Merger of two dispatch centres: does it improve quality and patient safety?

Alexandre Moser1, Annette Mettler1, Vincent Fuchs2, Walter Hanhart1, Claude-François Robert3, Vincent Della Santa1 and Fabrice Dami2,4

Abstract

Background: Dispatch centres (DCs) are considered an essential but expensive component of many highly developed healthcare systems. The number of DCs in a country, region, or state is usually based on local history and often related to highly decentralised healthcare systems. Today, current technology (Global Positioning System or Internet access) abolishes the need for closeness between DCs and the population. Switzerland went from 22 DCs in 2006 to 17 today. This study describes from a quality and patient safety point of view the merger of two DCs.

Methods: The study analysed the performance (over and under-triage) of two medical DCs for 12 months prior to merging and for 12 months again after the merger in 2015. Performance was measured comparing the priority level chosen by dispatcher and the severity of cases assessed by paramedics on site using the National Advisory Committee for Aeronautics (NACA) score. We ruled that NACA score > 3 (injuries/diseases which can possibly lead to deterioration of vital signs) to 7 (lethal injuries/diseases) should require a priority dispatch with lights and siren (L&S). While NACA score < 4 should require a priority dispatch without L&S. Over-triage was defined as the proportion of L&S dispatches with a NACA score < 4, and under-triage as the proportion of dispatches without L&S with a NACA > 3.

Results: Prior to merging, Dispatch A had a sensitivity/specificity regarding the use of lights and sirens and severity of cases of 86%/48% with over- and under-triage rates of 78% and 5%, respectively. Dispatch B had sensitivity and specificity of 92%/20% and over- and under-triage rates of 84% and 7%, respectively. After they merged, global sensitivity/specificity reached 87%/67%, and over- and under-triage rates were 71% and 3%, respectively.

Conclusions: A part the potential cost advantage achieved by the merger of two DCs, it can improve the quality of services to the population, reducing over- and under-triage and the use of lights and sirens and therefore, the risk of accidents. This is especially the case when a DC with poor triage performance merges with a high-performing DC.

Keywords: Criteria-based dispatch centre (CBD), Over- and under-triage, Prehospital triage, Patient safety, Merger
Despite reluctance to merge DCs for non-rational or political reasons, Switzerland went from 22 DCs in 2006 to 17 in 2015 to serve a total population of 8 million inhabitants [1]. The last merger took place in January 2015 when the DC of state 'A' (catchment population of 768,000) took over the DC of state 'B' (catchment population of 178,000), resulting in a total catchment population of 946,000 inhabitants. From 2006 to 2015 the average Swiss catchment population size per dispatch evolved from 340,000 to 470,000 [1].

Priority dispatch accuracy is of prime concern in research on prehospital care and consists of optimising the match between patients’ needs and prehospital resources [12, 13], despite a missing consensus on the accepted percentage of over- and under-triage for dispatch activity. Our hypothesis is that the merger of these two DCs can have a positive impact on quality and patient safety, the most efficient dispatch offering a better service to the population of over- and under-triage before and after the merger for each state separately and for the whole catchment population (A + B) after merging.

Method
Setting
The Swiss healthcare system is highly decentralised, as each of the 26 states is sovereign regarding its healthcare system, including its prehospital systems (emergency medical services [EMS] and DCs).

This study was conducted throughout the states of Vaud (Dispatch A) and Neuchâtel (Dispatch B), both located in the French-speaking part of Switzerland. Dispatch A is a medical dispatch only, staffed by registered nurses and certified paramedics with at least five years of field experiences. It is a CBD system based on callers’ descriptions of symptoms [13]. Dispatchers rely on their own experience to conduct the interview. Each call is processed by the same dispatcher from the beginning (interview) to the end (dispatch) [13], and when appropriate, dispatchers deliver telephone-guided life-saving manoeuvres to bystanders [14]. Dispatch B takes care of medical, fire, and police calls and is staffed by employees without any medical background. Their task regarding medical calls consists in localising the event and then transmitting the information to one of the EMS agencies according to pre-established sectors without giving any pre-arrival instructions to the witness. As dispatcher are not trained to perform medical priority triage, to reduce risks, most interventions would run with lights and sirens (L&S). In order to simplify its system, State B proposed to merge its dispatch with State A’s, which was accepted.

