

# A literature review and analysis of the value of high-speed strip-packaging automation in retail and institutional pharmacy.

C:\Documents and Settings\Wayne Caverly\My Documents\Efficient Pharmacy\Articles\Analysis of high-speed strip-packaging automation  
ARTICLE.doc 4/07/08 9:26:15 AM

By Wayne Morgan Caverly, President, Caverly Consulting Group Inc.

- Efficient Pharmacy Solutions (automation advice, return on investment tools, re-engineering consulting)
- Solutions by Design (pharmacy design services)
- The Efficient Pharmacy Institute (articles, lectures, continuing education events)
- Caverly Management Consulting Services (management consulting for small & medium size businesses).

## Value of high-speed strip-packaging automation in retail and institutional pharmacy

### **Table of contents:**

Introduction: .....	3
How they work:.....	5
Value analyses .....	6
Added revenue / growth for the pharmacy: .....	6
Competitive advantage: .....	6
Reduced medication waste:.....	6
Inventory control:.....	6
Time savings - pharmacy:.....	7
Time savings - nursing:.....	8
Long-Term Care: .....	8
Home Health Care: .....	9
Cost savings: .....	9
Reduced waste .....	9
Reduced time to return-to-stock.....	10
Improved compliance: .....	10
Reduction in process errors, errors reaching the patient, and clinically significant errors: ....	10
Financial impact of errors: .....	11
Errors and patient safety considerations: .....	12
Reduced occurrence of re-admittance, reduced hospital costs: .....	12
Compliance issues:.....	12
Pharmacist redeployment:.....	13
Shortage .....	13
Nursing.....	13
Pharmacy.....	14
Conclusion .....	14
Key Benefits: .....	16
References.....	17

### **Introduction:**

North Americans are aging. In 2000, 12.5% of Americans were over the age of 65, a percentage that's expected to rise to 16% by 2020 and almost 20% by 2050<sup>1</sup>. The Canadian figures are even higher (13% in 2006, 19% by 2021 and 23% by 2031<sup>2</sup>). As we age our health needs increase. Add to this the move to shorter hospital stays and the burden on home care and long-term care facilities increases dramatically<sup>3</sup>.

Prescription medication use also increases as we age, and indeed grows exponentially in the elderly. In 2002, 60 – 68% of elderly men and 68-78% of elderly women were using prescription drugs. Routine medication use by the home-dwelling elderly was reported as 8.8 medications per person<sup>4</sup> with prescriptions per capita estimated at more than 30, and growing at 3 – 4% annually.<sup>5-17</sup>

These are some of the factors that have led to the increase in compliance packaging options. Originally designed only for hospital and long-term care use, compliance packaging has progressed to enter the homes of both the ambulatory elderly and younger patients in the form of in-home oral solid medication aids and automated dispensers. These tools assist patients of all ages in ensuring compliance.<sup>18, i</sup>

Seniors in particular are at risk for medication-related problems that result in hundreds of thousands of deaths each year, and account for the consumption of more than \$100 billion annually in North America's scarce health care resources.<sup>19</sup>

Another major issue affecting healthcare is the labour shortages in both nursing and pharmacy. In a recent report, 84% of hospital administrators said they are experiencing a nursing shortage and 49% said the same for pharmacy.<sup>20</sup> Current estimates place the vacancy rate at 8.5% for nursing and more than 10% for pharmacy.

While the old compliance packaging systems (blister or 'bingo' cards) provided relief for nursing, reducing both med pass time and the potential for errors, they added significant labour requirements to pharmacy, which must repackage oral solid medications in a very labour-intensive manner.

Newer systems, such as Opus<sup>TM</sup>, Medicine on Time<sup>®</sup>, Atromick<sup>®</sup>, Doc-U-Dose<sup>®</sup> and Mediset<sup>®</sup>, continue to evolve and improve from the viewpoint of nursing, however they demand as much or more time from pharmacy staff.

The most recent trend in compliance packaging – and one that has a major time savings benefit to pharmacy – is automated high-speed strip packaging. Strip-packaging itself is not new: the Sergeant line of semi-automated packagers has been around for years, but the automation of multi-dose (versus unit-dose) packages, and the ability of these new machines to provide custom printing, sorting and

---

<sup>i</sup> Non-compliance is a major issue in healthcare today, hovering around 50% and accounting for 28% of hospital admissions of older Americans. Col N, Fanale JE, Kronholm P. The role of medication non-compliance and adverse drug reactions in hospitalizations of the elderly. Arch Intern Med. 1990; 150:841-5

## Value of high-speed strip-packaging automation in retail and institutional pharmacy

reporting, has changed strip-packaging to the extent that some see it as a potential (long-term) replacement for vials in retail pharmacy.<sup>ii</sup>

Multi-dose strip packaging (see figure 1) automates the preparation of compliance packaging in the pharmacy, reduces checking time for pharmacists, and can significantly reduce med-pass times while reducing the potential for error at every step along the way.<sup>21</sup>

For hospital-based home care companies, high-speed packaging systems increase safety and reduce the chance of errors. They increase patient compliance, reduce costs, and through improved medication use and compliance, contribute to the healthcare systems' overall goal of avoiding readmissions to hospital.<sup>22</sup>

As with all automated drug dispensing systems, the high-speed packagers enhance the utilization of pharmacy and nursing personnel, permitting the continued advancement of pharmaceutical care<sup>23</sup> and improving our use of pharmacist and nurse professional skills and time.

Financially, the system can reduce the pharmacy's requirements for licensed staff and related salary and benefit costs, increase the pharmacy's production and revenue potential, and reduce patient medication waste and out-of-pocket costs. High-speed packagers may even reduce the amount of physical space customers must lease or purchase.<sup>24</sup> Some states help to make medication compliance systems even more appealing by not requiring a licensed nurse to administer prescriptions.<sup>25</sup>

Very important to the small chain or community pharmacy, especially those just entering (or considering entering) this growing market, high-speed packagers are good for business. Automated systems enable consultant pharmacists to stand out and deliver exactly what customers want. Considering the dynamics of the managed care marketplace and the implications for long-term care pharmacy, automated systems are a logical choice. As one consultant pharmacist stated, *"It's really all about service. I saw the opportunity to serve a need that's out there, to offer a better quality service to the customer."* And to quote another, *"The beauty of this technology is that you can devote your time to analysis and clinical intervention, while something else simply packages the medication. That's key for us."*<sup>26</sup>



Figure 1: multi-dose strip package

<sup>ii</sup> In an unpublished study by Efficient Pharmacy Solutions ([www.efficientpharmacy.com](http://www.efficientpharmacy.com)) a retail pharmacy, who automated their long-term care prescriptions with multi-dose strip packaging, converted more than 10% of their ambulatory patients to strip packaging within 6-months through the use of a consumer marketing campaign. Other pharmacists have reported retail clients willing to use compliance packaging even when their prescription plans won't cover the packaging costs. Lockwood W. Opportunity in Medication Compliance. Computer Talk, Sept/Oct 2002

