

Published in 1984
Proceedings of Computer
Applications in Radiology
Conference

**COMPUTERIZED RADIOLOGICAL PRACTICE SYSTEMS:
AN IMPLEMENTATION SURVEY**

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ABSTRACT

Computerized accounts receivable (A/R) systems are often the initial rationale for the implementation of computers in many Radiological practices. This paper addresses the acceptance of those computerized billing systems by surveying five hundred private and group Radiological practices. Responses by Radiologists, Radiology Practice Managers and staff to such topics as relevance to practice, personnel acceptance, software and hardware specifics, salient features, difficulties, vendor support, and pricing are presented. Conclusions and recommendations are drawn for Practitioners yet considering a computerized Radiological billing system.

INTRODUCTION

Computers have historically been used in the private and group practice of Radiology for accounts receivable (A/R) or billing purposes via remote batch billing services on a service company's mainframe. Since the commercial advent of the micro in the late seventies and decreasing hardware prices, it would appear that Radiology practices have availed themselves of this new technology. This assumption is made due to the number of vendors of Radiology practice software, particularly billing systems, and the enthusiasm expressed by the physicians. Thus it becomes of interest to ascertain what current capabilities of

a computerized, in-house, Radiological practice system do Radiologists view as most important and to what degree have their expectations been met by the current A/R software.

METHOD

A mail survey was conducted during the first quarter of 1984. The mailings were to a simple random sample of five hundred physicians drawn from the 1983 membership directory of the American College of Radiology. The sample represented approximately 3.5% of the membership. The selected physicians were sent a two page, eighteen question survey with cover letter and an addressed return envelope. A follow-up mailing was sent approximately a month after the initial mailing to those individuals not responding to the first mailing. A copy of the survey is shown in Figure 1.

All respondents were asked to complete the first three questions of the survey. The first three questions dealt with practice data, capabilities of a computerized Radiological practice thought most useful, and current computer usage. Respondents were instructed to complete the remaining fifteen questions if they were using a computer for billing purposes.

The repository for and the analysis of the data were accomplished on an Apple II+ micro using Micronetics MUMPS.

RESULTS

From the five hundred questionnaires sent, seven were returned as unforwardable and fifty-four or 10.8% were completed and returned. Of the fifty-four returned questionnaires, fifty-two were usable. The 10.8% response rate is approximately three times the normal unsolicited, mail survey response rate. This higher than usual response rate thus lends credence to the contention that Radiologists and Practice Managers are indeed interested in computerization.

The number of responses received for each of the eighteen questions, where appropriate, are detailed in Figure 1. The responses to sub-questions 1b and 1c are not detailed since these questions seemed to be ambiguous to some of the respondents. The numbers beneath rank in question two are not the number of responses but the actual resultant ranking of each of the capabilities. The responses to questions four, ten, fifteen and sixteen required narrative responses and are not detailed in Figure 1, but will be discussed below.

The responses to question 1a, "Individual completing questionnaire?", show that 65.4% of the respondents were Radiologists, 25.0% were Practice Managers, 3.8% were staff, and 5.8% were not sure of or were uncommunicative regarding their capacity as they failed to answer the question. It is interesting to note that one quarter of the respondents were Practice Managers, suggesting the importance of running a Radiology practice as a business.

Figure 1. Use of Computer Billing (A/R) Systems in the Practice of Radiology

Please place an 'x' in the appropriate box or line or fill in your response.

1. Practice Data

- a. Individual completing questionnaire? MD 34 Practice Manager 13 Staff 2
- b. Number of full time equivalent radiologists with this practice?
- c. Average number of patient films viewed per day? _____

2. In your opinion, which four of the following do you consider the most important capabilities of a Radiological Practice computer system? Please rank the four from 1 to 4, 1 being the most important.

<u>Capability</u>	<u>Rank</u>	<u>Comments</u>
Appointment Scheduling.....	(5)	_____
Billing System (A/R, inclu. insurance)..	(1)	_____
Check printing.....	(9)	_____
Estate records and planning.....	(12)	_____
General ledger (A/R & accounts payable)..	(2)	_____
Image (XRay, NMR, ..) display/enhancement.	(8)	_____
Image digitally stored & retrievable....	(7)	_____
Income tax preparation.....	(11)	_____
Inventory control.....	(13)	_____
Office security (intrusion alarm).....	(14)	_____
Patients records (DOB, impressions, etc)..	(3)	_____
Payroll.....	(6)	_____
Telecommunications.....	(10)	_____
Word processing (inclu. transcription)..	(4)	_____
_____ ..	(-)	_____

3. Computer Usage

- (5) a. No computer usage in this practice and no plans to do so.
- (2) b. No current computer usage but plan to get on a remote billing system.
- (5) c. No current computer usage but plan to get an A/R system in next 12 mo.
- (6) d. Computer used in functions other than billing, e.g., word processing.
- (17) e. Computer used only for billing purposes.
- (17) f. Computer used for billing and other purposes.