In Switzerland, priority 1 (P1, immediate departure with L&S) is used in case of assumed vital risk for the patient. Priority 2 (P2, immediate departure without L&S) is used for emergencies without vital risk for the patient, and priority 3 (P3) is a delayed departure for patients requiring a transport [11, 13]. The prehospital network in both states consists of a three-tier system. Prehospital emergency physicians may be dispatched by the DC or later at the request from paramedics, either by ground or by helicopter [13].

Study design
We retrospectively analysed the triage performance of the two DCs for 12 months prior to merging and then for 12 months after the merger. Secondary missions (inter-hospital transfers), missions aborted, and those with missing data (NACA score or priority of dispatch) were excluded.

The data collected from each mission were the priority decided by the dispatcher and the NACA score (National Advisory Committee for Aeronautics) (Fig 1.) [15] assessed by the prehospital crews and transmitted to the DCs at the end of the mission. The NACA scale is an eight-level scale to assess the prehospital severity status of the patient; the score is defined by the most serious clinical state experienced at any time during the mission [13] and is used in many Austrian and German EMS. In Switzerland, its use is mandatory for all prehospital missions [15]. The NACA score is significantly correlated with survival [16].

Over-triage consists of an immediate response with L&S for a non-vital condition and implies the consumption of limited resources [13], and it could also represent a danger for EMS workers and the general population.

| NACA 0: No injury or disease |
|-------------------------------|
| NACA 1: Injuries/diseases without any need for acute physician care |
| NACA 2: Injuries/diseases requiring examination and therapy by a physician but hospital admission is not indicated. Including: large contusions, finger and toe fracture, 2nd degree burn (10–20% of body surface), exhaustion without hypothermia |
| NACA 3: Injuries/diseases without acute threat to life but requiring hospital admission. Including: maxillofacial trauma, wound with a vascular/neurological impact, 3rd degree burn (10–20%), hypoglycaemia without coma, TIA, supraventricular arrhythmia with conserved haemodynamic, right iliac fossa pain syndrome, hypothermia stage I, 2nd degree burn (20–30%), isolated limb fracture (femur excluded) |
| NACA 4: Injuries/diseases that can possibly lead to deterioration of vital signs. Including: open skull fracture, hypothermia stage II, suspicion SCA, suspicion ectopic pregnancy/placenta praevia |
| NACA 5: Injuries/diseases with acute threat to life. Including: head trauma GCS<8, heart infarct, bradycardia (30/min), tachycardia (>180/min), complete heart bloc, eclampsia, hypothermia stage III, haemodynamic shock, multiple limb fractures, acute dyspnoea, pulmonary oedema |
| NACA 6: Injuries/diseases transported after successful resuscitation. Including: chest trauma with severe dyspnoea, aortic rupture, total airway obstruction, central apnoea, emergency external pacing, cardiac arrest (ventricular fibrillation or asystole from any cause) |
| NACA 7: Lethal injuries or disease (with or without resuscitation attempts) |

Fig. 1 National Advisory Committee for Aeronautics (NACA) score revised by the State of Vaud (13)
while running with L&S [17], with little or no benefit to the patient [18, 19]. Under-triage is defined as an inappropriate low response without priority signs in the presence of an acute case and may be harmful for the patient [13].

According to the NACA scale (Fig. 1), a score of 4 or greater may lead to a potentially vital threat. Therefore, we assumed that those interventions are P1. All interventions with an NACA score of 1 to 3 are P2 or P3. Accordingly, P1 missions with NACA scores < 4 were classified as over-triage, and P2 and P3 missions with NACA scores >3 were classified as under-triage.

Statistics
Simple descriptive statistics were used. Sensitivity, specificity, positive and negative predictive value (PPV & NPV), averages, percentages, and standard deviation (SD) with a 95% Confidence Interval (CI) were calculated using Microsoft Office Excel®.

Definitions
Over-triage = P1 dispatch with NACA < 4 (false positives)/ all P1 dispatch (false positives + true positives).
Under-triage = P2 or 3 dispatch with NACA > 3 (false negatives)/all P2 or P3 dispatch (false negatives + true negatives).

Sensitivity was calculated as true positives/true positives + false negatives; specificity as true negatives/false positives + true negatives.
Positive predictive value (PPV) was calculated as true positives/true positives + false positives; negative predictive value (NPV) as true negatives/true negatives + false negatives.

