar may inadvertently change milk flow rate even if on same level of flow.
 - Changing the flow indicator level may not significantly change flow delivered.
- Dr. Brown's** is the most consistent brand of those tested (all nipples had excellent or good COV).
- Both **Enfamil Slow** and **Similac Slow** nipples had individual tests that were faster than some of the **Standard** flow nipples of these brands.

LIMITATIONS

- Dr. Brown's** Y-cut nipple tested using standard formula; usually used with thickened formula.
- Only negative pressure applied to nipples. The **Enfamil** cross-cut and **Medela SpecialNeeds Feeder** have a slit opening instead of a hole and likely perform differently during feeding when positive pressure is applied.

CONCLUSIONS

- Choosing a nipple is an important decision given the wide range of flow rates of available nipples.
- The name of a nipple (e.g., slow, preemie) does not always give an accurate indication of the flow rate.
- Variability in flow rate between and within nipple types is an added challenge that may contribute to feeding difficulty in vulnerable infants.

GUIDING DECISION-MAKING NURSES

- Start with the slowest flow nipple available for vulnerable infants.
- Consider changing to a different nipple of the same type if having a difficult feeding.
- Consider checking that the nipple hole is open and reapply nipple to bottle to release suction if not transferring milk.

PARENTS

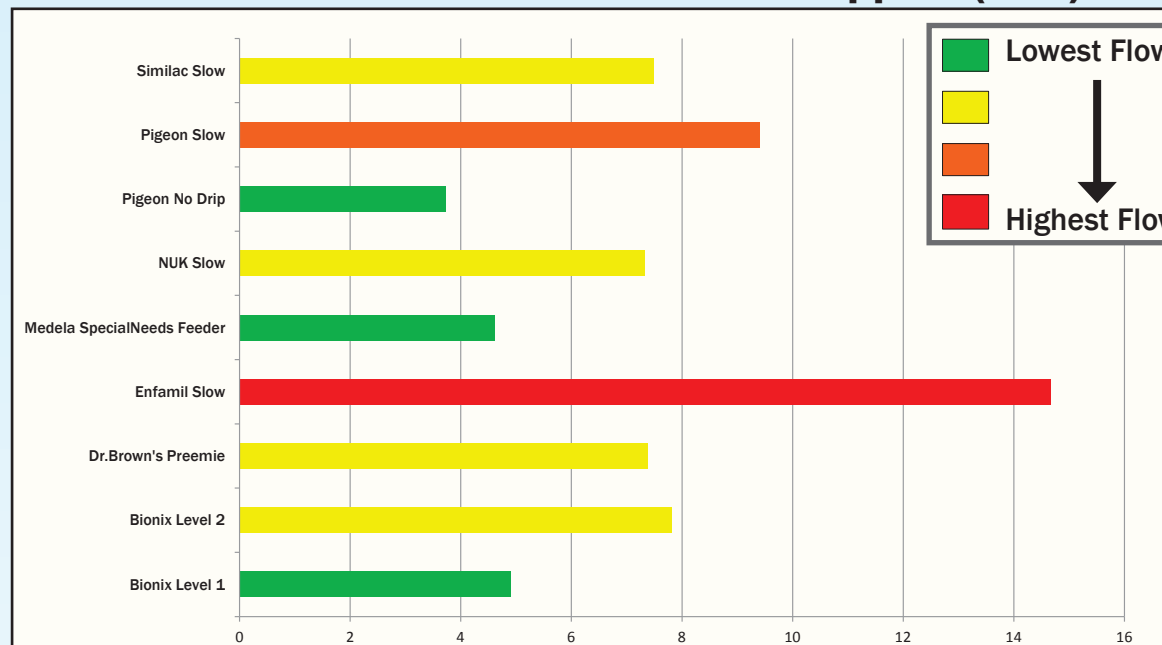
- When an infant is ready to be discharged home, choose a nipple of comparable flow to that used successfully in the hospital.
- If a baby is having difficulty feeding with the nipples available in the hospital, purchase a nipple with lower flow and low variability to take into the hospital for feedings.

RESEARCHERS

- In studies evaluating effect of feeding interventions, it is critical to:
 - Know the flow rate of the nipple chosen for the study.
 - Choose a nipple with low variability in flow rate to ensure consistency.
 - Report the nipple used in the study.

COMPARISONS WITHIN CATEGORY

Mean Flow Rate of "Slow" Flow Nipples (n=9)



Note. Nipples indicated with the same color bar are of comparable flow rates to one another.

Mean Flow Rate of "Standard" Flow Nipples (n=14)



Note. Nipples indicated with the same color bar are of comparable flow rates to one another. In the post-hoc analysis, some nipples overlapped between groups. Nipples with mean flow rates that were not significantly different from one another are indicated by the same letter to the right of the bar.

COMPARISONS WITHIN BRAND

Bionix Controlled Flow Baby Feeder

- Nipple and Collar tested separately because interchangeable.
- Nipple tests: Levels 2-5 not different from one another.
- Collar tests: Levels 2 and 3 the same. Levels 4 and 5 the same.
- Bionix Levels 4 and 5 were among the most variable of all of the nipples tested.

Dr. Brown's

- Tests performed with venting system in place.
- All levels significantly different from one another.
- Dr. Brown's Preemie, level 1, 2, and 3 among least variable of all nipples tested.

Enfamil

- All levels significantly different from one another.
- Enfamil Preemie was highest flow of all Enfamil nipples.
- Some Enfamil Slow nipples faster than Enfamil Standard.

Similac

- Similac Slow and Standard were not significantly different from one another.
- Similac Premature was significantly faster than other Similac nipples.
- Some Similac Slow nipples faster than Similac Standard.

Medela

- All nipple types significantly different.

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THE FEEDING FLOCK
Feeding Interest Group

