Table 1: Studies showing the extent of failure to follow-up test results for inpatients and emergency department patients

| **Reference, country, setting** | | **Design & sample** | **Test type and indication of test result follow-up** | **System used to follow-up results** | **Extent of failure to follow-up** | **Patient outcomes** |
| --- | --- | --- | --- | --- | --- | --- |
| Abujudeh et al.  2009  USA  General hospital | | Retrospective observational study  **Sample:** All Important Finding Alert (IFA) radiology reports generated from January 2005 to December 2007. | **Test type:** Important but not urgent radiology reports (for example possible cancer).  **Indicator:** Number of emails indicating ‘important imaging finding alert’ viewed by the referring physician.  % reported per test | An important finding alert (IFA) system that uses email technology to alert the referring physician to important but non-urgent imaging findings. The automated tracked email is sent to the referring physician on report finalisation by the attending radiologist. When the physician opens the IFA email message they can ‘click here to view report’ to read the full electronic report. This system had been operational since January 2005. | 10,598/52,883 or 20.04% reports not viewed | Not examined |
| Block et al.  1996  Israel  250 bed university affiliated general hospital | | Prospective observational study – medical record review  **Sample:** Specimens of urine for culture collected consecutively from 180 patients seen at the Emergency Department. | **Test type**: Urine cultures.  **Indicator**: Noting of urine culture results either by telephone enquiry or by note in patients’ charts.  % reported per test | Electronic and ad-hoc paper and telephone reporting system.  Results available on-line through a central computer. Some printing of results at ward and clinic level but this was not automatic, not consistent and not universally practised. | Overall 66.7% (120/180) not followed up  **Cultures:**   * 52.4% (22/42) of positive cultures not followed up * 71.0% (98/138) of negative cultures not followed up   **Patients:**   * 27.0% (10/37) of hospitalised ED patients not followed up * 76.9% (110/143) of discharged ED patients not followed up | 3 of the 14 (21.4%) positive culture patients who were discharged home received inappropriate therapy (the organism isolated was resistant to the drug prescribed).  23/116 (19.8%) negative culture patients who were discharged home received antimicrobial treatment. |
| Callen et al.  2009  Australia  Emergency Department of a 370 bed metropolitan teaching hospital | | Prospective medical record review and data abstraction from CPOE system  **Sample:** ED of a 370 bed metropolitan teaching hospital (30,000 attendances pa). All radiology and microbiology tests ordered for a one week period in August 2007. 263 tests ordered for the study period (for 194 patients): 197 radiology; 66 microbiology. | **Test types**: Radiology and microbiology tests.  **Indicator**: Physicians’ documentation on the printed paper copy of the test result or in the medical record.  % reported per test | The Computerised Physician Order Entry (CPOE) system was used in the ED to order all diagnostic tests and view all test results for every patient. A duplicate manual follow-up system for radiology and microbiology results was used as a safety check for discharged ED patients. Therefore, for radiology and microbiology test results the CPOE system checks whether the patient was discharged from the ED or admitted to a ward. The CPOE system then sends only discharged ED patients’ radiology and microbiology reports to a dedicated ED printer. | Two radiology (1.0% 2/197) and two microbiology reports (3.0% 2/66) all of which had negative findings. | No impact on patient outcomes or management. |
| Choksi et al.  2006  USA  University affiliated hospital. | | Retrospective electronic medical record audit  **Sample:** 395 possible malignant cases between April 2003 and March 2004 | **Test type:** Suspected malignancy in radiology examinations (including conventional radiology, sonography, CT, MRI, barium exams, excretory urography, myelography, angiography and excluding mammography).  **Indicator:** Documentation of follow-up in electronic medical record.  % reported per patient (each patient had only one test) | A semi-automated process involving electronic, paper and telephone reporting was employed for the coding and review of potentially malignant findings.  If a malignancy was found the radiologist contacted the referring clinician or appropriate member of the clinical team by telephone or rarely by secure email. The radiologist documented the contact in the report. Radiologist also assigned a code 8 to the report to signify possible malignancy and documented this in the electronic record. On a weekly basis the cancer registrar (a nurse practitioner) retrieved a list of all suspected malignancy patients from the database of all oncology patients at the hospital. The registrar monitored the electronic clinical record for documentation of appropriate follow-up. | Provider unaware of imaging findings in 8/395  (2.0%) code 8 cases (IPs, OPs and ED patients).  **Patient types where provider unaware of imaging finding:** ER/Urgent care 0 (0%); Primary medicine clinic 4/395 (1.0%) IP (Med/surg) 4/395 (1.0%).  The type of imaging test did not predict appropriate follow-up (p=0.18). | 5 of the 8 patients (IP or OP) where the provider was unaware of the findings had a final diagnosis of cancer. |