Results
Before merging, DC A totalled 27,886 primary missions (Table 1): 15,749 P1 (56.5%), 8,484 P2 (30.4%), and 3,635 P3 (13.1%). The most frequent score attributed at the end of the missions was NACA 3 (54.5%) (Table 1). The most frequent score attributed was 3 (51.6%) (Table 1). Global sensitivity/specificity reached 86.8%/67.4%, over-triage 70.8%, and under-triage 3.0% (Table 2).

Most over-triage before and after merging concern NACA 3 missions regardless of DC (Table 3). Most under-triage before and after merging concern NACA 4 missions regardless of population (Table 4). After merging, there were 5598 missions (12.2% of all primary dispatches) with missing data.

Discussion
Following the merger, the performance of DC A showed a decrease in under-triage (3.0% vs 4.6%) without any increase in over-triage (70.8% vs 78%), a better sensitivity (86.8% vs 86.0%), and specificity (67.4% vs 48.0%) as a more restrictive use of L&S (39.9% vs 56.5%). DC A was already more efficient than DC B prior the merger but came even better after merging. The only explanation is the impact of the intensive continuous training taking place in this dispatch for many years regarding over and under-triage.

DC B’s performance compared with post-merger performance (A + B) showed a reduction in over-triage (70.8% vs 83.9%) and under-triage (3.0% vs 6.5) and improved specificity (67.4% vs 20.3%). As a result of the over-triage reduction, sensitivity decreased from 91.6% to 86.8%. The use of L&S strongly decreased from 81.4% of all missions to 39.9%.

Under-triage in dispatch may have a negative impact on patients’ safety [13]. Therefore, we can consider the reduced under-triage rate after the merger as an indicator of improved quality of services for the whole population. Over-triage is not harmful for the patients who benefit from it. It may however lead to an excessive use of L&S ambulances running hot for no or only little benefit for the patient [18, 19] and potentially fatal complications for the general population and EMS personnel [17, 20]. Over-triage may also lead to a scarcity of ambulances and endanger patients, as P1 dispatch will not be diverted to another suspected severe patient while P2 and P3 are very often in our system. We can therefore consider the reduction of the over-triage rate post-merger as an indicator not only of improved quality but also safety.

After the merger, the most frequent over-triage cases remained NACA 3 missions and under-triage cases NACA 4 missions. An explanation could be the subjectivity of the NACA score established by paramedics, and secondly, the difficulty for dispatchers, as they triage without visual cues, to differentiate future NACA 3 or 4 missions with their engagement criteria (P1, P2).