# Value of high-speed strip-packaging automation in retail and institutional pharmacy

## How they work:

High-speed packagers consist of a number of product-specific canisters that are directed to drop a single dose (via stainless steel chutes) onto a strip - which is then 'sandwich' sealed by a second strip. Each resulting "pouch" may contain only 1 product (unit dose) or may contain multiple products as in a patient's morning meds (multi-dose, see Figure 1). Each strip is printed with the product's information (name, strength, NDC/DIN, etc.) and may be printed with patient and doctor data as desired/required. A bar code may also be printed to allow for faster checking, inventory control, and bedside scanning.<sup>27</sup>

Many systems can produce up to 2,000 doses per hour without the need for continuous operator involvement and come in various sizes, ranging from as few as 3 product canisters (Figure 2) to more than 500 (Figure 4 & Figure 5). These, and many in-between sizes, are available from multiple firms<sup>iii</sup>. For tablets not located in one of the packager's canisters, or for tablets that require special handling (i.e. splitting), a special tray is used (Figure 3). While loading this tray is very similar to a manual fill process it is usually restricted to a small quantity (2 – 3%) of all products handled.



Figure 2: PacMed™ JV60-C3



Figure 4: AutoMed's FastPak @EXP



Figure 5: PacMed™ JV500SL

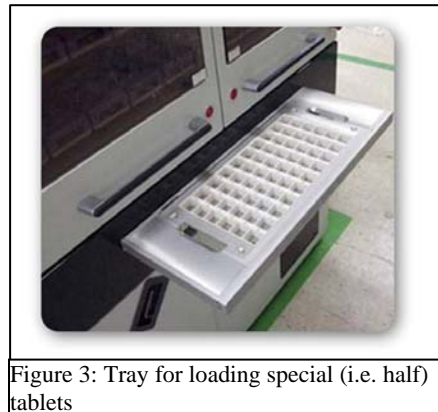


Figure 3: Tray for loading special (i.e. half) tablets

<sup>iii</sup> Which system best suits your practice needs is based on your current and projected volumes, as well as your formulary. A full drug-movement-report analysis should be performed to ensure the right size system is chosen to handle your business-needs.

## **Value analyses**

### **Added revenue / growth for the pharmacy:**

In order to win assisted living business pharmacies must be innovative and offer unique capabilities to their clients. Automated oral medication packaging systems (like high-speed packagers) are key elements in the strategies of many successful home care pharmacies who automate because they want *"something that would appeal to the assisted living market, set (our) services apart, and make (us) the innovator of the area."*<sup>28</sup>

The highly detailed labelling and medication identification provided by this technology (showing patient, day, time, physician, prescription number, physical identification of the meds and bar codes – all displayable in customized formats) is also important to assisted living facilities. Assisted living clients are looking for a system that's virtually foolproof, something with which they can trust a caregiver, prompting comments like *"Not only is this easy to use, but in case you have to identify the medication all the information is right here."*<sup>29</sup>

### **Competitive advantage:**

When pharmacies are trying to build or expand a market - such as assisted living, skilled nursing facilities, and other long-term care settings, they have to be competitive. Smart management involves not just meeting customers' needs, but requires the use of equipment and strategies that result in operational and cost efficiencies. With the continuing decline in reimbursement, it is impossible to maintain the luxury of a large staff and the labour-intensive aspects of current methods of repackaging medications. Providing the level of service that high-speed packagers allow, including completely customized packaging and labelling, distinguishes a pharmacy from their competition.<sup>30</sup>

### **Reduced medication waste:**

Reducing medication waste and the resulting out-of-pocket cost to the patient is another benefit provided with automated systems. Most patients currently receive at minimum a 30-day supply of medication. With high-speed packagers, days-supply can be reduced to weekly (or less) so when medications are changed due to changes in dosage strength, cancellation, or for other reasons, patients will have only minimal amounts of medication to discard. With traditional vials, blister cards, etc., patients often waste an entire 30-day supply.<sup>31</sup>

### **Inventory control:**

In a blister card environment the pharmacy usually prepares multiple non-patient-specific 30+ days-supply cards to hold in stock until needed. This advance pre-packing results in higher inventory levels. With high-speed packaging's speed and ease of use, there is no need to prepare more than a day or two in advance thus reducing on-hand inventory. In addition, many facilities use high-speed packagers to reduce their days supply from 30+ days to weekly or even less (often using a 2,2,3 days

## Value of high-speed strip-packaging automation in retail and institutional pharmacy

supply: Monday/Tuesday; Wednesday/Thursday; Friday and Weekend). This decreases waste and/or returns (when the patient's regimen changes or is discontinued).

High-speed packagers also provide the ability to purchase pharmaceuticals in bulk, reducing the need to pay suppliers a premium to receive medications in pre-packed cards. These savings alone have been reported to pay for high speed packagers in less than two years. Institutional facilities have reported reducing inventories by more than a third and improving order fulfillment time by 50% or more. One major health system's Director of Pharmacy reported their high speed packager created an immediate one-time savings of \$250,000 by eliminating extra inventory and, through ongoing tight inventory control, reduced per unit packaging cost from 10.5 cents for pre-packaged doses to 1.6 cents per dose out of (the high speed packager).<sup>32</sup>

### Time savings - pharmacy:

The elimination of filling blister cards, vials or other manual systems is undeniably the largest single benefit to pharmacy. While this is primarily technician time, studies have also shown significant savings for pharmacists, as checking a 'run' from a high-speed packager often takes significantly less time than checking a stack of blister cards or other packaging types.

