



NEWSLETTER

Volume 4 Number 1, February 1996

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Letter from the President

Chuck Evans

Happy New Year!!

1996 marks the 5th year for the Alberta Clinical Engineering Society. In that time we have seen it grow from a small group of people involved in the field of Clinical Engineering, to the Province wide organization it is today.

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I feel that 1996 holds great promise for A.C.E.S. members, we have a dynamic team on the Board of Directors with equal representation from both the Calgary & Edmonton regions. We currently have two general meetings scheduled for the spring, Wednesday March 6th, and Wednesday, May 8th, as well as a social event on June 22nd. I hope to see you all there. (See the Internet home page for more details as they are available.) I am really excited this year about our new Home Page on the Internet. The home page takes over from the ACES bulletin board which had been running for the last couple of years, but with the added advantage that it is accessible worldwide. Future meeting dates & locations, social events, newsletters, up-coming training courses etc. will all be available through the Home Page.

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It is my hope that the Home Page will also serve as a powerful tool in the compilation and sharing of technical knowledge and information for the biomedical community. Such things as service tips and techniques, or substitute parts lists, could enable BMET's to save both time and money in completing repairs.

Technical Report:

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For those of you who have not yet seen our Home Page, the address is:

<http://skynet.uah.ualberta.ca/~aces>.

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If anyone has any questions about the Home Page, they may be directed to Brandon Beaudry at (email): Brandon.Beaudry@crha-health.ab.ca

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I would like to thank Brandon Beaudry and Michael Mah for a job well done in setting up the ACES Home Page, as of this writing, Brandon informs me that the Journal of Clinical Engineering has requested that we submit an article on the ACES Home Page, and intent for its use within ACES. Congratulations!

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I welcome hearing from you in the coming year with any thoughts, questions, ideas, or concerns that you may have. My email address is: cevans@freenet.edmonton.ab.ca

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If you would like to contact any of the ACES board members their address and phone numbers are listed later in this newsletter and also on the Home Page.

I look forward to serving as your President in 1996, and wish you all the best in the coming year.



Letter From The Editor

Tim Belec

Welcome to another year of the ACES Newsletter. I hope everyone has enjoyed the past issues and found them interesting. This years issues will continue in much the same format with, hopefully, a stronger technical content. There will also be an attempt to reach a wider audience, including those involved in Clinical Engineering outside the hospital environment. This will be accomplished by including the newsletter on the new ACES Internet Home Page.

Finally, if you like or dislike the Newsletter, write me a letter or drop some e-mail. If you would like to see more information on a specific topic, have ideas for technical reports or articles, I would love to hear from you.

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NAITline

Ken McDonald

1996 is going to be another banner year for the Biomedical Engineering Technology program! Much of our success is due to the support of our friends in industry. The level of industry support and participation we are receiving is unmatched by any other program ~~and~~ Nait.

This year, the BET program, in cooperation with the Capital Health Authority, launched the weekly Clinical Applications Guest Lecture series. This series is delivered at the Royal Alexandra Hospital, by clinical specialists from both the UAH and RAH. The series includes lectures and presentations on a variety of clinical topics including: Electrocardiology, infusion therapy, blood pressure measurement, hemodynamics, fetal monitoring, neonatal intensive care, laparoscopic surgery, medical lasers and ultrasound. In addition to the lectures, field trips have been planned to the ECG lab, the ICU, the OR and the Diagnostic Treatment Centre. The lectures we have received to date, from Betty Anderson, Ray Cislo, Paul

Timoshenko, Deanna Vaters, Sharon Schwindt, Pat Warren and Gail Erkhart, have been of superb quality. We wish to acknowledge the assistance of Ray Cislo, in organizing this lecture series.