There is a lack of consensus on under- and over-triage rates in dispatch science, despite expert recommendations [21]. We should not forget that over-triage may reduce EMS capacities to respond to other patients, while eradication of under-triage is impossible without an increase of over-triage and reduced specificity.
| NACA | DC A (%) | DC B (%) | A + B (%) | DC A (%) | DC B (%) | A + B (%) | DC A (%) | DC B (%) | A + B (%) | DC A (%) | DC B (%) | A + B (%) |
|------|---------|---------|----------|---------|---------|----------|---------|---------|----------|---------|---------|----------|
| 0    | 322 (1.2) | 334 (4.3) | 617 (1.6) | 245 (73.4) | 128 (36.8) | 590 (60.0) | 20 (6.0) | 20 (6.0) | 41 (6.6) |
| 1    | 1,247 (4.5) | 462 (5.9) | 2,285 (5.9) | 393 (85.1) | 371 (29.8) | 1,326 (58.0) | 46 (3.7) | 15 (3.2) | 190 (8.3) |
| 2    | 7,122 (25.6) | 2,209 (28.4) | 10,339 (27.5) | 1,899 (86.0) | 2,228 (31.3) | 5,808 (54.6) | 609 (8.5) | 49 (2.2) | 1,441 (13.5) |
| 3    | 15,208 (54.5) | 3,668 (47.1) | 19,995 (51.6) | 7,034 (46.2) | 5,290 (34.8) | 9,483 (47.4) | 183 (5.0) | 3,929 (19.6) |
| 4    | 2,480 (8.9) | 803 (10.3) | 3,490 (9.0) | 2,034 (82.0) | 2,888 (82.8) | 517 (14.8) | 8 (1.0) | 85 (2.4) |
| 5    | 867 (3.1) | 155 (2.0) | 1,022 (2.6) | 767 (88.5) | 595 (93.9) | 955 (93.9) | 55 (4.4) | 2 (1.3) | 7 (0.7) |
| 6    | 203 (0.7) | 29 (0.4) | 232 (0.5) | 196 (96.5) | 28 (96.6) | 175 (98.3) | 2 (1.1) | 2 (1.0) | 0 (0.0) |
| 7    | 427 (1.5) | 131 (1.7) | 558 (1.4) | 419 (98.1) | 129 (98.5) | 504 (95.6) | 2 (1.7) | 3 (4.4) | 1 (0.2) |
| Total | 27,886 (100) | 7,791 (100) | 38,748 (100) | 15,749 (56.5) | 15,470 (39.9) | 36,553 (45.4) | 277 (3.6) | 5,694 (14.7) |
This is due mainly to the heterogeneity of the dispatch system (CBD, MPDS, physician dispatch) and EMS system (two or three tiers), as well as to the absence of consensus on the definition of high- versus low-acuity cases [13]. The study design also plays an important role in benchmarking. Some compare dispatch priority and emergency department (ED) evaluation [22], others dispatch priority, EMS, and ED evaluations [23], and some dispatch priority and EMS evaluation [13], like in this study. As in Dami et al. [13], we decided to use the same methodology and compare only dispatch priorities and EMS field findings using the NACA score. We are deeply convinced that in a three-tier system the accuracy of priority dispatch should be evaluated by the first professional on scene for two reasons. First, it would reduce the impact of elapsed time from dispatch to clinical evaluation to its minimal, and seconds. Second, an ED evaluation does not take into consideration the availability of resources, and reducing the use of L&S and, therefore, the risk of accidents. This is especially the case when a DC with poor triage performance merges with a high-performing DC.

Conclusion
Apart from the potential cost advantages achieved by the merger of two DCs, it can improve the quality of services to the population, reducing over- and under-triage, increasing the availability of resources, and reducing the use of L&S and, therefore, the risk of accidents. This is especially the case when a DC with poor triage performance merges with a high-performing DC.

Table 2 Sensitivity, specificity, PPV, NPV, and under- and over-triage for DC A and B before and after merging (A + B)

|                | DC A (% (95% CI)) | DC B (% (95% CI)) | A + B (% (95% CI)) |
|----------------|-------------------|-------------------|--------------------|
| Sensitivity    | 86.0 (85.6–86.4)  | 91.6 (91.0–92.2)  | 86.8 (86.5–87.1)   |
| Specificity    | 48.0 (47.4–48.6)  | 20.3 (19.4–21.2)  | 67.4 (66.9–67.9)   |
| PPV            | 21.7 (21.2–22.2)  | 16.1 (15.3–16.9)  | 29.2 (28.7–29.7)   |
| NPV            | 95.4 (95.2–95.6)  | 93.5 (93.0–94.0)  | 97.0 (96.8–97.2)   |
| Over-triage    | 78.0 (77.5–78.5)  | 83.9 (83.1–84.7)  | 70.8 (70.3–71.3)   |
| Under-triage   | 4.6 (4.4–4.8)     | 6.5 (6.0–7.0)     | 3.0 (2.8–3.2)      |

Over-triage = P1 dispatch with NACA <4 (false positives)/all P1 dispatch (false positives + true positives) Under-triage = P2 or 3 dispatch with NACA >3 (false negatives)/all P2 or P3 dispatch (false negatives + true negatives) Sensitivity was calculated as true positives/(true positives + false negatives); specificity as true negatives/(false positives + true negatives); Positive predictive value (PPV) was calculated as true positives/(true positives + false positives); negative predictive value (NPV) as true negatives/(true negatives + false negatives).