Savings to technicians have been reported to range from 1.3 to more than 10-minutes per prescription and savings to pharmacists as high as 3-minutes per prescription. As an example, consider the time it would take to manually fill and



Figure 6: Opus™ packaging system

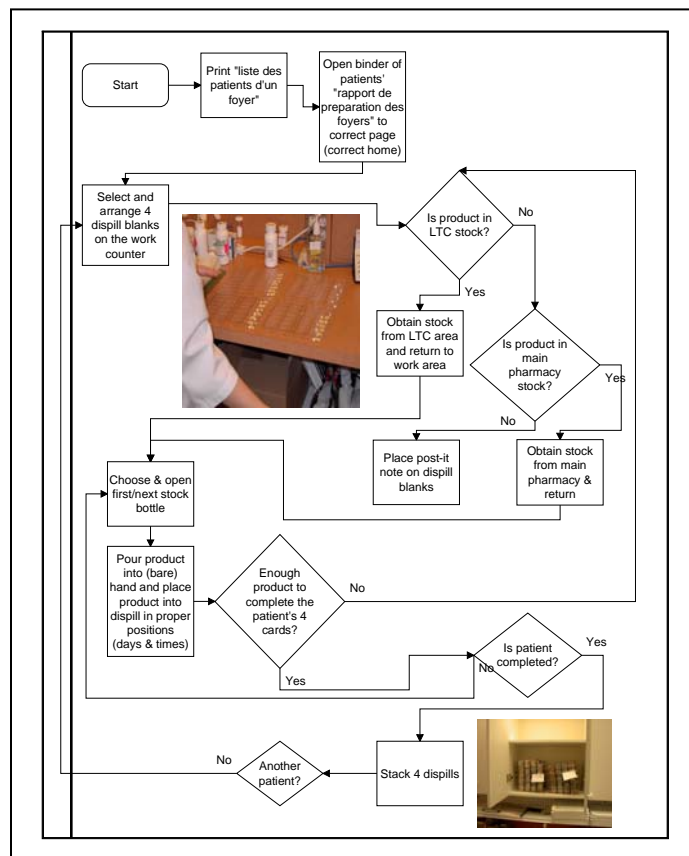


Figure 7: Manual filling of cards

verify Opus cassettes (where multiple products are placed in each cassette and there are different cassettes for each dosage time – see Figure 6) vs. checking the multi-dose strip shown in Figure 1.

In manual systems (see Figure 7) technicians usually retrieve stock bottles individually per patient. They then must dispense individual tablets or capsules into the correct (day & time) depression, ensuring nothing falls into the wrong space. This is repeated for each of the patient's products, often 10 or more individual items, and each one multiple times a day. Once all the blisters or cassettes are filled, the pharmacist must verify not only the products themselves, but administration times as well.

With strip packaging the technician's tasks are almost completely replaced by

## Value of high-speed strip-packaging automation in retail and institutional pharmacy

automation<sup>iv</sup> and verification of the transparent strips, which allow similar administration times to be compared side by side, can be completed in significantly less time than with other systems.

Reduced return-to-stock issues are another potential time savings opportunity as any unused stock returned to the pharmacy must be dealt with by staff. By supplying shorter dosage periods, return to stock may be significantly reduced or eliminated.

### Time savings - nursing:

One of the greatest values to nursing is derived from reducing their workload during med passes, a task that takes up to 40% of their time<sup>33</sup> and where up to 38% of medication errors occur.<sup>34</sup>

In a unit of use blister card environment the nurse must first locate all the cards for that particular patient and administration time (which often consists of 5 – 10 medications) and push one (or more) oral solids out of each card (into a cup). With high-speed packagers, the products would either be combined into one package<sup>v</sup> or – if still in individual packs<sup>vi</sup> – they would be sequential in the strip (based on patient and administration time). The nurse simply takes the next pouch from the patient's roll, verifies administration time (printed on the pouch and verifiable by bar code scan if the technology is in use) and tears the pouch open.

Substantial savings are also realized in cabinet/cart restocking when new medications are delivered from the pharmacy. Restocking 1 roll of a patient's pouches takes substantially less time than restocking multiple blister cards (see Figure 8 & Figure 9).

Incorporating high-speed packagers into a manual environment will result in the system segregating and automating many of the department's mundane and non-professional tasks to free up the pharmacists' time for both clinical and private duties. Thanks to automation, pharmacists will stay on the patient floors, accompanying physicians on patient rounds and serving as clinical consultants as a matter of course. Additionally, staffing may be substantially reduced on weekends.<sup>35</sup>

### Long-Term Care:

Approximately 21,000 nursing care facilities in the U.S. provide care for over 1.6 million people<sup>36</sup> and in Canada one out of every 30 people aged 65 or older (more than 150,000 seniors) are living in residential care facilities.<sup>37</sup> The level of care provided by these facilities has increased over the last decade and they now provide much of the healthcare that was previously found in hospitals.

Saving nursing time is crucial as almost two thirds of U.S. nursing homes fall below minimum staffing requirements.<sup>vii</sup> This situation is often blamed on reductions in

<sup>iv</sup> Technicians maintain the automation, including periodic replenishment of canisters – performed with bar code scan verification.

<sup>v</sup> Multi-dose packaging

<sup>vi</sup> Single-dose packaging

<sup>vii</sup> According to the Department of Health & Human Services



Figure 8: Med cart with blister cards



Figure 9: Patient strip pack container with patient photo



## Value of high-speed strip-packaging automation in retail and institutional pharmacy

medical cost reimbursement (especially by U.S. Medicare and Medicaid programs) that make it difficult to afford adequate levels of staff.<sup>38</sup>

These staffing issues are especially acute as nursing home residents often receive complex drug regimens and are at increased risk of adverse drug events caused by changes in pharmacokinetics and pharmacodynamics due to aging, as well as multiple comorbid conditions. The cost of medication-related problems in U.S. nursing care facilities is estimated to be \$8.2 billion each year.<sup>39</sup>

### **Home Health Care:**

Home health care usually consists of a skilled-nurse visiting a patient's home to perform activities to improve patient health. This often includes repackaging the patient's medications into various types of medication organizers (pill boxes) to assist patients with medication adherence. To do this the nurse must open all the vials (as dispensed by the pharmacy) and transfer medications into the appropriate day and administration time in the patient's pill box or reminder system. Unfortunately, this repackaging of the patients medications eliminates the labelling provided by the original vials.<sup>40</sup>

In order to complete the repackaging task the patient must have adequate quantities of all medications on hand. If not, the nurse is forced to temporarily leave the patient with incompletely repackaged medication and a return visit will be required to complete the operation (increasing labour costs for the agency and reducing the availability of skilled nursing services to other patients).<sup>41</sup> One way of dealing with these issues - alleviating the demands on skilled-nursing - is to pass these time-consuming tasks to the pharmacy, where the patients' medications are packaged in pill boxes prior to delivery or pick-up. However this option simply shifts the labour burden to pharmacy, where reimbursement and labour shortages are no less acute.

Changing to automated strip packaging at the local pharmacy level provides labour savings to pharmacy, to nursing, and improves the quality of patient care, including allowing nursing to spend more time on other, more professional tasks, or to see more patients.

### **Cost savings:**

As noted above, drug spending may be lowered by purchasing bulk medications versus pre-packaged medications.

Shrinkage may also be a significant benefit: The longer the days supply sent to decentralized locations the greater the opportunity for theft. Reducing a 30+ day's supply to weekly (or less) reduces shrinkage in the dispensing facility. Shrinkage, which has been reported as 3 – 8% of the full value of the product shipped<sup>42</sup>, is also high on return to stock items. When blister cards are returned partially filled, the pharmacy usually has no way of knowing how many tablets/capsules should be missing while returned compliance packs provide caregivers a detailed review of what medications the patient missed and when.