Another first this year is the weekly Field Experience program. Every Thursday afternoon students disperse to the clinical engineering units at five Edmonton area hospitals. Under the supervision of trained BMETs, students develop their skills in preventative and corrective maintenance. The students work is evaluated and documented by their BMET supervisors. These evaluations, are reviewed by instructor, Dave Burry, and contribute toward the final course grade. Evaluations also provide Dave with feedback on the effectiveness of the BET program, and provide him with direction in making future course changes. This activity provides students with "hands-on" experience in a real-world environment. Students also benefit from the first-hand knowledge and expertise of industry professionals. Students returning from their weekly Field Experience are charged with enthusiasm and energy. We are confident that this program will provide industry with better trained, more effective graduates. We wish to acknowledge Bill Rutledge who assisted in initiating this program as well as Field Experience Site Coordinators, Rob Jerome, Matt Tracy, Dan Limoges, Dan Moore and Scott Young. We also wish to thank all of the BMETs who take time from their busy schedules to serve as student supervisors.

In 1996, the BET program will receive no-cost medical and test equipment loans in the amount of **THREE HUNDRED AND FIFTY THOUSAND DOLLARS!** Every week, our small inventory of test equipment is generously supplemented by the Clinical Engineering department of the Capital Health Authority.

Virtually all of the medical equipment used in our labs is also generously provided by manufacturers including, Hewlett Packard, Spacelabs, Ingram and Bell, Johnson & Johnson, Siemens, IVAC, IMED, McGaw, Links, Narco Scientific, Valleylab, and Physio Control. We wish to acknowledge all of our industry partners for their

...Naitline continued on next page



contribution to education.

Another exciting initiative this year, is the infusion pump acquisition exercise. As part of the requirements of their Medical Equipment Management course, the students have been given the task of assessing and specifying infusion pumps for a large acute care hospital. This simulation is based on an actual infusion pump acquisition performed three years ago by an Edmonton hospital. The exercise involves the purchase of 550 pumps and 85,000 infusion sets per year. Students will

be assessing the pumps from a technical, functional and cost perspective. Apart from "hands-on" testing and evaluation, students are required to generate comparison spreadsheets, a request-for-proposal letter, a written specification, and a memorandum-of-justification recommending the pump to be purchased. This exercise will provide students with valuable insight into the equipment acquisition process.

We wish to acknowledge manufacturers, IVAC, IMED, McGaw and Links who have agreed to participate in this simulation. We must emphasize that their participation and the outcomes of this exercise in no way represent an endorsement by the BET program. We also wish to thank Darrel Degenhart, BMET at the University of Alberta Hospital for his valuable assistance in designing this exercise.

Please pay us a visit at this year's Nait Open House March 8th and 9th in room H112 and meet with our enthusiastic group of students. See you there!

Mr. Gailord Gordon: Breakthrough Management

Gary Taylor, Manager of Biomedical Engineering Services at Rockyview General Hospital in Calgary, was instrumental in bringing Mr. Gailord Gordon to speak at the ACES Annual General Meeting. Mr. Gordon's presentation was provocative and timely and provided an interesting insight into his management style. Gary Taylor has prepared a brief overview of Mr. Gordon's talk. For more insight, Gailord Gordon's publication "Breakthrough Management" is available through A.A.M.I.

Mr. Gailord Gordon, post manager of the Clinical Engineering Department for Kaiser Permanente, was retained by the CRHA and ACES. Mr. Gordon's style of management, as documented in the A.A.M.I. publication "Breakthrough Management", is based on 30 years of experience in clinical engineering.

The one day talk covered the management structure of the 190 staff Kaiser Permanente operation in Northern California. Mr. Gordon discussed the business plan that focused on financial accountability, and compliance to regulatory agencies in California, while providing quality service to 18 hospitals and 43 clinics.

How this was accomplished:

- ' A stand alone business under the Kaiser Permanente mandate was formed.
- ' A 30 million dollar budget was established based on historical expenditures.
- ' The responsibility for service to clinical equipment was managed by the department.
- ' Service was provided by:
 - in-house service (190 staff)
 - partial contracts (4 million dollars)
 - third party (if cost effective)
- ' Technology Management was used for standardization in order to reduce operational and service costs.
- ' Second sourcing of replacement parts provided a 60% savings. Total parts budget was 6 million dollars.
- ' Drop shipment of parts reduced inventory and provided a 27-30% discount.
- ' Customers were responsible for all cost incurred for upgrades and equipment relocations.
- ' Frequency of Preventative Maintenance was reduced to a minimum and complied with legal guidelines.
- ' Written procedures developed for staff.
- ' Loaner equipment was provided utilizing rental agencies.
- ' Education was a strong component of operations - \$350,000/yr and included

...Gail Gordon continued next page



diagnostic software.