Table 3 Over-triage concerning NACA 3 missions before (DC A and B) and after (A + B) merging (% total over-triage)

|                | DC A | DC B | A + B |
|----------------|------|------|-------|
| 57.0%          | 52.3%| 60.1%|

Table 4 Under-triage concerning NACA 4 missions before (DC A and B) and after (A + B) merging (% of total under-triage)

|                | DC A before | DC B before | WCP after |
|----------------|-------------|-------------|-----------|
| Over-triage    | 79.5%       | 89.4%       | 87.2%     |

Abbreviations
L&S: Lights and sirens; CBD: Criteria-based dispatch centre; CI: Confidence interval; DC: Dispatch centres; ED: Emergency department; EMS: Emergency medical services; GPS: Global Positioning System; MPDS: Medical Priority Dispatch System; NACA: National Advisory Committee for Aeronautics; NPV: Negative predictive value; P1: Priority 1; P2: Priority 2; P3: Priority 3; PPV: Positive predictive value; SD: Standard deviation

Acknowledgement
We would like to thank Damian Göldi for his input on the manuscript. Our Paper has been professionally proofread by Proof-Reading-Service.com Ltd, Devonshire, United Kingdom.

Funding
The professional proofreading was financially support by the Lausanne University Hospital, Lausanne, Switzerland.

Availability of data and materials
The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Authors’ contributions
Study design: AM, WH, VDS, FD. Data collection: AM, CFR, VF. Statistics: AM. Manuscript writing: AM, FD. All authors made significant corrections to the final manuscript. All authors read and approved the final manuscript.

Competing interests
Walter Hanhart is the medical director of three ambulance companies included in the study. Fabrice Dami is the medical director and Vincent Fuchs the operational director of the dispatch centre for the states of Neuchâtel and Vaud.

Consent for publication
Not applicable

Ethics approval and consent to participate
According to Swiss law, this study does not require acceptance from an ethical committee because it does not include any clinical or personal patient data. This was confirmed by the president of the ethical commission of the states of Vaud and Neuchâtel.
Publisher’s Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Author details
1 Emergency Department, Hôpital Neuchâtelois, Maladière 45, 2000 Neuchâtel, Switzerland. 2 Dispatch Centre, State of Vaud (Fondation Urgences-Santé), César-Roux 31, 1005 Lausanne, Switzerland. 3 State of Neuchâtel, Public Health Office, Jacque-Louis De Pourtalès 2, 2000 Neuchâtel, Switzerland. 4 Emergency Department, Lausanne University Hospital, Lausanne, Switzerland.