### *Reduced waste:*

By reducing drug wastage, the nursing home is reducing its prescription drug costs for patients. Drug wastage (estimated at approximately 4 percent of drug costs<sup>43</sup>) results from medications dispensed by

## Value of high-speed strip-packaging automation in retail and institutional pharmacy

a pharmacy, but not used by the patient. The incidence of drug wastage within a long term care facility can be influenced primarily by 1) the number of times a medication is discontinued for a patient due to ineffectiveness or intolerability of the medication, or 2) the expiration of the patient, leaving unused, non-returnable medications for the facility to destroy.

A switch to high-speed packagers usually means returns can be retained and re-used<sup>viii</sup> while facilities using traditional vials for medication delivery are expected to dispose of any Rx products returned to the pharmacy<sup>ix</sup>.

*Reduced time to return-to-stock:* Following the above argument in regards to returns: When the returns are in blister cards the medication may be kept for future patients, however, it they will have to be removed from the partially used blister cards and repackaged. With high-speed packagers' strips, there is no repackaging required (unless the packages were patient-specific).

### **Improved compliance:**

Twenty-five percent of patients going to emergency rooms are due to medication issues. Of these, 10% require hospitalization. Poor compliance while in a medical facility also increases the number of days in hospital leading to higher costs for the facility. Current methods of improving medication adherence for health problems are mostly complex, labour-intensive, and not reliably effective. Compliance packaging has been proven to improve patient compliance – especially in the elderly, therefore medication ‘reminder packaging’ which incorporates a date or time for a medication to be taken in the packaging, should be used to act as a reminder system to improve adherence.<sup>44</sup>

### **Reduction in process errors, errors reaching the patient, and clinically significant errors:**

In nursing homes, approximately two dollars are spent to treat medication-related problems for every dollar spent on prescribed medications.<sup>45</sup> Processes that worked decades ago no longer ensure safe care in today's complex and highly technical health care system where the key to reducing medical errors is to focus on improving the health care delivery systems (rather than to assign blame).<sup>46</sup>

Unit-dose drug distribution systems have repeatedly been shown to reduce the incidence of medication errors<sup>47,48,49</sup> including one study that compared medication administration error rates in a long-term care facility using three different distribution systems: single unit-dose packaging; patient “med pak” packaging (all medications for a particular administration time packaged together); and blister cards. Medication administration error rates decreased from 8% using blister cards to 2.5% with single unit-dose packaging to 0% with the strip pack system.<sup>50</sup>

A more recent study reported an 80% reduction in total facility errors (including a 46% reduction in Rx errors) in a facility that transitioned from blister cards to multi-dose strip packaging.<sup>51</sup>

If your facility has not performed a direct-observation study to determine your error rate you probably don't realize the extent of the problem. National surveys reveal that actual error rates are 38% higher

---

<sup>viii</sup> This is only applicable if high-speed packager strips are single-dose. This benefit does not exist if the facility is using blister cards or other methods where the returned drugs have been maintained in an un-tampered state

<sup>ix</sup> In many jurisdictions it is not legal to return them to stock

## Value of high-speed strip-packaging automation in retail and institutional pharmacy

than reported error rates<sup>52</sup> and a study by Cardinale showed direct observation was far superior to chart review in detecting errors. A technician using direct observation for one hour detected 80% of the true errors, while only 7% would be found by the technician with cart review. The numbers for an L.P.N. were 92% (direct observation) versus 2% (chart review) and for an R.N. 70% versus 6%.<sup>53</sup> Cardinale's studies reported a 16% rate for med errors in the elderly (with 24% of those causing harm or leading to a fatal outcome)<sup>54</sup> and studies by Leape et al. found that 44% of adverse drug events occurred after the prescription order was written (i.e., during the medication delivery and administration processes) with 24% of the geriatric med errors traced to administration errors.<sup>55,56</sup>

It should come as no surprise that the use of technology in the form of robots used for filling prescriptions, automated dispensing devices, automated medication administration record, computerized provider order entry (CPOE), "smart" intravenous devices, and bar code-enabled point-of-care (BPOC) systems are all advocated technological methods for prevention of medication errors<sup>57</sup> and that in a survey of senior-level executives, department heads, and managers conducted by the Health Care Information and Management Systems Society, 93% of respondents identified medication errors as a patient safety issue that technology can address.<sup>58</sup> It is estimated the use of technology to increase the use of RNs and hours of nursing care per patient could help to avoid more than 6,700 patient deaths and 4 million days of care each year.<sup>59</sup>

As was noted earlier, nursing shortages have a negative impact on the quality of care, including an elevated risk of making an error when work shifts are longer than twelve hours, when nurses work overtime, or when they work more than forty hours per week. Nurses who work shifts longer than 12.5 hours are three times more likely to make mistakes than those working 8.5 hours or less.<sup>60</sup>

In addition to nursing shortages and overwork, we have the failure of staff to follow policies. This has been blamed for up to 72% of medication errors.<sup>61</sup> Strip packaging (and other technologies) add continuity between care-givers, making it easier for management to ensure established policies and procedures of medication administration are followed.

### **Financial impact of errors:**

While very few studies have been published on the accuracy of manual counting, one study reported count errors in 4% of all countable prescriptions (2% overcount, 2% undercount).<sup>62</sup> Some of these errors are undoubtedly caused by high work loads (named by pharmacists in community and institutional practice settings as the most significant cause of dispensing errors) - workloads that will be lessened with automation.<sup>63</sup> No matter the cause, undercounts and overcounts cost the system. In the former, the facilities reputation is at stake leading to loss of business. In the latter, profits are being given away in the form of free medications.

When significant errors reach the patient the average indemnity payment exceeds \$100,000<sup>x</sup>, but most medication error-related claims are settled out of court for much larger amounts<sup>64</sup> and some are awarded even though the medication error did not result in permanent physical harm to the victim and did not cause economic harm.<sup>65</sup>

---

<sup>x</sup> Between 1985 and 1992 the average was \$99,721

**Errors and patient safety considerations:**

The American Society of Health-System Pharmacists estimates about one out of every 100 doses of medication administered to patients is in error<sup>66</sup> and labelling and packaging issues are the second most frequent category of medication errors reported to the USP MERP, accounting for more than 20% of all reports.<sup>67</sup> Other studies have reported much higher rates than that – 12.5 to 16% and the percentage of errors that are ‘serious’ has been reported as high as 66.1% (of all errors, excluding wrong-time errors).<sup>68 69 70</sup>

Up to two million hospitalized patients are injured each year in the United States because of medication errors and these patients stay an average of two days longer in the hospital at an additional cost of \$4,865 per patient.<sup>71</sup>

Community pharmacy is not immune, reporting dispensing error rates as high as 24% with 4% considered “clinically significant.”<sup>72</sup>

Studies on the impact of automation on the quality of a drug distribution system have shown great results, with error rates declining from a range of 7.35 - 13% to 1.61 - 1.9%<sup>73</sup> and, as mentioned above, a transition from blister cards to multi-dose strip packaging has been shown to reduce long-term care facility errors by 80% .

