

## Bubbles survey

### 1. Differences between different pumps:

Note that 1 + 1 occasional etc implies 1 user reporting problems as frequent or regular, and another reporting problems as occasional. Reports of 'rare' problems are not listed.

Pump	Number of users	Bubble problems on filling cartridge	Bubble problems in tubing or cartridge during use
Accu-Chek Spirit*	7	1 occasional out of 5 (2 n/a)	1
Animas IR1200	2	0	1 if long tubing
Deltec Cozmo	8	1 + 1 occasional	2 occasional
D-TRON plus	4	n/a	1 since Sept 05#
H-Tronplus V100	2	1 occasional	0
MiniMed	13	4 + 1 occasional	3 + 1 occasional
Paradigm	13	5 + 1 occasional	4 + 2 occasional

\* 2 users of Accu-Chek Spirit wrote that they use pre-filled cartridges, the other 5 do not.

Please could someone verify that this is true. Someone wrote recently on the list that the D-Tron plus was the only pump which takes pre-filled cartridges.

# 1 D-TRON plus user had problems with bubbles in tubing since Sept 05, presumed to be due to a change in the manufacturing process of Humalog cartridges.

In summary, nearly half the users of MiniMed and Paradigm pumps experience some problems with bubbles. While the numbers of users of the other pumps are lower, so that no meaningful statistical analysis is possible, the numbers suggest that bubble problems are less prevalent, though not non-existent, for the Accu-Chek Spirit and the Deltec Cozmo, but a larger survey would have to be undertaken to verify this. There were too few responders using any of the other pumps to say anything about them. No clear differences were seen between the different MiniMed and Paradigm models.

### 2. Differences between different insulins:

Insulin	Number of users	Bubble problems on filling cartridge	Bubble problems in tubing or cartridge during use
Humalog	25	5 + 4 occasional	6 + 3 occasional
Novorapid	12	4 + 1 occasional	2 + 2 occasional
other	2	0	0

The only possibly meaningful comparison here is between Humalog and Novorapid, since too few responders use any other insulin. No evident difference was seen.

#### Notes:

1. The survey was only publicized on the UK Insulin Pumpers list, so participants were only members of this list (already a self-selected group), and since responding to the survey was entirely voluntary, there was a further self-selecting process going on. All this could lead to bias in the results.
2. In view of the limited number of participants and inexact nature of the questions asked, I didn't attempt to perform any statistical tests for significant differences – if anyone would like me to do so, I'd be happy to, though don't think they would be very meaningful.
3. Since motivation to contribute to this survey could be highest among people who have problems with bubbles either now or in the past, overall incidence of bubbles seen here could be higher than in the general population of pumpers, but there is no reason to suppose that this would result in bias between users of different pumps –

- i.e. there is no reason to suppose that pumpers with bubble problems using pump A would be motivated to respond, while pumpers with comparable bubble problems using pump B would be less motivated to respond.
4. Many responders wrote interesting comments about factors other than which pump and which insulin, that might affect incidence of bubbles:
    - a) temperature of insulin – many people claim better results when insulin is left out of the refrigerator at room temperature (whatever that might be!) for at least a few hours before filling cartridges.
    - b) injecting air (either total volume of cartridge or partial) into insulin vial before drawing up insulin
    - c) filling cartridge slowly rather than fast
    - d) filling cartridge from a penfill rather than from a vial
    - e) leaving cartridge standing in or out of refrigerator after filling and before connecting to pump
    - f) priming generously
    - g) exact design of cartridges – some people can date end or start of their bubble problems to changes in design of cartridges
    - h) which insulin
    - i) length of tubing – it has been suggested that problems of bubbles in tubing might be much more likely if you use the longer tubing length
    - j) whether pump is worn with connection from cartridge to tubing up or down.
  5. Despite all these interesting ways of avoiding bubbles, some people seem to have problems with bubbles despite apparently taking all precautions known to mankind, while others, despite neglecting all these recommendations, don't seem to have any problems whatsoever.
  6. There are some more basic questions about bubbles, and how this informal survey was posed – while we are talking about a physical objective phenomenon, and bubbles either are there or are not there, observing and reporting bubbles is not so objective. People with bad experience of problems of bubbles in tubing causing high blood glucose tend to check the tubing (and sometimes also the cartridge itself) for bubbles quite frequently, whereas others do not check. However I would assume that most people would notice when they remove a cartridge for changing whether or not there are bubbles in the residual bit of insulin left there – indeed some people reported presence or absence of bubbles in the cartridge at this stage as evidence that they do or do not have bubble problems. To clear up any misunderstandings, it is worth noting here that bubbles would not be expected to cause an occlusion in the tubing, but the air would simply flow through the tubing being injected into the body instead of the same volume of insulin, thus causing otherwise unexplained high blood glucose, but not a pump error.
  7. In addition, some people's eyesight may not be up to checking tubing accurately for bubbles without very bright light, so they may not readily check during day to day use, though may check very carefully while filling the pump. However there is no reason that this should affect users of different pumps in different ways. What is different in different pumps is how much of the cartridge is visible from the outside during regular use, and this might affect the ease of checking for bubbles.

### Conclusion

Given that this survey has raised the suggestion (but at this point no more than a suggestion) that bubble problems may be more likely to occur using MiniMed and Paradigm pumps, it seems to me that it would be of interest to attempt to conduct a wider survey – possibly on the Insulin Pumpers list in the US, if they would be interested. Before doing so, it would be important to learn from the mistakes of this quick informal survey in phrasing the questions more carefully in order to elucidate details of people's experience with bubbles, and also to include additional questions about other points raised such as length of tubing used. Further, I am very aware that the work I have done on this data is very limited, and if anyone can

suggest other questions that should be checked in the responses, I would be very happy to do so myself, or to send the Excel file with the data to whoever would like to do such analysis.

Many thanks to all who contributed, and apologies for the delay in analyzing the data – due to assorted work pressures, domestic circumstances etc.