- ' Unions - Biomedical staff were members of the Brotherhood of Operating Engineers.
- ' Wages - Biomedical personnel received \$50,000/yr and up depending on area of expertise.

The central operation was housed in a 4,000 square foot building and provided service to the satellite biomedical shops in each hospital. A computerized work order and inventory system was utilized to connect all remote operations. The scope of service included diagnostic imaging equipment including MRI and CT, laboratory service, general biomedical devices, and computer networks. The maximum distance traveled by the specialists was 100 miles.

Mr. Gordon's talk on Breakthrough Management provided delegates to the AGM with effective tools in developing a regional clinical engineering department.

The common sense approach is intended to re-focus our attention towards a business relationship with our internal market, the health care customers.

Key considerations to the internal market are:

- ' Customer relationship based on confidence and trust in providing service to clinical programs.
- ' Value of Service - break out the types of services provided and determine the value of each program. This is necessary to establish benchmarks used to evaluate internal service against the external market place.
- ' Financial management address accounting principles of planning, monitoring and reporting.
- ' Operational Support Software - a comprehensive application program providing work orders and preventative maintenance scheduling, inventory control, and financial accounting. The software to be linked to all service operation locations in order to provide customer service and financial reports.
- ' Service Agreements - remaining contracts to be re-negotiated to provide minimum downtime and provide for sharing of risk between owner and manufacturer of hardware and software.
- ' Benchmarking - a continuous process of

identifying, analyzing and adopting best competitive practices in relation to business. A tool necessary to establish a baseline for monitoring department efficiency and customer satisfaction.

In conclusion, the possibilities of developing a similar operation on a smaller scale is possible. However, Union issues and pay incentives are required in order to provide mobility of staff to achieve savings to the Region.

Are You Receiving Your ACES Newsletter?

Whether the answer is Yes or No, we would like to make sure you receive your newsletter.

If you would like to have your ACES Newsletter at home or at work, please let us know. You can contact :

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Technical Report

Lies, Damn Lies and Medical Device Statistics

Bryce Jones

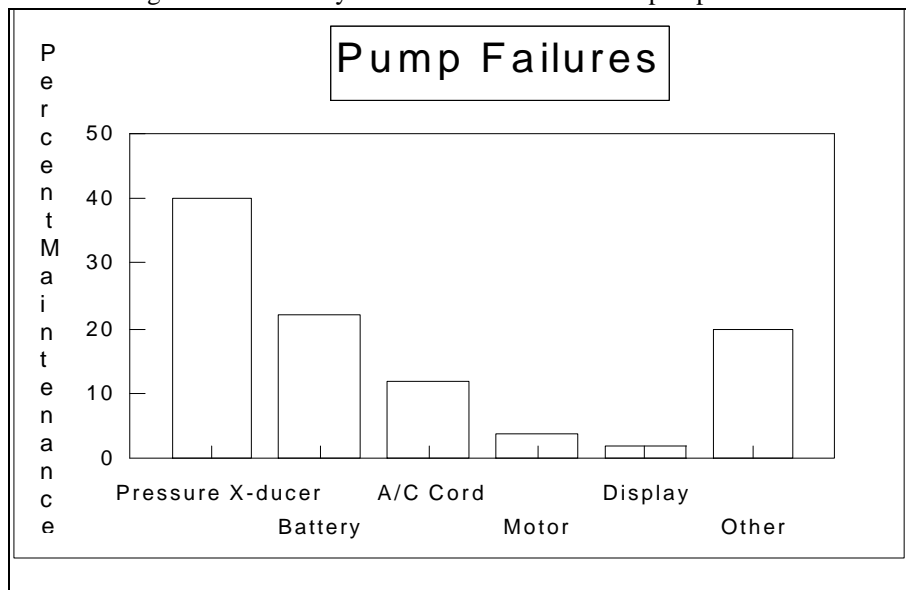
Introduction:

Everyday in our jobs we are inundated by a wealth of information that we mostly ignore. Here, I present three examples of adding value to this supposedly superfluous information. I argue that METs should adopt processing some of this information as a component of a total medical technology management program.