**Reduced occurrence of re-admittance, reduced hospital costs:**

Medication-related problems occur most often, and are more severe, in seniors where they are a major cause of confusion, depression, falls, loss of independence, and physical disability.<sup>74</sup>

It has been estimated that over one third of elderly patients taking three or more prescription drugs for chronic conditions are re-hospitalized within six months of hospital discharge, and 20% of readmissions were caused by drug-related problems.<sup>75</sup>

Increase in hospital stays caused by preventable medical errors is estimated at an annual cost of nearly \$3 million for a 700-bed teaching hospital based on an average additional length of stay of 4.6 days costing \$5,857 (per case).<sup>76</sup> The cost of a single error as seemingly insignificant as administering glyburide 5 mg instead of diazepam 5 mg was measured at more than \$13,000.<sup>77</sup>

**Compliance issues:**

The American Society of Consultant Pharmacists maintain, to be successful, a Medicare pharmacy benefit should allow seniors access to (among others) specialized dispensing and packaging services for institutional settings to reduce the potential for medication errors, enhance compliance, and provide for emergency dispensing.<sup>78</sup>

Not only do high-speed packagers speed up dispensing by eliminating the transfer of drugs from stock bottles to vials or blister cards, it also leads to better compliance; patients (or caregivers) see at a glance if they have broken the pack to extract their medication.<sup>79</sup> Compliance packaging could

## Value of high-speed strip-packaging automation in retail and institutional pharmacy

significantly reduce non-adherence to long-term medication therapy (that hovers at about 50% and results in 28% of hospitalizations of older Americans).<sup>80</sup> Indeed, the number of people in the United States who die each year from the effects of non-adherence is twice as large as the number of people killed in automobile accidents.<sup>81</sup>

### **Pharmacist redeployment:**

Downsizing may be a reality as hospitals (in the U.S. both public and private) struggle to achieve the leanness demanded in today's business environment.

When not looking at downsizing, facilities are looking to free pharmacist time for pharmacist interventions: In one study at an 849-bed institution, the pharmacists documented 4,648 interventions of which 87% were accepted by the medical staff. The accepted interventions represented a net therapy cost saving of \$487,833, as well as a cost avoidance of \$158,563 achieved by prevention of a potential net 871.9 additional hospital days.<sup>82</sup>

It is in these ways that automation can be looked at not just to reduce labour costs, but instead as an opportunity to justify additional staff. Through automation, redeployment, and hiring of additional staff, a 321-bed community hospital in Wisconsin was able to implement a clinical pharmacy program that generated net savings of \$217,551 (1995-96 dollars) after one year.<sup>83</sup>

### **Shortage:**

#### *Nursing:*

Staffing is one of the latent system failures receiving significant attention in light of the current nursing shortage. In a study by Blendon et al, nurse understaffing was ranked by the public and physicians as one of the greatest threats to patient safety.<sup>84</sup>

In a recent AHA report, 84% of hospital administrators said they are experiencing a nursing shortage and 49% said the same for pharmacy. The same is true of U.S. nursing homes where, according to the Department of Health & Human Services, almost two-thirds fall below the minimum-staffing requirement. Due in part to reductions in medical cost reimbursement by Medicare and Medicaid programs with emphasis on long-term care costs, many nursing homes simply cannot afford adequate staffing.<sup>85</sup>

According to a report released by the American Hospital Association in April 2006, United States hospitals need approximately 118,000 RNs to fill vacant positions nationwide. This translates to a national RN vacancy rate of 8.5 percent. And, this shortage presents a major problem for the quality of work, patient care and the amount of time nurses are able to spend with patients, according to an article in the March/April 2005 issue of Nursing Economics. A widespread dissatisfaction is not only driving nurses away, but it is also deterring many from choosing the profession. In a survey released by the United American Nurses, AFL-CIO reported three out of 10 nurse respondents said that it was unlikely they will be a hospital staff nurse in five years.<sup>86</sup>

As the need for healthcare grows, the nursing shortage is intensifying. It is estimated that the shortage will increase to 340,000 by the year 2020, according to an article in the January/February 2007 issue

## Value of high-speed strip-packaging automation in retail and institutional pharmacy

of Health Affairs. Some of the key factors contributing to the mass shortage include: 1) Nursing school enrolment is not growing fast enough. 2) The total population of nurses is growing at a slow rate. 3) The average age of an RN is climbing because there aren't enough new nurses entering the field. 4) Job burnout and dissatisfaction are driving nurses to leave the profession. 5) High nurse turnover and vacancy rates are affecting access to healthcare.

A recent American Hospital Association Commission on Workforce for Hospitals and Health Systems report cited the shortage of health professionals as a "major national healthcare crisis." A higher demand for medical services such as rehabilitation, long-term and assisted care living (where turnover among nursing home staff currently exceeds 100 percent a year in some facilities<sup>87</sup>), laboratory procedures, oncological needs and more, coupled with an increasing age demographic of patients and healthcare professionals alike, creates a looming challenge for healthcare administrators to manage both short- and long-term.<sup>88</sup>

### *Pharmacy:*

Pharmacist vacancy rates in hospitals and health systems are just under 10% nationwide. The growing emphasis on medication errors is driving hospitals to increase the numbers of staff pharmacists to handle an increasing volume of prescriptions. Annual prescriptions dispensed in hospital and retail settings continue to rise and both are scrambling to sustain adequate staff to meet the demands. Another strain on the system is the record number of pharmacists leaving retail and clinical practice settings for more satisfying practice and employment opportunities.<sup>89</sup>

A Drug Topics survey reveals pharmacist shortages are not expected to abate any time soon. More than half (51.5%) of all respondents indicated they expect the pharmacist shortage to continue over the next 25-years and almost 20% think these shortages will be very severe (79% think they will be somewhat severe).<sup>90</sup>

### **Conclusion:**

It is increasingly apparent that pharmacies and long-term care facilities will need the capability to repackage and bar code medications in unit of use form. High volume dose packagers can provide pharmacies with significant benefits, including increased efficiency and control over bar-coded drug availability.

The potential benefits of automated pharmacy systems are substantial, and the widespread adoption of the technology confirms the fact that these benefits are recognized in many practice settings.