If your answer to question three was a, b, c, or d then you need not answer the remaining questions but please return this questionnaire - thank you.

4. Vendor of Billing System (Important! Please answer completely):

Company _____
 Address _____
 Model & configuration _____
 Date Acquired _____

5. How was system acquired?

Purchase 23 Lease 4 Renting 0 Evaluating 0 monthly use fee 4

6. How did you find out about this product?

Prof. Trade Journal 2 Mail 1 Trade Show 3 Computer Store 1
 Co. Sales Personnel 4 Word of Mouth 6 Consultant 5 Other 5

Figure 1. (Continued)

7. Qualitative Parameters of Your Billing System:

	Excellent	Good	Fair	Poor	N/A
a. Relevance to practice.....	(16)	(12)	(0)	(0)	(1)
b. Cost effectiveness.....	(11)	(11)	(6)	(1)	(0)
c. Personnel acceptance.....	(16)	(11)	(1)	(1)	(0)
d. Ease of installation.....	(11)	(15)	(3)	(0)	(0)
e. Ease of conversion.....	(8)	(11)	(7)	(2)	(1)
f. Vendor user training.....	(9)	(10)	(7)	(1)	(2)
g. Quality of documentation.....	(9)	(16)	(2)	(1)	(1)
h. Ease of operation (use).....	(12)	(14)	(1)	(1)	(1)
i. Availability of vendor.....	(13)	(8)	(5)	(2)	(1)
j. Vendor's technical support.....	(11)	(9)	(7)	(1)	(1)
k. Maintenance service responsiveness...	(12)	(13)	(2)	(0)	(2)
l. Maintenance service effectiveness....	(12)	(11)	(4)	(0)	(2)
m. Pricing in line with functions.....	(9)	(9)	(7)	(3)	(1)
n. Hardware & software performance.....	(13)	(12)	(0)	(4)	(0)
o. Overall reliability.....	(10)	(17)	(2)	(0)	(0)
p. Overall satisfaction.....	(10)	(15)	(2)	(2)	(0)

8. Does this billing system interface to a hospital system?

No 19 It can but doesn't 6 It can and does 4

9. Total final hardware & software cost of system?

<\$10000 1 \$10000-14999 1 \$15000-24999 3 \$25000-34999 11 >\$35000 7

10. Why did you buy this system and configuration? _____

Is the computerization of your billing process cost effective?

Never will be 0 Not yet 3 Moderately so 9 very cost effective 17

Has the computer system improved your collection rate? Yes 23 No 6

Have you saved on personnel costs? Yes 22 No 7

The individual(s) most responsible for the purchase of the system were:

naive 6 knowledgable 20 expert 3 computer type individual(s).

15. Features you consider the most salient and useful in your billing system? _____

16. How would you improve upon this system? _____

If you were to do it over, would you computerize again? Yes 30 No 0

18. If you were to do it over, would you procure this system? Yes 20 No 7

Please return the questionnaire as soon as possible. Thank you for your time and responses.

Question number two requested the ranking, in the respondents opinion, of four of the most important capabilities of a Radiological practice computer system. As can be seen in Figure 1, the respondent was given a choice of fourteen possible computerized office functions with an additional blank for a fill in. None of the respondents wrote in any capability not previously listed. In addition, some of the functions, e.g. inventory control and estate records and planning were selected as desirable only once while office security was never chosen.

The extent of agreement between respondents in their ranking of the capabilities was tested using the Kendall Coefficient of Coincidence. It was found that there was indeed significant, $p < .01$, agreement between respondents as to the ranking of the capabilities. Additionally, the order of ranking can be seen in Figure 1 where the billing system capability was ranked first much more often than any other. General ledger, patient's records, and word processing capabilities were ranked second, third and fourth, respectively, and formed the next grouping of capabilities. The remaining capability rankings were in general less discernable though they could indeed be ranked in perceived importance as shown in Figure 1.

Additional support for the importance of computerized billing is seen by the responses to question three, where fully 85% of the respondents using computers had a billing system. Although the questionnaire was directed mainly to those individuals with on-site computer systems, several respondents were still using an off-site batch billing system and as

indicated by responses to 3b, two individuals planned to use such systems in the future. Using the data from questions 3c and 4 and making some fairly reasonable assumptions, it could be conservatively estimated that from 120 to 150 new Radiology practice computer systems would be purchased or leased in 1984

Of the thirty-four respondents using computers for billing purposes, thirty-three answered question four, see Figure 1. The vendors of the various billing systems and number of respondents with that system are presented in Figure 2. Not included in Figure 2 are the three systems developed in-house and the three systems where the respondents did not know the vendor.