The examples I present all deal with information from infusion pumps. The first example is an analysis of the types of failures seen in pumps and is an attempt to systematically reduce the number of failures. The second example is a hypothesis test of what is causing some failures. The final example is a detailed model evaluating the pump requirements for the Alberta Children's Hospital (ACH). I chose to use infusion pumps for these analyses for a couple of reasons: pumps are found nearly everywhere in the hospital and pumps often have battery backed error logs.

Failure Analysis:

The Alberta Children's Hospital uses IVAC 560 and pediatric 565 infusion pumps. These pumps are easy to use, accurate and safe in a pediatric setting. Persons familiar with these pumps will know that, in the past, their pressure transducers failed frequently. This is an example of the kind of information Clinical Engineering receives. It is unlikely that the clinical staff is aware of this information. Figure 1 is a Pareto diagram that describes the various types of failures versus the rate of occurrence. While there is a diversity of failures, the most frequent incident was a failed pressure transducer. What was happening was a pressure sensing disk could easily be loaded crooked into the pump.



When the pump door was closed, the door allowed a good strong crunch down on the pressure transducer, putting the pump out of service and causing the display to read "CAL REQD". I reviewed the loading procedure and decided that instead of loading the pumps from the top down, loading from the bottom up would ensure correct fitting of the sensing disk. Figure 2 shows the proposed "bottoms-up" loading procedure. Before I had an opportunity to set up this procedure though, the engineers

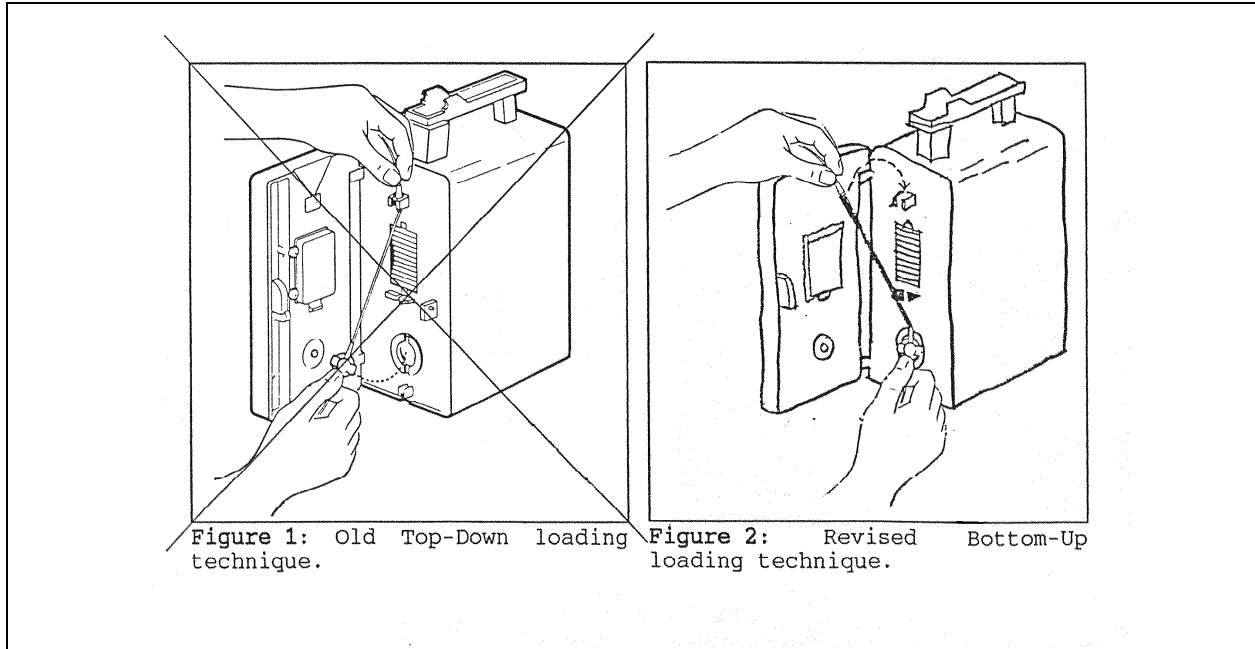


Figure 1: Old Top-Down loading technique.