| Cram et al.  2005  USA  Integrated service consisting of a 700 bed tertiary care hospital and more than 30 specialty and subspecialty clinics and numerous primary care clinics | | Retrospective medical record review  **Sample**: All patients who underwent DXA scanning between January and May 2001 (n=428). | **Test type:** DXA (dual energy x-ray absorptiometry) scans.  **Indicator:** Recommended treatment or documented evidence in record that result was reviewed by any provider.  % reported per patient (each patient only had 1 scan) | Well developed Electronic Medical Record in use since 1997, however DXA scan results not automatically posted to the EMR. A paper report of the DXA scan result was sent to the referring provider. | 11/48 patients (22.9%) – results not reviewed. | Failure to act on abnormal scans means the patient loses the opportunity to initiate therapy and reduce the risk of subsequent fractures. |
| Greenes et al.  2000  USA  Emergency Department of a 300 bed tertiary care paediatric hospital | | Retrospective medical record review  **Sample:** Specified late arriving tests performed between May 1996 and April 1998 | **Test type:** Late arriving serum lead levels, Chlamydia cultures and urine pregnancy tests.  **Indicator:** Documented acknowledgement of results in patient medical record, and documented patient follow-up.  % reported per test | Paper based reporting system, including telephone.  The ED used several mechanisms to ensure follow-up of late arriving laboratory results. Late arriving results considered critical by the laboratory were reported to the ED by telephone. In addition a report of all bacteriologic culture results (excluding Chlamydia) for ED patients was printed daily and reviewed by one of the ED physicians. For other late arriving laboratory results physicians in the ED attempted to identify a clinician who would follow-up on the results at the time that the tests were ordered. | Lead levels: 6/18 (33.3%)  Pregnancy tests: 3/4 (75%)  Chlamydia tests: 23/39 (59.0%).  Of these 23 cases of positive Chlamydia, 7 had appropriate therapy initiated empirically at the initial ED visit. | No complications of missed lead levels or missed pregnancy resultsnoted in the record.  Chlamydia tests. One (1) case of +ve Chlamydia for which there was no documented follow-up was associated with subsequent development of pelvic inflammatory disease. |
| Kachalia et al.  2007  USA  Emergency Department patients | | Retrospective review of litigation files and medical records  **Sample:** 122 completed claims sustained between 1979 and 2001 from 4 liability insurers | **Test type:** Not stated.  **Indicator:** Documented evidence of abnormal test results transmitted to and/or received by provider.  % reported per patient | Not stated in paper. | 13/79 claims (16.5%) where the breakdown occurred at the step of ‘test results transmitted to and received by the provider’. | Adverse outcomes reported for all 79 diagnostic errors (not just those due to test result follow-up problems): psychiatric/emotional (1/79, 1.3%); minor physical (9/79, 11.4%); significant physical (26/79, 32.9%); major physical (12/79, 15.2%); death (31/79, 39.2%). |
| Kilpatrick & Holding  2001  UK  Teaching hospital | Retrospective medical record review  **Sample:** Between August 1999 and January 2000, 1,836 urgent requests for biochemistry results from the acute medical admission ward and 3228 urgent requests for biochemistry results from the emergency department | **Test type:** Urgent biochemistry tests.  **Indicator:** Physician access to urgent biochemistry results online.  For abnormal results of hyper and hypokalaemia the A&E notes and full case notes were accessed to see if the result was documented.  % reported per test | Electronic and paper back-up system.  Results available via computer terminal access. The paper report was printed and delivered to the ward the following day. | **Accident and emergency:** 1443/3228 (44.7%)  **Acute medical** **admissions ward:** 529/1836 (28.8%) | Of the 1443 A&E results never viewed on the terminal, 43 (3.0%) could have led to an immediate change in patient management. |