Also of interest from question four are the dates when the billing systems were acquired. Thus one system was acquired in 1975 (in-house developed), one in 1977, three in each of 1978, 1979 and 1980, seven in 1981, five in 1982, four in 1983 and the remaining six acquisition dates unknown. From the above it would appear that there was an increase in system purchases in 1981. Furthermore, there seems to have been a leveling off in billing system purchases during the past three years, though a definitive conclusion shouldn't be drawn without further support.

From the responses to question five, it appears that the most popular method of system acquisition is purchase. Question six indicates that there is no one overwhelming method of product information dissemination that the respondents attend to. Even so, there does seem to be a general favoring of face-to-face interaction in the sense that the most likely way to make the

<u>Number of Respondants</u>	<u>Vendor</u>
6	IBM (no specific software vendor given)
3	Medical Data Services - Richmond, VA.
3	National Medical Computer Services San Diego, CA.
2	Fiscal Information Inc., Dayton Beach, FL.
1	AIS Corp., New Jersey
1	Cirby Creek Professionals
1	Cycare Inc., Dubuque, Iowa
1	Gastron Radiology, Gasonia, N.C.
1	Kalbao Corp., Moorestown, N.J.
1	Orion Systems, Santa Clara, CA
1	Professional Business Management of Iowa Clinton, Iowa
1	Software Brokers International, Tacoma, WA.

The following hardware vendors had one respondent each with no specific software vendor given: Burroughs Corp., Data General, Hewlett Packard, Microdata and Vector.

Figure 2. Vendors of Installed Radiology Billing Systems

initial contact is through sales personnel, word-of-mouth, trade shows, and consultants - 78% vs professional trade journals, mailings and RFP's - 22%.

Question seven was an attempt at addressing the qualitative parameters of the specific billing systems. Due to the paucity of the data the possibility of inaccurate or unfair representation of the various systems is great, thus the systems were treated in the aggregate. From Figure 3 it can be seen that, on the average, most of the respondents were at least satisfied with their billing system particularly in the relevance to the practice and personnel acceptance categories. The overall system reliability and satisfaction were slightly better than good. The only real problems, on the whole, seemed to be in the ease of conversion and the pricing structure of the systems.

As the responses to question eight in Figure 1 indicate, nearly two-thirds of the respondents stated that their billing system did not interface to the hospital's. There seems to be some ambiguity in the responses to this question in that a number of respondents commented that they would like to see their system interface to the hospitals but when other respondents had that capacity less than half of them availed themselves of it. The effects of TEFRA and DRG's were not directly addressed.

As noted in Figure 1, the total hardware and software costs ranged from less than \$10,000 to over \$35,000. Billing systems in the \$25,000 to \$34,999 range comprised 47.8% of the responses though eight individuals failed to answer the question. The pricing of the systems were not adjusted to any time base.

	Excellent	Good	Fair	Poor	Mean*
a. Relevance to practice.....	▲				
b. Cost effectiveness.....		▲			
c. Personnel acceptance.....	▲				3.45
d. Ease of installation.....	▲				3.28
e. Ease of conversion.....			▲		2.29
f. Vendor user training.....		▲			3.00
g. Quality of documentation.....		▲			3.18
h. Ease of operation (use).....	▲				3.32
i. Availability of vendor.....		▲			3.14
j. Vendor's technical support.....		▲			3.07
k. Maintenance service responsiveness...	▲				3.37
l. Maintenance service effectiveness....	▲				3.30
m. Pricing in line with functions.....			▲		2.86
n. Hardware & software performance.....		▲			3.17
o. Overall reliability.....	▲				3.28
p. Overall satisfaction.....		▲			

*Where Excellent=4, Good=3, Fair=2, Poor=1

Figure Three. Qualitative Parameters of Installed Billing Systems.

The twenty-three responses to question ten, "Why did you buy this system and configuration?", could generally be included in one or more of seven categories. These general categories and corresponding response rates were: reputation of hardware and/or software vendor - 10, practice needed computerization - 5, responses to RFP's - 2, recommended by consultant type - 2, cheapest that could do the job - 2, decision not respondents (reason unknown) - 2, and miscellaneous reasons - 2. The two miscellaneous reasons for the system purchase were: "The hospital used a Burroughs thus a compatible in-house system was developed", and "The practice needed a larger capacity machine" (prior computerization). From the above it appears that the reputation, thus established base, of the hardware and/or software vendor was of primary concern to the respondents.