Figure 2: Revised Bottom-Up loading technique.

at IVAC had come up with a better solution using a simple plastic transducer guide. I had to concede that the transducer guide was a better solution and significantly decreased our pump failures.

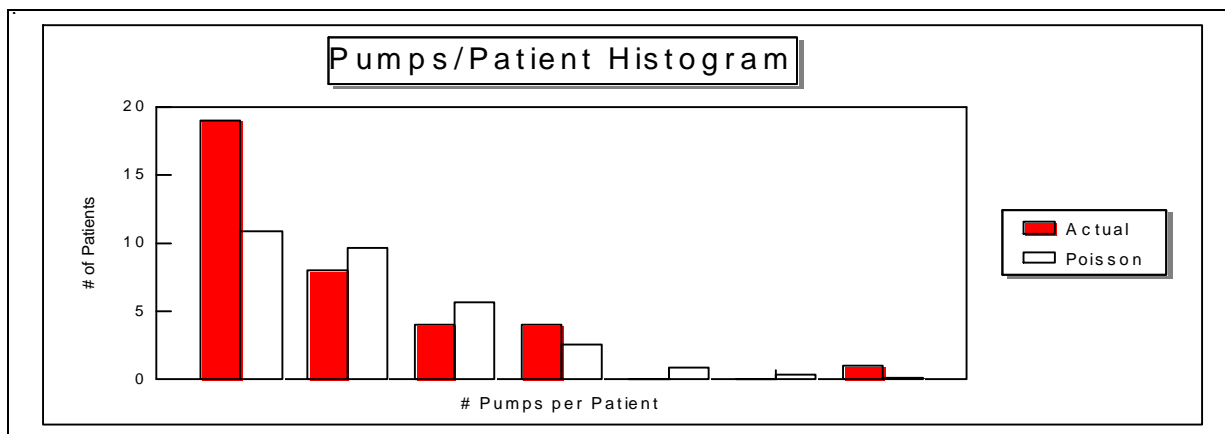
EMI Hypothesis Test:

Microprocessor Related Error							
Error Type	Before EMI Measures			After EMI Measures			Significance
	Average Total Hours	Std	n	Average Total Hours	Std	n	
Fix Me 0	875	394	3	985	428	4	n/s
Fix Me 1	1258	0	1	XXXXX	XXX	0	n/s
Fix Me 2	965	373	4	1023	415	4	n/s
Fix Me 3	1355	0	1	913	0	1	n/s
Fix Me 4	XXXXX	XXX	0	1323	434	1	n/s