| Platzer et al.  2006  Austria  Level 1 Trauma Unit of a general hospital | Retrospective medical record review  **Sample:** 367 patients with cervical spine injuries who were admitted between January 1980 and December 2000. | **Test type**: Radiology for cervical spine injury.  **Indicator:** Missed or failed diagnosis of cervical spine injury as a result of the treating surgeon having failed to witness the radiographic report.  % reported per patient | Not stated in paper. | 1/18 patients (5.6%) | In the 1 case where there was a delayed diagnosis the patient returned later with increasing neck pain and the correct diagnosis was made by another surgeon who checked the initial radiographs. |
| Roy et al.  2005  USA  Two general medicine hospitalist services in two academic tertiary care centres | Prospective cross-sectional study  **Sample:** Potentially actionable laboratory and radiology results pending at discharge for 2644 patients seen between February and June 2004. | **Test types:** Laboratory and radiology test results returning after patient discharge.  **Indicator:** Inpatient providers’ unawareness (self-reported on survey) of outstanding results on discharge.  % reported per test | Fully integrated electronic reporting system between all sites.  The 2 study hospitals shared the same common electronic clinical data repository that included test results, discharge orders, summaries, ambulatory notes and medication and problem lists. These data were accessible at all inpatient and outpatient sites through the same electronic medical record. In addition all physicians used the same email system. At hospital A, the hospitalist attending physician was usually responsible for all communication to outpatient physicians at discharge, as well as for follow-up of all pending test results that return after discharge. At hospital B, both hospitalists, non-hospitalist attending physicians and junior residents were responsible for follow-up of all results. | Physicians were unaware of 65/105 tests (61.9%).  Of these 65, 24 were actionable and8required urgent action. | Of the 8 results (12.6%, CI, 6.4% 23.3%) which required urgent action 6 were microbiological test results (blood, urine and wound cultures) which necessitated the starting or changing of antibiotic therapy and 1 showed increased TSH level consistent with a new diagnosis of hyperthyroidism.  Actionable but non urgent results included 3 incidental findings of a pulmonary nodule(s) or opacites on chest X-ray or computed tomography and 5 positive serologic test results for Helicobacter pylori |
| Schiff et al.  2005  USA  Hospital | Retrospective linkage and analysis of hospital laboratory and pharmacy databases.  Follow-up of patients with telephone call and record review.  **Sample:** 470 inpatients and outpatients from one hospital in 2000 and 512 inpatients and outpatients in 2001 with elevated TSH levels. All patients with levothyroxine prescriptions from the pharmacy computer system for the same periods (390 patients in 2000 and 415 patients in 2001). | **Test type:** Elevated TSH (thyroid stimulating hormone) levels not receiving therapy.  **Indicator:** Documentation of therapy for treatment of abnormal TSH (no pharmacy script) and patient knowledge of diagnosis of hypothyroidism.  % reported per patient | Not stated in paper. | A total of 23 patients out of 982 (2.3%) with elevated TSH levels for the 2 year period were unaware of their abnormal test results or their diagnosis of hypothyroidism.  Twelve out of 390 patients in 2000 with an elevated TSH level had a missed diagnosis of hypothyroidism (2.6%) and 11 patients out of 415 (2.1%) in 2001. | 23/982 patients (2.3%) had a missed diagnosis of hypothyroidism. |
| Tate & Gardner  1994  USA  520 bed tertiary care hospital | Retrospective medical record review  **Sample:** 124 medical records containing critical test values during January to February 1993. | **Test types:** Critical clinical laboratory results including: bilirubin, potassium, C02, magnesium, sodium, phosphate, H’crit, Hb, platelets, P. time, wbc, PTT.  **Indicator:** Documented evidence of provider awareness of critical results or corrective actions taken.  % reported per patient | Electronic and telephone notification system.  All laboratory test results are entered into a laboratory computer, verified and transmitted to a HELP system. The results are then available for review on any terminal within the hospital. Critical values are highlighted to indicate high or low. There is an established practice for critical value reporting whereby laboratory  Staff, having identified a critical laboratory test result, telephone the appropriate nursing unit and report the critical value to the nurse caring for the ‘critical’ patient. The time of the telephone call and identity of the person receiving the call are then recorded in the laboratory computer. It is the responsibility of the person receiving the critical value telephone call to ensure that appropriate action is taken. | 19/124 (15.3%) audited charts. | Not examined |