Automated pharmacy systems outperform manual systems and replace many labour-intensive tasks, thereby saving pharmacist, technician, and nursing time. Automated systems, such as high-speed packagers, enable the re-engineering of pharmacy practice and free pharmacists for the practice of pharmaceutical care.

Automated pharmacy systems can reduce medication errors, improve documentation, increase authorized access to both medications and information, and enhance security. Turnover of personnel and on-the-job stress is reduced when pharmacists are freed from bingo or blister pack dispensing for more rewarding, patient-centered tasks. These benefits are shown in terms of increased productivity, accuracy, and drug use control, and in improved patient care.

## Value of high-speed strip-packaging automation in retail and institutional pharmacy

With all previous packaging / dispensing systems there was a compromise between pharmacy and nursing. Systems that ease the workload on pharmacy tend to increase the workload on nursing, and those that nursing find easiest to use tend to require much higher labour within pharmacy. Automated strip-packaging is the only system that reduces labour requirements, and substantially reduces the chance of errors, in both departments.

## Value of high-speed strip-packaging automation in retail and institutional pharmacy

### *Key Benefits:*

Some of the key benefits of strip-packaging automation explored in this paper include:

- Technician time savings (automating manual processes)
- Pharmacist time savings (automating manual processes if involved in filling; plus opportunities to reduce checking times)
- Ability to grow LTC business with existing staff
- Reduction in both process and actual errors
- Reduction in facility space devoted to long term care Rx preparation
- Reduced waste
- Reduced shrinkage
- Reduced inventory costs
- Technician and pharmacist time savings due to reduced returns
- Reduction in days' supply (from 30 – 90, to as low as 2,2,3 days)
- Reduction in facility space devoted to nursing station storage
- Nurse time savings (reducing time for med-passes and providing reminder bags)
- Reduced time required to restock carts / cabinets
- More time for pharmacists to spend on rounds or in other professional duties
- More time for nurses to spend with patients or in other professional duties

Wayne Morgan Caverly is President, Caverly Consulting Group and its divisions: Efficient Pharmacy Solutions, Solutions by Design, the Efficient Pharmacy Institute and Caverly Management Consulting.

An industry expert with more than 20-years experience, Wayne has published more than 50 articles on pharmacy automation, pharmacy design and pharmacy re-engineering and is in demand internationally as a speaker on these topics.

Efficient Pharmacy Solutions is a consulting firm with a mandate to help North American pharmacists improve their practice through pharmacy design, selection and implementation of outpatient technologies, and re-engineering of pharmacy processes – helping to ensure your investments result in maximum financial & operational performance.



Watch for the publication of:

Enhancing Patient Safety: Preventing and Managing Medication Incidents in Pharmacy which will include a chapter by Caverly: *Technology solutions to promote safe medication practices*. Edited by Rantucci M, Stewart I, & Stewart C., the book is scheduled to be published in Spring 2008 by Lippincott, Williams & Wilkins, Baltimore



## Value of high-speed strip-packaging automation in retail and institutional pharmacy

### References:

- <sup>1</sup> U.S. Census Bureau, 2004, "U.S. Interim Projections by Age, Sex, Race, and Hispanic Origin," <http://www.census.gov/ipc/www/usinterimproj/> Accessed 9/12/07
- <sup>2</sup> Statistics Canada, CANSIM, table (for fee) 052-0004 and Catalogue no. 91-520-X. Last modified: 2005-12-21. Accessed 9/12/07
- <sup>3</sup> Mor V. Improving the Quality of Long-Term Care with Better Information. *Milbank Quarterly* Sept 2005 83 (3): 333-64
- <sup>4</sup> Triller DM Clause SL Domarew C. Analysis of Medication Management Activities for Home-Dwelling Patients, *Am J Health-Syst Pharm* 59(23):2356-2359, 2002
- <sup>5</sup> Prescription Drug Trends, Kaiser Family Foundation October 2004
- <sup>6</sup> Cost Overdose: Growth in Drug Spending for the Elderly, 1992 - 2010. *Families USA*, 2000
- <sup>7</sup> Chronic care patients consume huge amount of resources, yet remain largely undertreated. [Www.managedcaremag.com/archives/0312/0312.kaiserchronic.html](http://www.managedcaremag.com/archives/0312/0312.kaiserchronic.html) accessed 5/3/05
- <sup>8</sup> Prescription Drug Therapies: Reducing Costs and Improving Outcomes. *AHRQ Research in Action*. Issue #8 Sept 2002.
- <sup>9</sup> The Whole Package: Protecting Rural Beneficiaries with a Medicare Prescription Drug Benefit. Report from the Rural Pharmacies Issues Meeting of the National Rural Health Association
- <sup>10</sup> Seniors' Prescription Drug Bills Projected to More than Double In The Next 10 Years. *Families USA* July 2000
- <sup>11</sup> Prescription Drugs and the Elderly. [Www.therubins.com/geninfo/eldpresc.htm](http://www.therubins.com/geninfo/eldpresc.htm) accessed 5/3/05
- <sup>12</sup> Testimony of J.A.Poisal, Office of Stratgic Planning, Health Care Financing Administration on Prescription Drug Coverage before the House Ways & Means Subcommittee on Health, March 27,2001.
- <sup>13</sup> Prescription Drugs. Data Profile Number 5, September 2002. [ihcrp.georgetown.edu/agingsociety/pubhtml/rxdrugs/rxdrugs.html](http://ihcrp.georgetown.edu/agingsociety/pubhtml/rxdrugs/rxdrugs.html) accessed 5/3/05
- <sup>14</sup> Fink KS Byrns PJ. Changing Prescribing Patterns and Increasing Prescription Expenditures in Medicaid. *Annals of Family Medicine*, Vol.2 No.5, Sept/Oct 2004
- <sup>15</sup> Ingram RA. Prescription Medicines: The Costs, the Benefits, and the Promise. *NC Med J* Nov/Dec 2003, Vol 64, No.6
- <sup>16</sup> Prescription Drug Expenditures in the United States. May 2000 NIHCM. [Www.benzo.org.uk/jegwamh.htm](http://www.benzo.org.uk/jegwamh.htm) accessed 5/3/05
- <sup>17</sup> Friedland RB Summer L. Demography is Not Destiny, Revisited. Center on an Aging Society, Georgetown University March 2005
- <sup>18</sup> Caverly WM. In-home technology aids elderly compliance. *Pharmacy Post*, September, 2007
- <sup>19</sup> ASCP's Prescription for Quality Care: Preventing Medication-Related Problems Among America's Seniors. Available at <http://archive.ascp.com/public/ga/quality/>, accessed 9/6/07.
- <sup>20</sup> Anon. Nursing & Allied Healthcare Annual Compensation and Benefits Report. May 2002. Martin Fletcher
- <sup>21</sup> Semple L. Medication Delivery for Assisted Living. Accessed 11/17/04 <http://www.ascp.com/public/pubs/tcp/1997/dec/medication.html>
- <sup>22</sup> *ibid*
- <sup>23</sup> Shirley KL. Effect of an automated dispensing system on medication administration time. *AM J Health Syst Pharm*. 1999; 56:1542-5
- <sup>24</sup> Semple L. Medication Delivery for Assisted Living. Accessed 11/17/04 <http://www.ascp.com/public/pubs/tcp/1997/dec/medication.html>
- <sup>25</sup> Lockwood W. Opportunity in Medication Compliance. *Computer Talk*, Sept/Oct 2002
- <sup>26</sup> Semple L. Medication Delivery for Assisted Living. Accessed 11/17/04 <http://www.ascp.com/public/pubs/tcp/1997/dec/medication.html>
- <sup>27</sup> Caverly WM. Technology Solutions to Promote Safe Medication Practices. Chapter 7 in Rantucci M, Stewart I, Stewart C. *Enhancing Patient Safety: Preventing and Managing Medication Incidents in Pharmacy*. Lippincott, Williams & Wilkins, Baltimore, MD. 2008 (In Press)
- <sup>28</sup> Semple L. Medication Delivery for Assisted Living. Accessed 11/17/04 <http://www.ascp.com/public/pubs/tcp/1997/dec/medication.html>
- <sup>29</sup> *ibid*
- <sup>30</sup> *ibid*
- <sup>31</sup> *ibid*