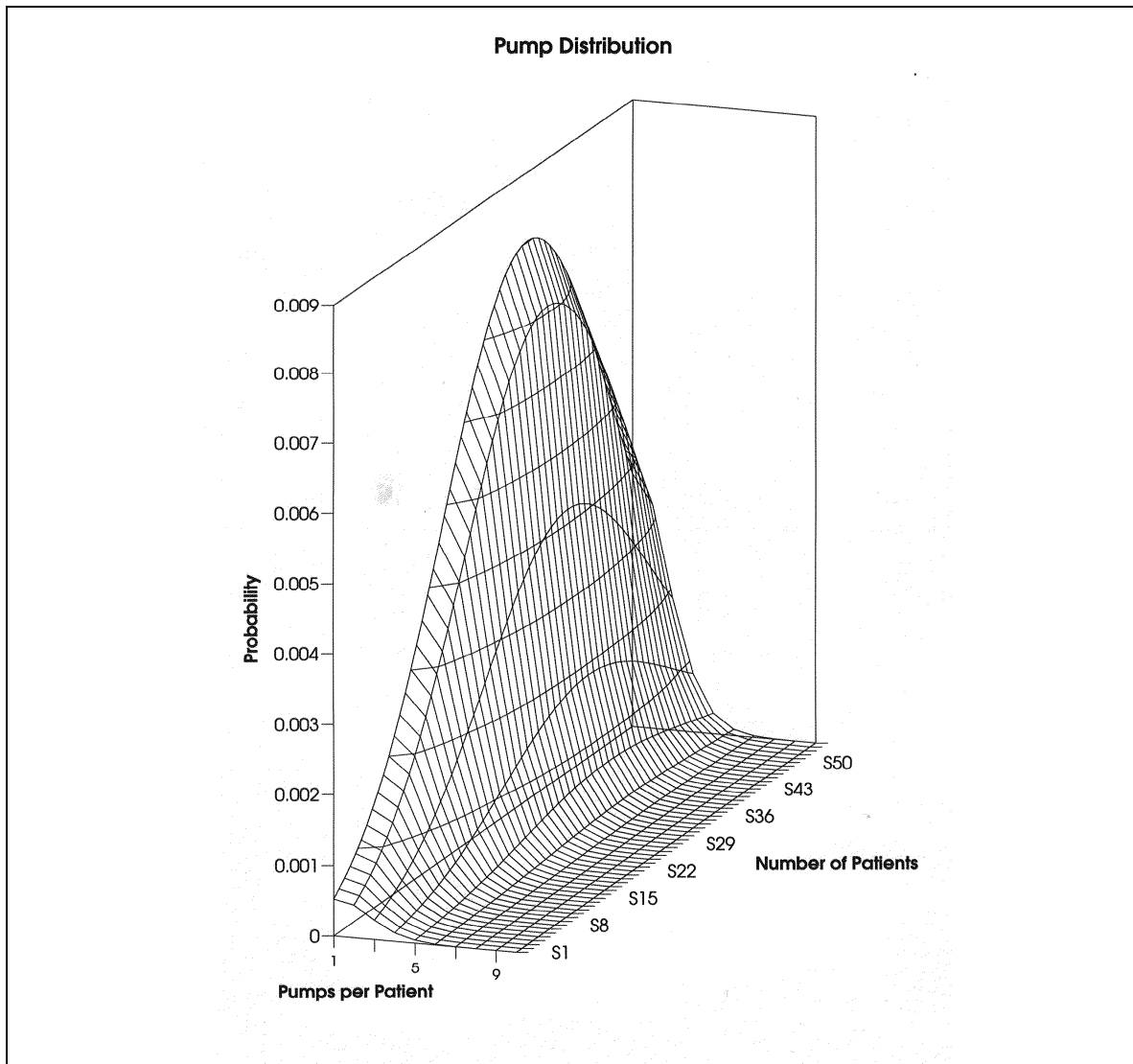
After installing the transducer guides we became aware that some of our failures were very ephemeral. These failures constituted a significant number in the Other category in Figure 1. Generally, these pumps had some anomalous microprocessor errors in their error stack. If the error stack was cleared and the pump set to run, nothing was wrong. There appeared to be some ghost in the machines. I began suspecting maybe the name of this ghost was electromagnetic interference (EMI). I had begun collecting statistics on these failures before EMI becoming a major issue. Since then, the use of cell phones and mobile radios in patient care areas has decreased. I compared the incidence of microprocessor related errors before and after the change in use of RF emitting devices. Table I shows the average number of hours before the occurrence of various anomalous errors. Using a single tailed t-test, I tested whether pumps ran longer before encountering such an error. The results show no significant difference between before and after a decrease in EMI. In other words I still don't know the name of the ghost in our pumps.

Pump Requirement Model:

Next I turn to a model I created to find the pump requirements for our hospital. Every Friday Pediatricians try to clear out the hospital by sending home all the patients possible. That means pump'em full of whatever and send'em home." When the hospital was busy, it was sometimes a race for a pump. I started asking the question, "How many pumps do we need to prevent this shortage?" The simple answer, of course, is the number of patients multiplied by the number of pumps per patient equals the number of pumps required. The problem was these values changed with time. The solution was to use an average number of patients times the average number of pumps per patient to yield an average number of pumps required. To develop these averages I needed to sample pump use on a number of busy Friday mornings. Figure 3 shows the histogram for the number of pumps per patient. This histogram is most closely modeled by a Poisson distribution. A Poisson distribution describes the number of customers in line at 12:15 at McDonalds; or phone calls arriving at an AGT exchange at 8:02 Christmas morning; or the number of pumps per patient at ACH one Friday morning in May. Note that each of these examples is for an instant in time. Statistics that change with respect to another variable are called stochastic processes. If the money justifies it, like it does for McDonalds, a stochastic processes can be defined for every minute in the day. For my purposes, all I wanted was a snapshot of pump use at its maximum level. So, now I knew the number of pumps per patient. Next, I wanted to know the other random variable in the equation, "how many patients using pumps?" This turned out to be the familiar bell curve, defined by the average number of patients and the standard deviation of that value. The two random variables combine to form a joint probability distribution function (pdf); figure 4. Notice the bell shape for the number of patients and the Poisson shape for the number of pumps per patient. Using the pdf to determine the number