Question eleven was included as an internal validity check as essentially the same question was asked in 7b. Subjecting the data to the Sign Test the hypothesis that the median differences between the two responses from the respondents is zero could not be rejected, two-tailed $p=.142$. Thus internal validity is supported.

Question twelve and thirteen address the improvement in the practice's collection rate and the savings on personnel costs, respectively. Not unexpectedly, the majority (79.3% of respondents to question twelve indicate that indeed their collection rate has improved. By combining the responses to questions ten and fifteen with twelve, it would appear that the major reasons for collection rate improvement are the timeliness,

multiplicity, and accuracy of the billings. It is surprising, at least to the author, that 75.9% of the respondents to question thirteen reported a personnel savings due to a computerized billing system. It seems that usually any personnel savings at one end of the system is utilized elsewhere in the system or in other tasks in the office.

According to the respondents of question fourteen, the majority, 79.3% of the individuals responsible for the purchase of the billing system were at least considered knowledgeable regarding computerization.

There were twenty-two responses to question fifteen "Features you consider the most salient and useful in you billing system?", which could generally be divided into one or more of six categories. These general categories and corresponding response rates were: availability of billing data (manageability)- 10, speed of billing - 7, insurance billing - 6 miscellaneous - 6, accuracy of billing - 3, and user friendly -2. The miscellaneous responses were: "multiple entry stations, large memory and faster printer", "good up-time", "referring physician analysis", "scheduling,..., general ledger", "mag tape insurance claim forms, word processing,...", and "tape to tape, large memory". Not surprising is the desire of the respondents to have readily available billing data as well as timely and accurate billing, particularly for insurance purposes.

The nineteen responses to question sixteen, "How would improve upon this system?" could be divided into one of six categories. These general categories and corresponding response rates were: increase software/hardware flexibility/capabilities - 5, increase software/hardware speed - 4, miscellaneous - 4, interface to hospitals computer system - 2, decrease cost - 2, and little if any improvements needed - 2. The miscellaneous category included such responses as: "better software", "interface digital images and retrieval and have computer to computer insurance billing", "A/R system poor" "improve training". It is interesting to note that only two of the respondents were totally satisfied with their billing systems. The general tone of the remarks suggested that it expensive or impossible for the respondent to get the vendor make changes or additions to the existing software.

It is encouraging to note that by the responses to question seventeen, all thirty respondents would computerize if they were to do it over. As an aside, in the comments received from all of the respondents, only two individuals stated that computers been very deleterious to their practice. Also encouraging is that 74.1% of the respondents to question eighteen would procure the same computer system, thus believing they made the best available system choice for themselves.

CONCLUSIONS AND RECOMMENDATIONS

As the respondents to the survey have indicated, the four most important capabilities, in a computerized Radiology office system are, 1. a billing (A/R system, 2. general ledger, 3. patient's records, and 4. word processing. The largest installed base of hardware was not surprisingly, IBM, with their PC, System 34, and Datamaster. According to the respondents, the three largest software vendors were: Medical Data Services, National Medical Computer Services, and Fiscal Information Inc.

The respondents, in general, were pleased with their computer systems. The only two areas where, in the aggregate, the respondents thought there were problems was in the conversion from manual to electronic and that the pricing was too high for the functions offered. Interfacing to the hospital system may become a more desired feature in the future due to insurance billings, patient data bases, digital image transfer, etc

Nearly fifty percent of the billing systems were in the \$25,000 to \$34,999 price range. It's likely that the systems (mainly hardware) will decrease in price in the future, but the purchase of an office system will remain a non-trivial expense if for no other reason but the personnel time and energy involved in the conversion. Once installed, the majority of the respondents believed that the computerized billing system increased their collection rate, saved on personnel costs and thus were cost effective.

From the responses to this survey and personal experience the following are a few recommendations for consideration by the practitioner yet considering a computerized Radiological billing system:

1. Carefully scrutinize your practice and determine your informational needs and the manner in which you want your billing to be accomplished.
2. From 1, create a RFP that the software/hardware vendors can address. It may be helpful in the generation of the RFP to enlist the help of a consultant
3. Disseminate the RFP to the appropriate vendors.
4. From the vendor responses narrow the field to three or four.
5. Investigate the vendors carefully and visit sites where their systems have been installed. Inquire extensively into the growth capabilities and flexibility of the systems.
6. Select two vendors, if possible, and negotiate the best deal you can.
7. After selection of the vendor, be aware of the pitfalls in conversion and be realistic in your expectations.
8. ENJOY!