- <sup>32</sup> Sipkoff M. Automated dispensing system offers savings, greater safety. *Drug Topics* Oct 25 2004;35
- <sup>33</sup> Armitage G Knapman H. Adverse events in drug administration: a literature review. *J Nurs Manag* 2003;11:130-40. Quoted in Dennison RD. Creating an Organizational Culture for Medication Safety. *Nurs Clin N AM* 40 (2005) 1-23
- <sup>34</sup> Leape LL. System analysis of adverse drug events. *JAMA* 1995;274(1):25-43. Quoted in Dennison RD. Creating an Organizational Culture for Medication Safety. *Nurs Clin N AM* 40 (2005) 1-23.
- <sup>35</sup> Marietti C. Robots Hooked on Drugs: Robotic automation expands pharmacy services. *Healthcare Informatics Tech update*. Accessed 11/17/04 [http://www.healthcare-informatics.com/issues/1997/11\\_97/robots.htm](http://www.healthcare-informatics.com/issues/1997/11_97/robots.htm)
- <sup>36</sup> Lapane KL Hiris J Hughes CM Feinberg J. Development and implementation of pharmaceutical care planning software for nursing homes based on the Fleetwood Model. *American Journal of Health-System Pharmacy*, Vol. 63, Issue 24, 2483-2487
- <sup>37</sup> Anon. Nursing homes: Fear and violence. *CBC news online*. Available at <http://www.cbc.ca/news/background/nursing-homes/#>. Accessed 11/5/2007
- <sup>38</sup> Martin Fletcher Annual Industry Trends and Benefits Report, 2007. Available at [http://www.martinfletcher.com/pdf/MF\\_CompSurvey\\_Nurse\\_07.pdf](http://www.martinfletcher.com/pdf/MF_CompSurvey_Nurse_07.pdf). Accessed 9/7/07
- <sup>39</sup> Lapane KL Hiris J Hughes CM Feinberg J. Development and implementation of pharmaceutical care planning software for nursing homes based on the Fleetwood Model. *American Journal of Health-System Pharmacy*, Vol. 63, Issue 24, 2483-2487
- <sup>40</sup> Triller DM Clause SL Domarew C. Analysis of Medication Management Activities for Home-Dwelling Patients. *Am J Health-Syst Pharm* 59(23):2356-2359, 2002
- <sup>41</sup> *ibid*
- <sup>42</sup> Private correspondence between author and Denis Nadeau & Denis Bois of MEDS Inc., circa 2003-2004
- <sup>43</sup> Anon. Automated Pharmacy Systems In Long-Term Care Facilities. January 1, 2003.
- <sup>44</sup> Heneghan CJ Glasziou P Perera R. Reminder packaging for improving adherence to self-administered long-term medications. *Cochrane Database of Systematic Reviews* 2006, Issue 1. Art No.: CD005025. DOI:10.1002/14651858.CD005025.pub2.
- <sup>45</sup> ASCP's Prescription for Quality Care: Preventing Medication-Related Problems Among America's Seniors. Available at <http://archive.ascp.com/public/ga/quality/>, accessed 9/6/07.
- <sup>46</sup> Kohn LT Corrigan JM Donaldson MS, editors. *To err is human: building a safer health system*. Washington, D.C.: National Academy Press; 1999. Quoted in Dennison RD. Creating an Organizational Culture for Medication Safety. *Nurs Clin N AM* 40 (2005) 1-23
- <sup>47</sup> Cohen M. Medication Errors. chapter 1
- <sup>48</sup> Shultz S While SJ Latiolais CJ. Medication errors reduced by unit dose. *Hospitals - JAHA*. 1973;47(6):106-112.
- <sup>49</sup> Anacieto TA Perini E Rosa MB Cesar CC. Medication errors and drug-dispensing systems in a hospital pharmacy. *Clinics* Vol 60 No. 4 Sao Paulo Aug 2005.
- <sup>50</sup> Felkey BG Flynn EA et al. Automation and Information Technology. *Glaxo Wellcome CE*;5
- <sup>51</sup> Private correspondence with Catalyst Healthcare. Unpublished data. Based on 7-months pre, and 5-months post data.
- <sup>52</sup> Larrabee JH Ruckstuhl M Salmons J, et al. Interdisciplinary monitoring of medication errors in a nursing quality assurance program. *Nursing Quality Assurance* 1991;73(4):50-4. Quoted in Dennison RD. Creating an Organizational Culture for Medication Safety. *Nurs Clin N AM* 40 (2005) 1-23
- <sup>53</sup> Flynn EA Barker KN Pepper GA et al. Comparison of methods for detecting medication errors in 36 hospitals and skilled-nursing facilities. *Am J Health-Syst Pharm* Vol 59 Mar 1, 2002
- <sup>54</sup> Cardinale V. Long-term care crying for more med-error reports. *Drug Topics* November 20, 2000; 63
- <sup>55</sup> Flynn EA Barker KN Pepper GA et al. Comparison of methods for detecting medication errors in 36 hospitals and skilled-nursing facilities. *Am J Health-Syst Pharm* Vol 59 Mar 1, 2002
- <sup>56</sup> Cardinale V. Long-term care crying for more med-error reports. *Drug Topics* November 20, 2000; 63
- <sup>57</sup> Dennison RD. Creating an Organizational Culture for Medication Safety. *Nurs Clin N AM* 40 (2005) 1-23
- <sup>58</sup> Healthcare Information Management System Society. Patient Safety Survey HIMSS. Quoted in Dennison RD. Creating an Organizational Culture for Medication Safety. *Nurs Clin N AM* 40 (2005) 1-23
- <sup>59</sup> Needleman J Buerhaus PI Stewart M et al. Nurse staffing in hospitals: Is there a business case for quality? *Health Affairs* Jan/Feb 2006 25 (1): 204-11