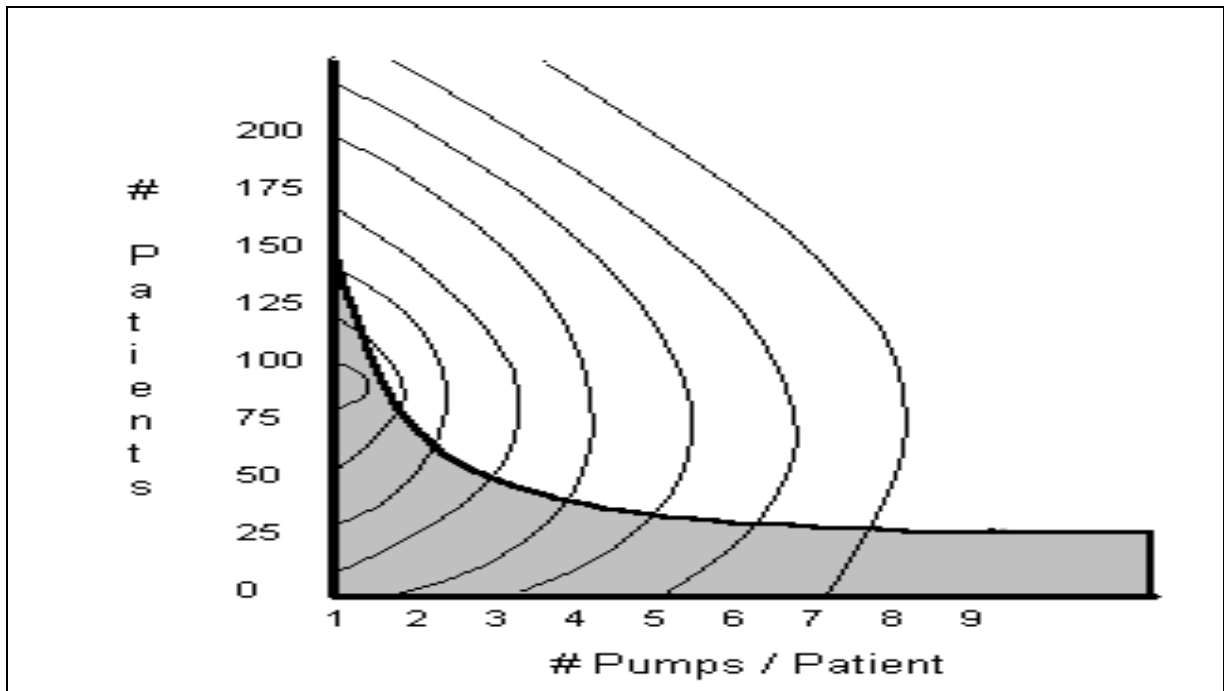


of pumps to have in a pool depends on what is deemed to be an acceptable probability of running out of pumps. The results from a political poll are described as accurate nineteen times out of twenty; that is the 95% confidence level. I chose the same. That is, nineteen busy Fridays out of twenty, the ACH should have enough pumps. Figure 5 shows a top view of the pdf and helps describe how this confidence level is figured out. If the ACH has a pool of 150 pumps and each patient needs only one, then a shortage would occur for more than 150 patients. If each patient had two pumps, then a shortage occurs for greater than 75 patients. The curve in figure 5 shows the shortage line for increasing numbers of pumps per patient. The probability of a shortage occurring is the volume above the shortage line. Conversely, the probability of having sufficient pumps is the volume below the curve. I skip over the specifics of integrating the pdf in two variables, but suffice it to say, "thank goodness for Lotus 123." The above procedure can be iterated for different size pump pools until the volume below the shortage curve represents a suitable level of reliability. For the 95% criteria at the ACH this represented a pool of 163 pumps. The result is, nineteen busy Friday mornings out of twenty the ACH has sufficient pumps to service all patients without waiting.