Received: 30 December 2016 Accepted: 3 April 2017

Published online: 13 April 2017

References
1. Dami F, Fuchs V, Hugli D. Dispatch centres: what is the right population catchment size? Scand J Trauma Resusc Emerg Med. 2015;23:32.
2. The Medical Priority Dispatch System; A System and Product Overview [Internet]. 2016 [cité 15 mai 2016]. Disponible sur: https://www.emergencydispatch.org/articles/ArticleMPDSCady.html
3. Sporer KA, Johnson NJ, Yeh CC, Youngblood GM. Can emergency medical dispatch codes predict prehospital interventions for common 9-1-1 call types? Prehospital Emerg Care Off J Natl Assoc EMS Physicians Natl Assoc State EMS Dir déc. 2008;12(4):470–8.
4. Feldman MJ, Verbeek PR, Lyons DG, Chad SJ, Craig AM, Schwartz B. Comparison of the medical priority dispatch system to an out-of-hospital patient acuity score. Acad Emerg Med Off J Soc Acad Emerg Med sept. 2006;13(9):954–60.
5. Cleggett GR, Lyon RM, James S, Branigan HP, Bard EG, Egan GJ. Dispatch-assisted CPR: where are the hold-ups during calls to emergency dispatchers? A preliminary analysis of caller-dispatcher interactions during out-of-hospital cardiac arrest using a novel call transcription technique. Resuscitation. 2014;85(1):49–52.
6. Adnet F, Lapostolle F. International EMS systems: France. Resuscitation. 2004;63(1):7–9.
7. Andersen MS, Johnsen SP, Sørensen JN, Jepsen SB, Hansen JB, Christensen EF. Implementing a nationwide criteria-based emergency medical dispatch system: a register-based follow-up study. Scand J Trauma Resusc Emerg Med. 2013;21:53.
8. Lewis M, Stubbs BA, Eisenberg MS. Dispatcher-assisted cardiopulmonary resuscitation: time to identify cardiac arrest and deliver chest compression instructions. Circulation. 2013;128(14):1522–30.
9. Myres JB, Slets CM, Erkstein M, Goodloe JM, Isaacs SM, Loflin JR et al. Evidence-based performance measures for emergency medical services systems: a model for expanded EMS Benchmarking Prehospital Emerg Care Off J Natl Assoc EMS Physicians Natl Assoc State EMS Dir juin. 2008;12(2):141–51.
10. Castrén M, Bohm K, Kvam AM, Bovim E, Christensen EF, Steen-Hansen J-E, et al. Reporting of data from out-of-hospital cardiac arrest has to involve emergency medical dispatching—taking the recommendations on reporting OHCA the Utstein style a step further. Resuscitation. 2011;82(12):1496–500.
11. Interassocation de sauvetage. Directives sur la reconnaissance des centrales d’appels sanitaires urgent CASU 144. 2010.
12. Snooks H, Evans A, Wells B, Peconi J, Thomas M, Woolford M, et al. What are the highest priorities for research in emergency prehospital care? Emerg Med J EMJ. 2009;26(8):549–50.
13. Dami F, Golay C, Pasquier M, Fuchs V, Caron P-N, Hugli D. Prehospital triage accuracy in a criteria based dispatch centre. BMC Emerg Med. 2015;15:32.
14. Dami F, Fuchs V, Paz L, Voder J-P. Introducing systematic dispatch-assisted cardiopulmonary resuscitation (telephone-CPR) in a non-Advanced Medical Priority Dispatch System (AMPDS): implementation process and costs. Resuscitation. 2010;81(7):848–52.
15. Weiss M, Bemoulki L, Zollinger A. The NACA scale. Construct and predictive validity of the NACA scale for prehospital severity rating in trauma patients. Anaesthesist. 2001;50(3):150–4.
16. Raatnamini L, Mikkelsen K, Fredriksen K, Wiborg T. Do pre-hospital anaesthesiologists reliably predict mortality using the NACA severity score? A retrospective cohort study. Acta Anaesthesiol Scand. 2013;57(10):1253–9.
17. Maguire BJ, Hunting JL, Smith GS, Levick NR. Occupational fatalities in emergency medical services: a hidden crisis. Ann Emerg Med. 2002;40(6):625–32.
18. Merlin MA, Baldino KT, Lehfeldt DP, Linger M, Lustiger E, Cascio A, et al. Use of a limited lights and siren protocol in the prehospital setting vs standard usage. Am J Emerg Med. 2012;30(4):519–25.
19. Dami F, Pasquier M, Caron P-N. Use of lights and sirens: is there room for improvement? Eur J Emerg Med Off J Eur Soc Emerg Med. 2014;21(1):52–6.
20. Maguire BJ, Underwood-McHale C, Headley J, Lawton M, Carron P-N. Dispatcher assisted operations among emergency medical technicians and paramedics. Prehospital Disaster Med. 2011;26(5):346–52.
21. Mann NC, Schmidt TA, Cone DC. Defining research criteria to characterize medical necessity in emergency medical services: a consensus among experts at the Neely Conference. Prehospital Emerg Care Off J Natl Assoc EMS Physicians Natl Assoc State EMS Dir. 2004;8(2):138–53.
22. Hettiger AZ, Cushman JT, Shah MN, Noyes K. Emergency medical dispatch codes association with emergency department outcomes. Prehospital Emerg Care Off J Natl Assoc EMS Physicians Natl Assoc State EMS Dir. 2013;17(1):29–37.
23. Khorram-Manesh A, Lennquist Montán K, Hedelin A, Kihlgren M, Örtengren P. Prehospital triage, discrepancy in priority-setting between emergency medical dispatch centre and ambulance crews. Eur J Trauma Emerg Surg Off Publ Eur Trauma Soc. 2011;37(1):73–8.
24. Schlechtliem T, Burghofer K, Lackner CK, Altemeyer KH. Validierung des NACA-Scoreenanhand objektiver Parameter. NotfallRettungsmedizin. 2005;8:96–108.
25. Knapp J, Bernhard M, Hainer C, Sklinger M, Brenner T, Schlechtliem T, et al. Is there an association between the rating of illness and injury severity and the experience of emergency medical physicians? Anaesthesist. 2008; 57(11):1069–74.

Submit your next manuscript to BioMed Central and we will help you at every step:
• We accept pre-submission inquiries
• Our selector tool helps you to find the most relevant journal
• We provide round the clock customer support
• Convenient online submission
• Thorough peer review
• Inclusion in PubMed and all major indexing services
• Maximum visibility for your research

Submit your manuscript at www.biomedcentral.com/submit