- <sup>60</sup> Rogers AE Hwang W-T Scott LD et al. The working hours of hospital staff nurses and patient safety. *Health Affairs* (2004; 23: 202-212) Abstract available at [content.healthaffairs.org/cgi/content/abstract/23/4/202](http://content.healthaffairs.org/cgi/content/abstract/23/4/202) accessed 10/22/2004,
- <sup>61</sup> Long G Johnson C. A pilot study for reducing medication errors. *QRB Qual Rev bull* 1981;7(4):6-9. Quoted in Dennison RD. *Creating an Organizational Culture for Medication Safety*. *Nurs Clin N AM* 40 (2005) 1-23
- <sup>62</sup> Campbell, DE., Lipowski, EE., Brushwood, DB., & Wilson, DL. (2001). Dispensing Efficiency Using Unit-of-Use Packaging. Poster Presentation at the American Pharmaceuticals Annual Meeting, March 17-19, 2001. Errors were: 70 vs. 75 Naproxen 500mg (undercount); 40 vs 45 Yohimbine 5.4mg (undercount); 100 vs 90 Neurontin 100mg (overcount); 46 vs 45 Buspar 15mg (overcount).
- <sup>63</sup> Cohen M. Medication Errors. chapter 9
- <sup>64</sup> *ibid.* chapter 6
- <sup>65</sup> Ukens C. Colorado jury sends message in hitting chain for med error. *Drug Topics* May 1 2000;40 The Adams County jury awarded the victim (of a medication error) \$500,000 for non-economic damages and another \$500,000 in punitive damages ... attorney for the plaintiff said his surprise came from the large size of the award for a medication error that did not result in permanent physical harm to the victim and did not cause economic harm..
- <sup>66</sup> Coleman IC. Medication Errors: Picking up the pieces. *Drug Topics* March 15 1999;83-92
- <sup>67</sup> Cohen M. Medication Errors. chapter 1
- <sup>68</sup> *ibid.* chapter 6
- <sup>69</sup> Coleman IC. Medication Errors: Picking up the pieces. *Drug Topics* March 15 1999;83-92
- <sup>70</sup> Kistner UA, Keith MR, Sergeant KA, Hokanson JA. Accuracy of dispensing in a high-volume, hospital-based outpatient pharmacy. *Am J Hosp Pharm*. Vol 51 Nov 14 1994: 2793-97
- <sup>71</sup> Bates DW, Spell N, Cullen DJ et al. The costs of adverse drug events in hospitalized patients. *JAMA*. 1997; 277:307-11.
- <sup>72</sup> Coleman IC. Medication Errors: Picking up the pieces. *Drug Topics* March 15 1999;83-92
- <sup>73</sup> Felkey BG Flynn EA et al. Automation and Information Technology. Glaxo Wellcome CE;5
- <sup>74</sup> ASCP's Prescription for Quality Care: Preventing Medication-Related Problems Among America's Seniors. Available at <http://archive.ascp.com/public/ga/quality/>, accessed 9/6/07.
- <sup>75</sup> Bero LA, Lipton HI, Bird JA. Characterization of geriatric drug-related hospital readmissions. *Med Care*. 1991; 29:989-1003
- <sup>76</sup> Strategies for error-proofing, drug labeling, packaging and nomenclature. Accessed 10/15/98 at <http://www.rpsgb.org.uk/260-hp9805.htm>.
- <sup>77</sup> Cohen M. Medication Errors. chapter 6
- <sup>78</sup> ASCP's Prescription for Quality Care: Preventing Medication-Related Problems Among America's Seniors. Available at <http://archive.ascp.com/public/ga/quality/>, accessed 9/6/07.
- <sup>79</sup> Ukens C. Community pharmacy weighs unit-of-use packaging. *Drug Topics* May 1 2000;36
- <sup>80</sup> Col N, Fanale JE, Kronholm P. The role of medication non-compliance and adverse drug reactions in hospitalizations of the elderly. *Arch Intern Med*. 1990; 150:841-5
- <sup>81</sup> Gans JA. Improving Medication Adherence: Pharmacists Should Take the Lead. *JAPhA*. Vol 43, No. 6 Nov/Dec 2003:665
- <sup>82</sup> Mutnick AH, Sterba KJ, Peroutka NE et al. Cost Savings and Avoidance from clinical interventions. *Am J Health-Syst Pharm* Vol 54 Feb 15 1997: 392-6
- <sup>83</sup> Schumock GT, Michaud J, Guenette AJ. Re-engineering: An opportunity to advance clinical practice in a community hospital. *Am J Health-Syst Pharm*. Vol 56 Oct 1 1999: 1945-9
- <sup>84</sup> Blendon RJ DesRoches CM Brodie M, et al. Views of practicing physicians and the public on medical errors. *N Engl J Med* 2002;347(24):1933-40. Quoted in Dennison RD. *Creating an Organizational Culture for Medication Safety*. *Nurs Clin N AM* 40 (2005) 1-23
- <sup>85</sup> Anon. *Nursing & Allied Healthcare Annual Compensation and Benefits Report*. May 2002. Martin Fletcher
- <sup>86</sup> Martin Fletcher Annual Industry Trends and Benefits Report, 2007. Available at [http://www.martinfletcher.com/pdf/MF\\_CompSurvey\\_Nurse\\_07.pdf](http://www.martinfletcher.com/pdf/MF_CompSurvey_Nurse_07.pdf). Accessed 9/7/07
- <sup>87</sup> Hostetter M. Issue of the Month: Changing the Culture of Nursing Homes. Commonwealth Fund. Available at [www.cmwf.org/publications\\_show.htm?doc\\_id=441561](http://www.cmwf.org/publications_show.htm?doc_id=441561). Accessed 1/18/07

<sup>88</sup> Martin Fletcher Annual Industry Trends and Benefits Report, 2007. Available at [http://www.martinfletcher.com/pdf/MF\\_CompSurvey\\_Nurse\\_07.pdf](http://www.martinfletcher.com/pdf/MF_CompSurvey_Nurse_07.pdf). Accessed 9/7/07

<sup>89</sup> *ibid*

<sup>90</sup> Cardinale V. Exclusive survey Pharmacy: 2032. Drug Topics March 19, 2007; 50-54