There is value in the information about how our medical devices function. Medical device manufacturers spend much time and money doing the kind of analyses described above so they can make their devices more reliable. Increases in reliability are putting BMETs out of the demand maintenance business. I argue that we must start adopting a new role of adding value to the information we receive everyday, and use that to save health care dollars. I hope these can be examples of how we can



get smart about managing health care technology.

Meet Your New Board of Directors

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Vice President: Sam Itani - Foothills
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Treasurer: Bill Rutledge - CHA
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Secretary: Brian Tischler - RAH
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Board Member: Bryce Jones - ACH
 Ph: 229-7944(wk)



BECOME A MEMBER !!

To enjoy the benefits of ACES, and ensure that you continue to receive the ACES newsletter and meeting notices, Become a member ! Complete the following Information form, and return with payment in the amount \$10.00 to:

The Alberta Clinical Engineering Society
c/o The University of Alberta Hospitals
Clinical Engineering Room OD1.00
8440-112 Street
Edmonton, Alberta, T6G 2B7
ATTENTION: ChuckEvans

Would you prefer receiving the aces newsletter & communications:

At Home or At Work.

First Name: _____

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Position: _____

Department: _____ Room: _____

Address: _____ Box# _____

City: _____ PC: _____

Wk Ph:(____) _____ Ext: _____

Fax: (____) _____

E.Mail: _____

**ATTENTION
ALL
MEMBERS !!!
Meet your colleagues of
the future...
NAIT Biomedical
Engineering Technology
invites one and all to a
mixer.
Where? NAIT Staff
Dining Room (U121)
When? February 21, 1996
5:30 P.M.**

Agenda

- 5:30 - 6:15 Free Pizza Buffet
- 6:15 - 7:30 Presentations by Previous NAIT Grads
- 7:30 - 9:00 Cash Bar and Social - Meet Colleagues, Students &

Faculty

Parking available in Parking Lot Dnorthwest corner of main campus.

**Please R.S.V.P. to Ken McDonald at
471-8503**



We Are on the Internet

**Access our sight at:
"http://skynet.uah.ualberta.ca/~aces"**

The ACES Internet Pages have been available to Our Members and the Public now since November 1995.

These pages were designed to facilitate information exchange between all Alberta Clinical Engineers as well as International Clinical Engineers, Medical Devices and Electronic Devices Manufacturers, Educational Facilities, etc.

Highlights of the ACES Web Pages are:

The Internet Software Utilities Page

A software library. Maximize your internet capability or even set up your own internet server.

The Biomedical Related Page Directory

A directory which points to many useful and informative sights related to Clinical Engineering. A list of Device Manufacturers with online technical specifications is available as well sights from various medical device manufacturers outlining products and support.

Second Source Price list

One of the most powerful pages on the ACES Web sight.

This list not only provides less expensive alternatives to OEM replacments, but it also fosters competition between suppliers providing further reductions in expenditures.

This page is especially effective when it eliminates duplicate time consuming parts searches that occur across

the province. Submissions for the Second Source Price list are required and accepted at any time.

Submissions can be made via email, fax or phone to the following contacts:

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Please Note: The information on these web pages can only be effective with the full support of all members of the Alberta Clinical Engineering Community.

If you do not have access to this information, hard copies can be provided and submissions to any of the pages can be made without internet access. Suggestions on improvements, additions or changes to the pages are also welcomed.

Thanks to this Newsletter's contributors:

**Ken McDonald
Bryce Jones
Gary Taylor
Brandon Beaudry
Michael Mah
Chuck Evans**



ACES (Northern Chapter) **General Meeting**

MARCH 6, 1996
7:30 TO 9:00 P.M.
Royal Alexandra Hospital
Main Auditorium

Speakers will present topics on:

Technology in Homecare

- refreshments and discussion to follow -

Check to ACES homepage for more details as they become available and for times and topics for ACES Southern Chapter General Meeting.

<http://skynet.uah.ualberta.ca/~aces>